

Intellectual Property and Innovation in the Knowledge-Based Economy

GENERAL EDITOR:
JONATHAN D. PUTNAM

Intellectual Property and Innovation in the Knowledge-Based Economy



Table of Contents

ACKNOWLEDGMENTS *i*

PREFACE *ii*

INTRODUCTION

JONATHAN D. PUTNAM

Overview 1-3
Firms and Industries 1-5
Productivity, Growth and Trade 1-8
Copyright and Innovation 1-10
Institutions 1-12
Endnotes 1-14
Bibliography 1-15

PART I: OVERVIEWS

1. CANADA'S INTELLECTUAL PROPERTY FRAMEWORK: A COMPARATIVE OVERVIEW

DAVID VAVER

Introduction 1-1
Copyright 1-6
Patents 1-19
Trade-marks 1-27
Remedies 1-32
Conclusion 1-38
Endnotes 1-41

Acknowledgments 1-54

Bibliography 1-54

2. THE IMPORTANCE OF INTELLECTUAL PROPERTY
INDUSTRIES IN THE CANADIAN ECONOMY

SANDRA CHARLES, GILLES MCDOUGALL & JULIE TRAN

Introduction 2-1

Patents 2-4

Copyright 2-17

Trade-marks 2-34

Conclusion 2-49

Endnotes 2-52

Acknowledgments 2-55

Bibliography 23-56

3. THE IMPORTANCE OF PATENTS, TRADE-MARKS AND
COPYRIGHT FOR INNOVATION AND ECONOMIC
PERFORMANCE: DEVELOPING A RESEARCH
AGENDA FOR CANADIAN POLICY

MOHAMMED RAFIUZZAMAN & SHUBHA GHOSH

Introduction: Canada's Place in the Intellectual Property System 3-1

Patent Law and Innovation in Canada 3-6

*Promotion of Brand and Firm Identification Through
Trade-mark Law* 3-31

Promoting Information Infrastructure Through Copyright Law 3-51

Summary and Conclusion 3-79

Appendix 3-81

Bibliography 3-81

PART II: FIRMS AND INDUSTRIES

4. CURRENT INTELLECTUAL PROPERTY PROTECTION
PRACTICES OF MANUFACTURING FIRMS IN CANADA

PETR HANEL

Introduction 4-1

Review of the Principal Findings of Previous Surveys 4-6

<i>Use of Intellectual Property Rights and Innovation</i>	
– Results of the 1999 Survey	4-10
<i>Probability Models of Innovation and Intellectual Property Use</i>	4-24
<i>Conclusion</i>	4-44
<i>Appendix A</i>	4-47
<i>Appendix B</i>	4-48
<i>Endnotes</i>	4-56
<i>Acknowledgments</i>	4-61
<i>Bibliography</i>	4-61

5. PATENT POLICY AND THE DIFFUSION OF
PHARMACEUTICAL INNOVATION

BOHUMÍR PAZDERKA & KLAUS STEGEMANN

<i>Introduction</i>	5-1
<i>Diffusion of Innovation</i>	5-2
<i>Measures of Diffusion</i>	5-7
<i>Government Policies Affecting Diffusion</i>	5-13
<i>Implications of Patent Theory for</i>	
<i>Canada's Patent and Diffusion Policy</i>	5-22
<i>Possible Changes in Patent Policy and</i>	
<i>their Impact on the Diffusion of Innovation</i>	5-30
<i>Summary and Conclusions</i>	5-45
<i>Endnotes</i>	5-48
<i>Acknowledgments</i>	5-51
<i>Bibliography</i>	5-51

6. ON THE ROLE OF PATENTING IN INNOVATION FOR THE
BIOTECHNOLOGY INDUSTRY IN CANADA

GARY LAZARUS

<i>Introduction</i>	6-1
<i>Issues</i>	6-3
<i>Data and Methodology</i>	6-14
<i>Empirical Findings</i>	6-23
<i>Summary and Conclusions</i>	6-36
<i>Endnotes</i>	6-39
<i>Acknowledgments</i>	6-40
<i>Bibliography</i>	6-40

7. INTELLECTUAL PROPERTY PROTECTION IN THE
U.S. SOFTWARE INDUSTRY

STUART J.H. GRAHAM & DAVID C. MOWERY

<i>Introduction</i>	7-1
<i>The Historical Development of the Computer Software Industry</i>	7-2
<i>The Evolution of Intellectual Property Rights Policy and Practice in the U.S. Software Industry</i>	7-5
<i>Patenting Trends in the U.S. Software Industry</i>	7-11
<i>The Relationship Between Patenting and Copyright in Software-related Intellectual Property</i>	7-28
<i>Conclusion</i>	7-32
<i>Endnotes</i>	7-35
<i>Acknowledgments</i>	7-38
<i>Bibliography</i>	7-39

PART III: PRODUCTIVITY, GROWTH AND TRADE

8. INTELLECTUAL PROPERTY RIGHTS AND
THE PROPENSITY TO PATENT

NANCY GALLINI, JONATHAN PUTNAM & ANDREW TEPPERMAN

<i>Introduction</i>	8-1
<i>The Propensity to Patent</i>	8-6
<i>Aggregate Analysis</i>	8-15
<i>Applying the Model to Canada</i>	8-24
<i>Industry-level Analysis</i>	8-26
<i>Conclusions</i>	8-31
<i>Endnotes</i>	8-33
<i>Acknowledgments</i>	8-37
<i>Bibliography</i>	8-38

9. DO INTELLECTUAL PROPERTY RIGHTS STIMULATE R&D
AND PRODUCTIVITY GROWTH? EVIDENCE FROM CROSS-
NATIONAL AND MANUFACTURING INDUSTRIES DATA

WALTER G. PARK

<i>Introduction</i>	9-1
<i>Brief Literature Review</i>	9-3

<i>Conceptual Framework</i>	9-5
<i>IPR Indexes</i>	9-10
<i>Data</i>	9-21
<i>Empirical Results</i>	9-28
<i>Conclusion</i>	9-39
<i>Appendix A</i>	9-42
<i>Appendix B</i>	9-46
<i>Endnotes</i>	9-47
<i>Acknowledgments</i>	9-49
<i>Bibliography</i>	9-49

10. IS CANADA STILL MISSING THE TECHNOLOGY BOAT? EVIDENCE BASED ON THE QUANTITY AND QUALITY OF INNOVATIONS

MOHAMMED RAFIQUZZAMAN & ARIF MAHMUD

<i>Summary</i>	10-1
<i>Introduction</i>	10-3
<i>Overall Trends in Patenting Activity by Country</i>	10-6
<i>Patent Activity in Industry Sectors</i>	10-12
<i>Overall Trends in the Quality of Patents</i>	10-24
<i>Quality of Patents by Industry Sector</i>	10-30
<i>Conclusions</i>	10-38
<i>Appendix</i>	10-41
<i>Endnotes</i>	10-43
<i>Acknowledgments</i>	10-45
<i>Bibliography</i>	10-46

11. CANADIAN PATENT POLICY IN THE NORTH AMERICAN CONTEXT

KEITH E. MASKUS

<i>Introduction</i>	11-1
<i>Differences in Patent Protection</i>	11-3
<i>Economic Aspects of Regional IP Protection</i>	11-7
<i>Harmonization and the Regional Dimension</i>	11-22
<i>Conclusions and Recommendations</i>	11-31
<i>Endnotes</i>	11-32
<i>Acknowledgments</i>	11-35
<i>Bibliography</i>	11-35

PART IV: COPYRIGHT AND INNOVATION

12. THE ECONOMICS OF DIGITAL COPYRIGHT IN THE KNOWLEDGE-BASED ECONOMY

JONATHAN D. PUTNAM

<i>Introduction</i>	12-1
<i>The Economic Paradigm</i>	12-2
<i>The Shift in Technology</i>	12-3
<i>The Consumer as Agent</i>	12-8
<i>Changes in the Distribution Chain for Digital Goods</i>	12-11
<i>Voting for Price Discrimination</i>	12-14
<i>The Decline of Privacy</i>	12-16
<i>Infringement and the Non-copyright Protection of Digital Goods</i>	12-17
<i>The Apparent Rise in Productivity</i>	12-21
<i>The Rising Trade Deficit</i>	12-22
<i>The Decline in Average Product Quality</i>	12-22
<i>Conclusions</i>	12-24
<i>Endnotes</i>	12-25
<i>Acknowledgments</i>	12-33
<i>Bibliography</i>	12-33

13. ACROSS TWO WORLDS: DATABASE PROTECTION IN THE UNITED STATES AND EUROPE

STEPHEN M. MAURER

<i>Summary</i>	13-1
<i>Overview</i>	13-2
<i>Modern Databases</i>	13-4
<i>Databases in the United States and Europe</i>	13-7
<i>The Canadian Database Industry</i>	13-18
<i>Database Protection in North America</i>	13-25
<i>European Law</i>	13-34
<i>Is the European Commission Directive Working?</i>	13-44
<i>Unintended Side Effects</i>	13-53
<i>Canadian Choices</i>	13-57
<i>Conclusion</i>	13-62
<i>Appendix</i>	13-63
<i>Endnotes</i>	13-67
<i>Acknowledgments</i>	13-78
<i>Bibliography</i>	13-79

PART V: INSTITUTIONS

14. MANAGING INTELLECTUAL PROPERTY RIGHTS FROM PUBLIC RESEARCH

BÉNÉDICTE CALLAN & MARIO CERVANTES

<i>Changes in National IP Regimes and IP Management</i>	14-1
<i>The Delicate Balance of IP Management</i>	14-4
<i>Increasing Economic Spillovers from Publicly Funded Research: The Role of IPRs</i>	14-8
<i>Conflict Management: The Making of Models and Guidelines</i>	14-12
<i>Institution Building</i>	14-18
<i>Economic Impacts and Outcomes</i>	14-20
<i>Conclusions</i>	14-23
<i>Appendix: IP Regime Reforms</i>	14-24
<i>Endnotes</i>	14-31
<i>Bibliography</i>	14-33

15. THE CANADIAN INTELLECTUAL PROPERTY OFFICE AS INNOVATION CATALYST

GILLES PAQUET & JEFFREY ROY

<i>Mandate</i>	15-1
<i>Introduction</i>	15-1
<i>Governance and the Intellectual Property Regime in a Learning Economy</i>	15-2
<i>The Intellectual Property Regime as a Learning System</i>	15-6
<i>A Comparative Review</i>	15-10
<i>Strategic Options for CIPO</i>	15-15
<i>Recommendations</i>	15-25
<i>Conclusion</i>	15-29
<i>Endnotes</i>	15-30
<i>Bibliography</i>	15-30

16. THE ENFORCEMENT OF INTELLECTUAL PROPERTY RIGHTS IN CANADA

STEVEN B. GARLAND & JEREMY E. WANT

<i>Introduction</i>	16-1
<i>Patents</i>	16-3

<i>Trade-marks</i>	16-11
<i>Copyright</i>	16-19
<i>Canada Has Strong IPR Enforcement Regimes</i>	16-22
<i>Conclusions</i>	16-27
<i>Endnotes</i>	16-28
<i>Bibliography</i>	16-37

17. POLICY OPTIONS FOR CANADA IN THE KNOWLEDGE-BASED ECONOMY

JONATHAN D. PUTNAM

<i>Introduction: Issues in Policy Assessment</i>	17-1
<i>Overview: Harmonization of Subject Matter and Other Issues</i>	17-6
<i>Firms, Industries and Other Technology-specific Initiatives</i>	17-9
<i>Productivity, Growth and Trade</i>	17-16
<i>Copyright and Innovation</i>	17-19
<i>Institutions</i>	17-23
<i>Additional Remarks</i>	17-25
<i>Endnotes</i>	17-27
<i>Bibliography</i>	17-30

DISCUSSANTS' COMMENTS A-1

ABOUT THE CONTRIBUTORS B-1



Acknowledgments

THIS PROJECT IS THE RESULT OF A COOPERATIVE EFFORT between the Marketplace Framework Policy Branch, the Micro-Economic Policy Analysis Branch, the Innovation Policy Branch and the Canadian Intellectual Property Office, of Industry Canada. The General Editor would like to thank all the individuals from these groups who were involved in this project, and in particular Serge Dupont, Marie-Josée Thivierge, Serge Nadeau, Renée St-Jacques, Maureen Dougan and Marie Tobin, for supporting the project from its early beginnings as an abstract idea, to the holding of the Toronto Conference culminating in this publication. More specifically, the General Editor would like to thank Gilles McDougall, Sandra Charles, Julie Tran and Gary Lazarus, all from the Marketplace Framework Policy Branch, for the enormous amount of time they collectively spent on the project. Finally, Richard Owens of the University of Toronto's Centre for Innovation Law and Policy should also be thanked for his and the Centre's staff involvement in the Conference.



Preface

INTELLECTUAL PROPERTY (IP) IS A CRITICAL INSTRUMENT that provides the foundation for innovation, investment and growth opportunities in the knowledge-based economy. Indeed, leading-edge, knowledge industries are intensive users of the IP regime. Thus, although IP regimes must balance the interests of all stakeholders, they must contribute to Canada's success in the new economy.

Intellectual property protection on the one hand provides innovators with some degree of market exclusivity for exploiting the benefits of their own creation. IP rights (IPRs) are, therefore, important in helping creators and innovators secure a fair return for their creative activities. On the other hand, intellectual property protection forms the basis from which Canadians have access to the benefits of this knowledge and these innovations. The question of finding the right balance is crucial for IP policy makers. A central issue to this volume is, therefore, to explore how the IP regime can stimulate both the creation and diffusion of new knowledge and affordable access to these innovations, thereby making the best contribution to Canada's knowledge-based economy.

This volume is the outcome of a research initiative undertaken by the Marketplace Framework Policy Branch and the Micro-Economic Policy Analysis Branch of Industry Canada. Together with the Innovation Policy Branch, the Canadian Intellectual Property Office and the University of Toronto Centre for Innovation Law and Policy, they commissioned sixteen papers for a conference held in Toronto, in May 2001. The final versions of these papers appear in this research volume. Professor Jonathan D. Putnam has served as General Editor of the publication.

The volume will be of interest to the policy-making community as well as to everyone interested in intellectual property policy issues, here in Canada and abroad.



Jonathan D. Putnam
University of Toronto

Introduction

LIKE MANY CLICHÉS, the *knowledge-based economy* distorts the very phenomenon it seeks to describe. In reality, all economies are knowledge-based, in the sense that they attach value to the discovery and disclosure of new information, while they suffer from imperfect and asymmetric information. The simplest economic relations — search, bargaining, contracting — as well as collective rewards and punishments, vary in their efficacy with investments in the acquisition of knowledge.

What is meant by *knowledge-based economy* is not really a different economy, but a new source of comparative advantage in trade among nations. International trade theory developed from the observation that countries were endowed with different relative amounts of labour and capital: capital-rich England should supply capital-poor Portugal with cloth from its capital-intensive mills, which labour-rich Portugal would pay for with wine from its labour-intensive vineyards. The notion of national *endowment* extended easily to natural endowment of mineral and other resources. With further theoretical refinements, the current explanation for the source of comparative advantage has moved from resource endowment exogenously provided by Nature to endogenously determined stocks of knowledge. And because these stocks are determined endogenously, they are supposed to lie within the realm of policy-making.

To nurture the growth of the domestic economy, the Government of Canada has recently undertaken to increase its direct investment in the production of knowledge.¹ It has also invested in understanding the environmental and institutional factors that stimulate the private production of knowledge. Perhaps the most pervasive public means for rewarding the successful searcher is itself private: the conversion of (an embodiment of) non-excludable information resulting from the search process into an exclusive property right. The present volume

represents the most recent, though by no means the only,² effort to identify the relationship between private intellectual property (IP) rights and the source of a nation's comparative advantage.

For economists, the notions that the growth of an economy is *knowledge-based*, and that the government's direct investment in new knowledge and indirect encouragement of such investment by the private sector influence the rate of economic growth, are relatively old news. Although both notions comprise a micro-economic and a macro-economic dimension, we can conveniently associate the first micro-economic empirical analysis of direct government investment with the early studies of Zvi Griliches, who measured the rate of return on the U.S. government's investment in high-yielding hybrid corn.³ It is equally convenient to associate the first macro-economic empirical analysis of productivity growth with the seminal work of Robert Solow, published at about the same time, who first identified the gap between the value of an economy's output and the value of its inputs, a gap mostly explained by private sector investments in research and development (R&D).⁴ Since then, both micro and macro analysts of technical change have built on the basic insights of Griliches and Solow in hundreds of studies that document, directly and indirectly, the relationship between investment in knowledge, and the returns, private and social, on that investment.

Even before economists formally recognized and measured the contribution of new information to economic growth, policy-makers were aware that intellectual property rights stimulate private investments that contribute to the growth of the collective welfare. That private property may be treated as a policy lever with which to further economic growth was recognized explicitly in such 18th century sources as the U.S. Constitution,⁵ though the policy distinction between monopolies granted for the public good and for purely private gain can be observed in the reform of the *Statute of Monopolies* under James I, nearly 150 years earlier.

Thus, the recent declaration of a *knowledge-based economy* is a conceit that ignores the substantial intellectual and political history behind government efforts to promote economic growth. Its use seems to stem, more than anything, from the widespread diffusion of the Internet over the last decade, and the consequent reduction in the cost of *disseminating* certain types of knowledge that the economy has been *discovering*, and depended upon, for centuries.⁶

Whatever the terms used to describe it, the phenomenon that lies at the heart of the studies published in this volume prompts a number of fascinating and difficult questions, both for policy-makers and for economists. While the tools that economists apply to the study of knowledge investment have rapidly grown in sophistication, it often seems that their main effect is not to answer, but to raise, questions. For example, contrary to the ancient idea that intellectual

property rights are justified by a market failure that causes firms to under-invest in acquiring new information, economists have identified certain conditions under which patent *racine* causes the amount of resources devoted to searching for new information to be inefficiently large.⁷ This possibility naturally raises several straightforward policy questions, such as: What types of markets are characterized by over-investment *vs.* under-investment? Unfortunately, economic theory does not provide good general guidance on a number of the most fundamental issues, and empirical economics supplies even less factual assistance.

To address these gaps, the Intellectual Property Policy Directorate of Industry Canada organized a conference on *Intellectual Property and Innovation in the Knowledge-Based Economy*. The conference, co-sponsored by Industry Canada and the Centre for Innovation Law and Policy of the Faculty of Law, University of Toronto, was held in Toronto on May 23-24, 2001. The present research volume is the result of this exercise.

The volume displays a number of serious attempts to identify the incremental role that intellectual property rights play in knowledge investment and the dissemination of new information, on the one hand, and in consumer welfare, on the other. Most studies strive both for a Canadian context and for a general grounding in economic theory and empirical analysis. Although the focus is on economics, the basic unit of account is private property rights, so the volume necessarily looks at Canadian legal institutions as well.

The volume is divided into five parts: Overview; Firms and Industries; Productivity, Growth and Trade; Copyright and Innovation; and Institutions.

OVERVIEW

THE FIRST PART BEGINS WITH A REVIEW by intellectual property lawyer David Vaver, entitled *Canada's Intellectual Property Framework: A Comparative Overview*, which summarizes Canadian statutes and jurisprudence in the three principal regimes of intellectual property rights: patents, trade-marks and copyright. Although the broad contours of Canadian intellectual property legislation are similar to those of other common law jurisdictions, Professor Vaver's review points out some distinctively Canadian features that may be unfamiliar to an economic audience. Despite the overwhelming contribution of trade with the United States to Canada's gross domestic product (GDP), Canada imports a greater share of its legal principles from the jurisprudence of the United Kingdom and other Commonwealth countries. This pattern has begun to change, however, as courts on both sides of the border must come to grips with the constraints imposed by the North American Free Trade Agreement (NAFTA). That agreement establishes certain standards for the treatment of intellectual property; failure to observe these standards constitutes a sanctionable trade violation. The effects of NAFTA, and more generally of the standards

mandated by the implementation of the Trade-Related Aspects of Intellectual Property (TRIPs) of the World Trade Organization, can be felt in Canadian judicial and legislative debates about the appropriate scope of patentable subject matter, and the appropriate degree of relative protection to be given to innovators and imitators. Professor Vaver's review provides the necessary legal staging in front of which policy-makers and interest groups play out debates over the claimed merits of international harmonization and of protecting uniquely Canadian interests.

As the second study published in this part of the volume demonstrates, the economic significance of these debates is apparent in several important sectors of the Canadian economy. In *The Importance of Intellectual Property Industries in the Canadian Economy*, Sandra Charles, Gilles McDougall and Julie Tran of Industry Canada offer a broad quantification of the effects of IP-intensive sectors on the rest of the Canadian economy. For example, they show that patent-intensive industries represent about one-sixth of Canada's GDP, but accounted for over one-third of its economic growth during the period 1992-2000. The authors offer some methods for determining the extent to which Canadian industries use patents, trade-marks and copyrights in their pursuit of a competitive advantage, and they show how each industry's reliance upon IP protection has changed over the past 20 years. Their results indicate that the role of intellectual property rights in the Canadian economy has steadily gained in importance. While this finding is not surprising, it is perhaps more striking to observe that the increase is not confined to a few industries (like pharmaceuticals) where IP has traditionally played a critical role. That growth runs broader and deeper, cutting across manufacturing industries, as well as service industries and other providers of intangibles. In addition to the gains implied by new investments in information technology, and the multiplication of these gains through networking and improved communications, the rise of intellectual property governs diverse sources of economic growth in Canada such as venture capital investment and the realm of *copyright industries*, like the many new forms of publishing.

Finally, Mohammed Rafiquzzaman of Industry Canada and Shubha Ghosh of the University of Buffalo, in *The Importance of Patents, Trade-marks and Copyright for Innovation and Economic Performance: Developing a Research Agenda for Canadian Policy*, discover a large body of theoretical literature focussing on how patents, trade-marks and copyright can play a vital role in improving economic performance, and thus in raising the living standard of a nation, through influencing the incentives for, and the diffusion of, innovations. Although this literature has yielded many important insights, the resulting impact of intellectual property rights on economic performance is generally ambiguous and depends upon circumstances. Empirical works on the subject

are, however, extremely limited. As a result, our understanding of the impact of intellectual property rights on most measures of economic performance is still far from satisfactory.

FIRMS AND INDUSTRIES

THE DIFFERENT CAUSES AND CONSEQUENCES of effective IP protection across industries is an important theme of the second part of the volume, dealing with Firms and Industries. It begins with an analysis by economist Petr Hanel, entitled *Current Intellectual Property Protection Practices of Manufacturing Firms in Canada*. The basis of this study is the most recent of a series of innovation surveys undertaken by Statistics Canada. Unlike the well-known surveys conducted by Levin, Klevorick, Nelson and Winter (1987) and Cohen, Nelson and Walsh (2000) (which queried large R&D-performing firms in the United States about the mechanisms, including intellectual property, for appropriating returns to their R&D investment), the former seeks to understand better the innovation decisions of a sample of Canadian firms encompassing both firms that introduce innovations featuring various degrees of novelty (first in the world, first in Canada, etc.), and firms that, by any standard, do not innovate. The Statistics Canada survey poses a wide variety of questions about inducements to innovate, the relative quality of the innovation once developed, and the diffusion of the innovation within and between industries. This survey is unique in the breadth of its examination of the use of intellectual property rights by innovating firms: in addition to patenting and trade secrecy, appropriation mechanisms scrutinized by the survey include copyright, trade-marks and confidentiality (non-disclosure) agreements.

The first section of Hanel's study provides a descriptive summary of the survey results. In the second section, the responses to survey questions become the basis for a more formal statistical investigation of the determinants of the decision to use intellectual property rights. Hanel finds that the self-reported rate of use of intellectual property rights exceeds 70 percent of all surveyed Canadian firms. In the context of current Canadian law (which routinely creates some intellectual property rights as a by-product of everyday efforts to record and protect new information), even this relatively high rate must be interpreted as an underestimate, reflecting only the deliberate intent to employ intellectual property rights as a strategic asset. Among the most innovative firms (those introducing a *world-first* innovation), the proportion of firms reporting the use of intellectual property rights exceeds 90 percent. As prior surveys found, however, patents are not necessarily the only or the most important IP mechanism: less than two thirds of self-described world-first innovators employed patents as a means of protecting their innovations from imitation.

The remainder of this part of the volume is devoted to analyses of three industries where the role of intellectual property rights, particularly patents, takes a central place in the debate over the industry's future health. These industries are pharmaceuticals, biotechnology and software. While few would claim that patents are irrelevant to these industries, opinions are frequently divided on the net contribution of patents to each. The benchmark in this group is the pharmaceutical industry, characterized by a relatively well-understood business model that seems to support strong patent protection: extremely high R&D costs, a very low success rate, one principal patent per invention (usually), relatively clear claim definitions, and low imitation costs. Under such conditions, patent holders find patents both profitable and essential: there is substantial evidence showing that the level of R&D conducted by pharmaceutical firms would decrease substantially if patent protection was not available. In part because patent protection is very effective, the pharmaceutical industry earns profit margins that are among the highest, albeit for higher-than-average risk. Moreover, the pharmaceutical industry has benefited from measures adopted by Canada to strengthen patent protection in 1992, a policy change undertaken in part to encourage domestic R&D.

Biotechnology shares many of the characteristics of the pharmaceutical industry: high R&D costs, a low success rate and low imitation costs. There are, however, significant differences that bear on the role of patent protection and on industry market structure more generally. First, biotechnology inventions do not necessarily follow the *one-patent-per-product* model. Biotechnology products are much more likely to draw on a variety of production techniques, sometimes termed "research tools," each of which may be patentable. Research tools are often patented by universities and other non-profit organizations (which benefit from the decision of some jurisdictions to assign title to inventions that it funded to the research-performing organization). Biotechnology firms are often spun off from university laboratories. Given the relative ease of entry into the market, biotechnology firms are smaller, more connected to basic science, less capable of carrying out clinical trials, more dependent on venture financing, and therefore even more dependent on patents, than are traditional pharmaceutical companies.

Like biotechnology, the software industry represents an outgrowth of an older business model (computer hardware) having its own unique relationship to patent laws. Historically, patent protection was not available for software, which was mostly tied to the sale of hardware. To the extent it was protected at all, software was protected by trade secret, confidentiality and non-compete agreements. By the time patent protection became available, several generations of programmers had grown accustomed to an environment that encouraged

the sharing of ideas and even of computer code itself. The availability of patent protection has, therefore, raised considerable controversy.

In *Patent Policy and the Diffusion of Pharmaceutical Innovations*, Bohumir Pazderka and Klaus Stegemann evaluate the evolving Canadian approach to encouraging domestic pharmaceutical research while attempting to maximize the *diffusion* of pharmaceuticals to final consumers. The authors provide a comparative background of Canadian and U.S. policies, including efforts by the United States (under the so-called *Hatch-Waxman Act* of 1984) to strengthen simultaneously the incentives for pharmaceutical R&D and the incentives for generic imitation. They identify four functions of patents — motivation of innovation; inducement of commercialization; disclosure of information; and control of exploration — as the objectives pursued by policy-makers. The main objective of their study is to evaluate critically the policy options available to Canada, in the context of its obligations under NAFTA and the TRIPs provisions administered by the World Trade Organization. The authors conclude that, as a relatively small open economy, Canada does not need stronger motivation for pharmaceutical innovation, and that it should meet — but not exceed — the standards set for it by international agreements.

Canada's biotechnology sector is the subject of an original survey by Gary Lazarus of Industry Canada, entitled *On the Role of Patenting in Innovation for the Biotechnology Industry in Canada*. The author uses a survey of 218 Canadian biotechnology firms to develop an innovative structural model that explores interdependencies among patent application counts, R&D expenditures and strategic alliances. One motivation for this model is that patenting can be viewed as a necessary first step on the road to becoming a publicly traded firm; public firms generally have better access to capital than do private firms. The selection process by which private biotechnology firms go public is influenced, to a large degree, by the strength of a firm's patent portfolio. While the author shows that the behaviour of sample firms is split according to whether they are public or private, the expected signalling effect of patents does not materialize. Instead, there is evidence that biotechnology firms have made strategic choices between increased use of patents and increased use of strategic alliances. Thus, even within science-based ventures at an early developmental stage, firms appear to differentiate themselves as successful, independent innovators or more collaborative firms with fewer verifiable inventions. One encouraging finding of the study is the high rate of alliance formation among firms (an average of over three alliances per firm), which suggests that available institutions facilitate rather than inhibit the sharing of information. As firms move from purely research-based entities to competitive actors in product markets, concerns about horizontal agreements may chill to some extent the information flow running through alliances between firms. In that case, firms in other industries

(such as computers and peripheral hardware) have found that a large patent portfolio is a useful strategic alternative when licensing negotiations must be conducted at arm's length. This observation reinforces Lazarus's finding that the size of the patent portfolio and the number of alliances may be substitute inputs to commercial success.

While the software industry appears alive and well in Canada, its welfare must not depend on the availability of Canadian patents, because the Canadian Intellectual Property Office does not grant software patents.⁸ Of necessity, therefore, Stuart Graham and David Mowery direct their attention south of the border in *Intellectual Property Protection in the U.S. Software Industry*. The authors examine the patenting and copyright behaviour of the whole software sector, as well as that of representative large firms. They document the sharp rise of software patents since 1984, not only as software-based firms like Microsoft began to take advantage of expanded patent protection, but also as traditional hardware firms like Intel and IBM shifted more research resources into software-based technologies. (According to Graham and Mowery's classification of inventions, IBM's software patents accounted for about one fifth of the firm's total in 1984; by 1998, the proportion was one third.) The authors also document the rising share of university software patents, particularly after the government gave universities title to federally funded inventions in 1982. Finally, they construct a novel index of *copyright propensity*, analogous to those derived from patent data. These propensities indicate that, for large firms like Microsoft and for the industry as a whole, the propensity to register copyrighted software has declined even as the propensity to patent has increased.

PRODUCTIVITY, GROWTH AND TRADE

PERHAPS THE FOCUS OF A VOLUME dedicated to exploring national policy options and consequences should be the relationship between inter-country differences in intellectual property regimes and economic outcomes. Until recently, intellectual property laws changed at a relatively slow pace within any one jurisdiction. Therefore, cross-sectional differences have constituted the major source of variation in policy regimes with which to test various hypotheses about the relative efficacy of proposed reforms or other policy alternatives.

The first two studies in this part of the volume use similar datasets to address different questions. In *Intellectual Property Rights and the Propensity to Patent*, Nancy Gallini, Andrew Tepperman and Jonathan Putnam examine the propensity to patent of Canadian inventors both prior and subsequent to the significant reform of the patent system in 1989. The authors ask: What economic factors explain changes in the propensity to patent, and how have these changes been felt in Canada? They estimate this effect with a cross-sectional model of international patenting patterns, and from a more detailed industry-level study of

the propensity to patent. They find that the quality of patent protection offered by a destination country has a significant impact on the propensity of source-country inventors to seek patents in that country, especially if it has a permissive antitrust policy or high imports from the source country. With particular reference to Canada, however, they find that the Canadian propensity to patent is less than would be predicted from the remaining countries in the dataset. The authors explore various possible reasons for this finding at the industry level. They find considerable evidence of industry-level heterogeneity in the value of patent protection. The overall lower-than-predicted level of patenting masks significant increases in some industries and may be due to the mix of Canadian industries (which, governed by the economic laws of trade and comparative advantage, reflects the importance of sectors where patenting is relatively less valuable). The authors also observe industry-level evidence that the repeal of compulsory licensing for pharmaceuticals (in 1992) was associated with a large increase in pharmaceutical patenting at about the same time.

At the other end of the causal chain that runs from economic activity through intellectual property and back, Walter Park, in a study entitled *Do Intellectual Property Rights Stimulate R&D and Productivity? Evidence from Cross-national and Manufacturing Industry Data*, asks the following question: To what extent do differences in intellectual property rights explain economic outcomes, like productivity and growth? The author examines the implications for Canadian productivity growth of intellectual property rights reform using evidence from international and manufacturing sector data. Building on his earlier research, Park develops measures of the existence and strength of different kinds of intellectual property rights, and probes the extent to which they can explain productivity growth and R&D accumulation. His empirical results reveal different mechanisms by which the various categories of intellectual property rights (patents, trade-marks and copyright) affect growth and R&D. However, these results emphasize the relative importance of enforcement, as distinct from the nominal existence, of the types of IP rights under investigation (patents, trade-marks, copyright, parallel import protection, software rights). Overall, the study leads to the conclusion that the patent system makes a significant contribution to Canada's R&D and productivity.

The next two studies deal specifically with economic impacts of intellectual property rights in Canada. Mohammed Rafiquzzaman and Arif Mahmud of Industry Canada ask: *Is Canada Still Missing the Technology Boat? Evidence Based on the Quantity and Quality of Innovations*. The authors investigate the hypothesis, originally proposed by economist Manuel Trajtenberg, that Canada is 'missing the boat,' i.e. lagging behind its G-7 counterparts in the quantity of both R&D inputs and R&D outputs (innovations). Trajtenberg's thesis is based on the relative dearth of Canadian-origin inventions in what he termed "general purpose

technologies,” which comprise productivity-enhancing information technology inventions. Rafiquzzaman and Mahmud find that reports of a dearth of Canadian innovations are greatly exaggerated: measured by patenting in the single largest common region (the United States), the rate of growth of Canadian patenting has exceeded that of Germany, France, the United Kingdom and Italy, and lags only that of the United States and Japan. Contrary to Trajtenberg’s central finding, patenting growth in the computers and communications sector has been especially rapid.

In a particularly original attack on the problem, the authors also investigate the *quality* of Canadian patenting, as measured by the frequency with which these patents are cited in subsequent U.S. patents. They find that, by this measure, the quality of Canadian inventions exceeds that of every other G-7 country except the United States itself. However, they also find that the *quality gap* between the United States and its chief economic rivals is widening: despite its apparent success relative to other peers, Canada must invest more resources to match the U.S. level of R&D productivity.

The final study in this part of the volume evaluates *Canadian Patent Policy in the North American Context*, asking what are the threats and opportunities that Canada faces in harmonizing its patent laws with those of other countries, notably the United States. Drawing on an extensive background in international trade theory and policy, Keith Maskus finds mixed evidence on the central question of whether harmonization would prove helpful or harmful on balance. He notes that Canada’s innovation indicators are improving rapidly, including the country’s technological balance of payments. By itself, this phenomenon does not suggest that Canadian innovative activity would be markedly improved by a decision to adopt American patent standards. In Maskus’ view, many recent U.S. policy *innovations* do not make sense even in the context of U.S. objectives and institutions; there is little argument for transferring them to Canada. Finally, he concludes that harmonization of Canadian standards with U.S. standards would have mixed effects on inward foreign direct investment and technology transfer, depending in part on whether Mexico would also harmonize its standards at the same time.

COPYRIGHT AND INNOVATION

ALTHOUGH PRODUCTIVITY IMPROVEMENTS are traditionally associated with R&D and the patent system, the rise of software and of digital media has brought to centre stage the role of copyright in spurring innovation. Copyright protects a different type of investment than does patenting: while the latter protects investments in *successful* research and offers some protection to multiple embodiments of the same basic *research idea*, copyright protects all original works, but only against copying all or a substantial part of the work, not against

imitation more broadly defined. Granted for the author's life plus 50 years, copyright lasts on average at least three times as long as patent rights. Thus, in abstract economic models, copyright protection is *long and thin*, while patent protection is relatively *wide and short*.

The protection of computer software raised a number of conceptual issues for copyright, including the protection of functionality, the distinction between program code and the *look and feel* presented to a user, and the protection of user keystroke sequences. Copyright in software has spawned its own innovation in intellectual property, the so-called *copyleft*, a non-legal regime under which authors place computer code in the public domain for all to use, provided that users of the code also put their adaptations and improvements in the public domain. With the rise of the Internet, ordinary computer users (those who use computers as appliances) face a second set of issues that challenge traditional conceptions of copyright. Digital goods have a unique property: their use requires making a copy (if only into a computer's temporary memory), which implies that unlike (say) reading a book, the consumption of digital media implicates copyright laws. Because they can be acquired and spread costlessly all over the networked world, digital media promise both an unprecedented increase in the efficiency of consumption, and a concomitant unprecedented threat to copyright holders. In *The Economics of Digital Copyright in the Knowledge-Based Economy*, Jonathan Putnam examines the ways in which copyright's governance of the relationship among creators, distributors and consumers has fundamentally altered the classical model that links consumers to upstream distributors and manufacturers through a sale of goods contract. He also discusses the implications of increased price discrimination in a variety of contexts, from traditional economic notions such as efficiency, productivity and the equilibrium quality of goods, to privacy and international trade.

There is an important exception to the global trend towards strengthening the rights of both patentees and authors, which directly touches the advance of productivity in a knowledge-based economy. Traditionally, copyright protected the *labour, judgment and skill* of a compiler of facts, whose copyright lay not in the facts themselves but in their original selection and arrangement. Over the past decade, the Supreme Courts of both Canada and the United States have decisively narrowed that view, requiring a minimum level of *creativity* to justify copyright protection rather than mere *labour*. Claims were rejected in the context of telephone listings, whose alphabetical arrangement was held to be so unoriginal that it did not meet even the normally undemanding standards of copyright. The language employed by both Courts made clear that this rationale would extend to other databases whose selection and ordering were driven entirely by utilitarian considerations rather than by creative selection and arrangement.⁹ The ironic result is that databases, whose creation becomes so

much cheaper and more valuable in a networked economy, may receive insufficient protection from copyright law.

In *Across Two Worlds: Database Protection in the United States and Europe*, Stephen Maurer surveys the global state of investment in databases, strategies derived from existing law to protect those investments, and proposals for further protection. The author draws a conceptual distinction among database publishers, gatherers, refiners and portals, and provides a helpful empirical summary of databases by type and nationality for the leading five countries (Canada, United States, Germany, France and United Kingdom). He also sets the debate over the appropriate scope of copyright protection in the context of other intellectual property, intellectual property-like and technological mechanisms (such as trade secrecy, unfair competition law, and encryption), that have been arrayed against the alleged misappropriation of databases. Perhaps the most novel measure has been the *Directive on the Legal Protection of Databases* issued by the European Union in 1996. The Directive offers *sui generis* protection to database owners for a period of 15 years if its content remains unchanged. Intriguingly, the Directive's standard for determining whether a database deserves indefinite protection is whether or not "the accumulation of successive additions, deletions, or alterations" amounts to a "substantial new investment." Maurer suggests that the Directive may have given the European database industry a one-time boost "roughly equivalent to a year's worth of normal growth." However, he offers both empirical and theoretical reasons for cautioning Canada against adopting the European Directive too readily, and evaluates other legislative proposals to fill the *protection gap* for databases.

INSTITUTIONS

AS THE PROPOSALS FOR THE PROTECTION OF DATABASES SUGGEST, current institutions and institutional reforms must figure prominently in any analysis of government policy towards knowledge-based investments. The final part of the volume reviews three important institutions that correspond to the discovery, creation and enforcement of intellectual property: the public research sector, which funds and obtains an increasing share of total patents granted; the patent office, which examines applications for patents on new discoveries and helps set intellectual property policy; and the courts, in which private litigants seek to enforce the rights granted to them against others.

In *Managing Intellectual Property Rights from Public Research*, Benedicte Callan and Mario Cervantes provide a comparative review of national policies regarding the ownership of publicly funded intellectual property among members of the Organisation for Economic Co-operation and Development (OECD). While universities, hospitals and research institutes have been innovating for a long time, the past two decades have witnessed a rapid evolution in

the terms under which the public funds research, and owns and exploits its fruits. Perhaps the most fundamental policy change has been the decision to grant title to intellectual property created by federally funded research in the United States to the performing organization, but there are many other developments, such as the increasingly rapid and pervasive relationships formed between university innovators and providers of venture capital. The authors find that the diffusion of these institutional innovations in the OECD has been fairly uneven. They also note that certain innovative approaches, such as corporate sponsorships conditioned on exclusive access to research, raise real or apparent conflicts of interest that may reduce a public institution's control over the intellectual property it creates. As Canada's academic research institutions — all of which are public — must compete with private academic institutions that have greater funding flexibility, their competitive effort must be funded by an increased commitment from general tax revenues. But the current trend is away from substantially increasing public funding. Canada is an exception because it has recently committed to increase spending on research at Canadian universities, so it may well meet the challenges posed by competing private institutions. However, in an era where both private and public institutions display a stronger interest in the creation of intellectual property as a research output, there is little evidence that Canada is seeking innovative ways to capitalize on the fruits of its additional spending.

As for the institution at the heart of the intellectual property process — the Canadian Intellectual Property Office (CIPO) — Gilles Paquet and Jeffrey Roy discuss the opportunities for what they call *knowledge management* and *social learning* by CIPO in its role as aggregator of information, in a study entitled *The Canadian Intellectual Property Office as an Innovation Catalyst*. The scope of these opportunities is defined in the context of a broader dialogue with CIPO's stakeholders, including large multinational corporations (MNCs), small- and medium-sized enterprises (SMEs), and consumers. Having potentially divergent interests, these stakeholders may prefer different resource allocations by the CIPO (particularly if one contrasts the interests of domestic SMEs with that of foreign MNCs). The authors also compare the position of Canada's patent office — in a small, open economy, granting the vast majority of its patents to foreigners — with that of Denmark, which has redefined its role in light of the dominant position of the European Patent Office. Finally, they present the case for an increasing range of intellectual property options, such as the adoption of an *innovation patent* in Australia, and they evaluate the potential benefits for CIPO and for Canada from such an expanded menu.

In the final essay, Stephen Garland and Jeremy Want review *The Enforcement of Intellectual Property Rights in Canada*. In another original contribution, the authors survey all reported decisions in Canadian patent, trade-mark and

copyright litigation over the past two decades, and report the results by type of cases and the party receiving a favourable disposition. Although surprisingly few cases proceed to judgment in Canada, they discern several patterns. Unlike recent studies on the United States (which show an unexpectedly high reversal rate), the authors demonstrate that the Federal Court of Appeal is much more likely than not to affirm the decision of the trial court in an intellectual property dispute. Whether this finding reflects greater deference to the findings of the trial judge, a clearer set of precedents (which have not undergone as much recent revision as they have in the United States) or superior examination procedures by CIPPO is, unfortunately, a subject for further study. Even with a lower incidence of litigation, however, Canada retains the opportunity to provide another public good of considerable value in the knowledge-based economy: cheap, fast, innovative and reliable resolutions of intellectual property disputes in the increasingly integrated North American market.

We began with the observation that clichés distort the very phenomenon that they signify. That observation is also true with respect to the disclaimer inevitably offered by the authors of studies at the research frontier: that more research is required. While that is as true here as elsewhere, in the present case, authors have drawn together a wealth of new research about Canada, as well as applications of research methods and techniques to Canadian knowledge sectors, and they have significantly advanced the state of the economic art. They have also provided a solid basis for Canadian policy-making towards innovation and intellectual property in the first decade of the new millennium.

ENDNOTES

- 1 For example, in her 2001 Speech from the Throne, the Governor General announced that the government "... will at least double the current federal investment in research and development by 2010."
- 2 See Zerbe, 1986.
- 3 See Griliches, 1958.
- 4 See Solow, 1957.
- 5 Article I, sec. 8, cl. 8 reads: "Congress shall have the power ... to promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries."
- 6 Assuming one must summarize recent changes in the economy in a single adjective, a reasonable case could be made for that adjective to be *networked*, rather than *knowledge-based*. Networks really do alter the relations among buyers and sellers of information, in ways that interact unpredictably with such diverse arenas as competition policy, privacy, education and crime. For a helpful and non-technical introduction to network economics, see Varian and Shapiro, 1999.

- 7 See, for example, Reinganum, 1982.
- 8 The definitional question, ‘What is a software patent?’ arises here, and it is surprisingly difficult to answer. In the first place, many functions performed by software may also be *hard coded* into a computer chip, which as an apparatus is clearly patentable. (This independence of the invention from the medium of its embodiment is one of the arguments cited in favour of software patents.) Canada does not grant *pure* software patents, but it may grant patents on inventions that can be embodied in either hardware or software.
- 9 For example, a database that derives value from comprehending all possible elements of a particular category of data cannot have been subject to *selection*. Similarly, a database whose value derives from its chronological ordering of events cannot protect that ordering, which (being a fact itself) necessarily belongs in the public domain.

BIBLIOGRAPHY

- Cohen, W.M., R.R. Nelson and J.P. Walsh. 2000. *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)*, NBER Working Paper No. 7552 (February).
- Griliches, Z. 1958. “Research Costs and Social Returns: Hybrid Corn and Related Innovations.” *Journal of Political Economy* (October): 419-431.
- Levin, R.C., A.K. Klevorick, R.R. Nelson and S.G. Winter. 1987. “Appropriating the Returns from Industrial Research and Development.” *Brookings Papers on Economic Activity* 3: 783-831.
- Reinganum, J. 1982. “A Dynamic Game of R&D: Patent Protection and Competitive Behavior.” *Econometrica* 50: 671-688.
- Solow, R. 1957. “Technical Change and the Aggregate Production Function.” *Review of Economics and Statistics* 39: 312-320.
- Varian, H. and C. Shapiro. 1999. *Information Rules: A Strategic Guide to the Network Economy*, Cambridge (Mass.): Harvard Business School Press.
- Zerbe R.O. (ed.). 1986. *The Economics of Patents and Copyrights, Research in Law and Economics* 8, Greenwich (Conn.): JAI Press.



David Vaver
University of Oxford and St Peter's College

1

Canada's Intellectual Property Framework: A Comparative Overview

IN THIS PAPER, I ATTEMPT TO SKETCH the current state of some of Canada's intellectual property (IP) laws, particularly on copyright, patents and trademarks.¹ These laws are compared with U.S., and occasionally other, laws, and conclude by suggesting some future developments and concerns.²

During this exercise, two questions persistently suggested themselves: (1) Are Canadian and U.S. laws really that far apart? (2) Could the differences be easily bridged?

The following analysis suggests that the answers to these questions are, respectively, (1) yes, and (2) no. In spite of the homogenizing tendency of recent international initiatives, Canadian and U.S. IP laws differ from one another as much as do their respective legal systems and economic and social policies. The IP legal divide could, no doubt, be narrowed. The United States has indeed narrowed it unilaterally in some fields (e.g. domain names) by imposing U.S. law and the jurisdiction of U.S. courts extraterritorially not only on disputes between Canadian and U.S. firms but also on disputes between Canadians.³ Apart from such aberrant behaviour, what measures would objectively be desirable for both countries, and, perhaps more to the point, what would be politically achievable, are questions that cannot be answered without considerable further research.

INTRODUCTION

OF CONSTITUTIONS AND JUSTIFICATIONS

WHY DO WE HAVE IP LAWS? Canada's basic law, the *Constitution Act*, is unenlightening, other than to emphasize the national importance of

“Copyrights” and “Patents of Invention and Discovery” by allocating to the federal parliament exclusive power to legislate about them.⁴ The U.S. Constitution is a little more forthcoming. It also allocates exclusive legislative power over copyrights and patents to the federal legislature, explicitly to “promote the Progress of Science and useful Arts”.⁵ On this theory, rewarding authors and inventors for their efforts is considered secondary; at least as important is “encourag[ing] others to build freely upon the ideas and information conveyed” by IP-protected material.⁶

In practice, however, much IP law and policy sits uneasily in either country with these sentiments. Instead, cruder, and theoretically less justifiable, notions — that creators of anything of value have a natural right to exploit it, or that those who sow should reap the full harvest to the exclusion of all others — seem to propel much lawmaking nationally and internationally.⁷

Trade-marks are not explicitly referred to in either Constitution. In Canada, Parliament can legislate for registered marks under its power to regulate trade and commerce, while provinces may protect peripheral IP such as unregistered marks and trade secrets under provincial laws, the common law or the law of delict.⁸ Similarly, in the United States, trade-marks used in interstate commerce fall under Congress’s power to “regulate commerce with foreign nations, and among the several States”.⁹ Such marks can be registered and protected federally, while local marks are protected under the common law¹⁰ and registration statutes of individual states.

Other laws such as constitutional guarantees of freedom of expression under the *Canadian Charter of Rights and Freedoms* of 1982 and provincial bills of rights may affect how far copyright and trade-mark owners may press their rights. Federal and state constitutional guarantees of free speech and against taking property without due process similarly affect the exercise of intellectual property rights (IPRs) in the United States.¹¹ So does the notion of state sovereign immunity, under which the U.S. Congress cannot unilaterally subject the states to IP laws. Thus, Florida has successfully pleaded sovereign immunity to a patent infringement suit brought against one of its state corporations.¹²

INTERNATIONAL TREATIES

IP LAWS ARE WRITTEN AGAINST A BACKDROP of multilateral international treaty obligations assumed since the late 19th century. These treaties effectively dictate the types and levels of protection that Canada must extend without discrimination to nationals from other adhering states. This position also holds true for the United States, which has, especially over the last two decades, led the field in promoting high, standardized international IP norms to further the economic interests of its industries.

The most important IP treaties to which Canada and the United States both currently adhere are:

- the *Paris Convention for the Protection of Industrial Property* of 1883, as revised up to 1971 (“Paris Convention”), mandating national treatment for patent, trade-mark and design rights;
- the *Berne Convention for the Protection of Literary and Artistic Works* of 1886, as revised up to 1971 (“Berne Convention”), mandating national treatment and high minimum standards of protection for copyright and moral rights, without registration or other formality;
- the *North American Free Trade Agreement* of 1992 (“NAFTA”), especially Chapter 17, mandating national treatment and high levels of protection for copyright, patents, trade-marks and other IPRs in Canada, the United States and Mexico; and
- the *Agreement on Trade-Related Aspects of Intellectual Property Rights* (“TRIPs”), annexed to the *World Trade Organization Agreement* of 1994 (“WTO Agreement”), mandating national and most-favoured nation treatment and high levels of protection for all IPRs globally.¹³

Canada also recently joined the *Rome Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organisations* of 1961 (“Rome Convention”), a treaty which the United States has avoided in the past and which it will likely continue to avoid now that the Rome Convention is partly eclipsed by the more digital-friendly 1996 Performances and Phonograms Treaty of the World Intellectual Property Organization (“WIPO Performances and Phonograms Treaty”). Whether Canada will accede to the latter or its companion WIPO *Copyright Treaty* of 1996 is not a foregone conclusion. Canada has not acceded to various other IP treaties of which the United States is a member,¹⁴ presumably finding no clear balance of advantage for accession.

Of the treaties common to both countries, undoubtedly the most important regionally has been NAFTA, and the most important internationally has been the TRIPs Agreement. Besides imposing high levels of IP protection and enforcement and a framework for the progressive standardization of IP laws, these treaties also establish binding dispute settlement procedures, backed by trade sanctions in the event of non-compliance.¹⁵

National and Independent Treatment

IPRs are territorial in character but their scope is extended through the obligation of national and independent treatment commonly imposed by international treaties. *National treatment* requires a state to extend to nationals from

foreign states the same treatment as its own nationals receive. *Independent treatment* requires local treatment to be extended, however that item is treated elsewhere.

To take an example from copyright: If a U.S. national seeks to protect her copyright in Canada for a work, Canada does not usually care whether the work is in or out of copyright in the United States. If the work would have been protected if created by a Canadian national, it is equally protected when a U.S. national claims Canadian copyright.

It follows that U.S. firms may, through the exercise of their Canadian copyright, bar exports into Canada and may also stop local imitation of works that lack U.S. copyright protection. Canadian makers of similar non-copied items can recoup their sunk costs and any superprofit from the Canadian market and from other territories which recognize such copyrights, but must accept copiers and competition in the United States.¹⁶

Intellectual Property as Trade Barrier

A more common variant of the last example is the situation where an IPR is owned or controlled by the same entity in both jurisdictions. The owner may then use the IPR to create non-tariff trade barriers and to practice price discrimination by preventing parallel imports. For example, since a Canadian patent is separate and different from a U.S. patent, a patented product lawfully made in the United States cannot be exported to Canada for use or resale without infringing the Canadian patent. Canada reinforced this policy in 1997 by granting copyright-like rights to holders of sole Canadian book distribution contracts to prevent parallel imports. The use of IPRs to achieve such ends is clearly inconsistent with the notion of a single free market.¹⁷ Whether the strategic transfer and exercise of IPRs by affiliated corporations amounts to an unenforceable anti-competitive practice, as it may in the European Community, remains to be seen.¹⁸

MULTIPLE PROTECTION

AS IPRS HAVE PROLIFERATED AND EXPANDED, instances of multiple IP protection have increased.¹⁹ For example, a firm's logo may be registered or protected at common law as a trade-mark, a textile pattern may be registered as an industrial design, a computer program can be protected by a patent; yet, copyright protection for all three may be cumulatively available.²⁰ Patent and design right holders also strive to create trade-mark rights over aspects of their product and so as to lessen free competition on expiry of the patent or design registration.²¹ Plant breeders may acquire both patents and plant breeders rights over their new seeds and enforce the rights cumulatively, thereby circumventing any inconvenient user exemptions found in one Act but not the other.²²

IPRs are here treated like products in a supermarket: a shopper with enough money and information can acquire as many items as he wishes. Given that innovation levels are hardly enhanced by the prospect of adventitious multiple protections, the question may be asked whether this rule of *take as many as you can carry* should be replaced by a rule of *only one per customer*.

Sometimes IP legislation itself partly discourages multiple protections. Thus, the Canadian *Copyright Act* steers design features towards the *Industrial Design Act* and eliminates copyright protection for mass-produced designs.²³ It has also been suggested that it is “not the intention of Parliament (nor is it desirable) to interpret the *Patent Act* and the *Copyright Act* as to give overlapping protection.”²⁴ Were this logic applied to all IP laws, one could then match the new product or technology to the protective system that fits it best, and eliminate or minimize overlap except where the law explicitly authorizes it for a good reason. For example, seeking or obtaining an IP registration could bar reliance on any right that attaches without registration (e.g. copyright or common law trade-mark) and that substantially corresponds with the registered right, both during the pendency of the registration and also on its expiry.²⁵ The case law does not yet go this far in Canada or elsewhere.²⁶

LITIGATION

IN CANADA, IP LITIGATION TYPICALLY OCCURS in the Federal Court, but provincial courts exercise concurrent jurisdiction except to correct a federal register (for example, by expunging a trade-mark, patent or copyright registration) or to issue nationwide orders.²⁷ Appeals from the Trial Division of the Federal Court go to the Federal Court of Appeal; appeals from provincial trial courts go to the respective provincial appeal courts. A final appeal to the Supreme Court of Canada is available with leave of that Court. The Supreme Court is the final arbiter of all issues of federal and provincial statute and constitutional law, as well as of the civil law in Quebec and the common law in other provinces.

By contrast, in the United States the federal courts alone have jurisdiction over IP matters arising under federal statutes, but also often have concurrent jurisdiction over state claims. Indeed, much of the U.S. law on unfair competition, including infringement of common law trade-marks and of publicity rights for celebrities, was created and developed by the federal courts. But the interpretation of state law — common law and state legislation — is ultimately for each state to decide.²⁸ Federal courts (including the U.S. Supreme Court) cannot authoritatively tell a state what its common law is or what a state statute means, although they may invalidate or trim state law where it conflicts with the U.S. *Constitution* or an overriding federal law.

Interpreting U.S. federal law is even trickier than the counterpart exercise in Canada, for there is no single U.S. federal court of appeal.²⁹ Instead, the

United States is divided into 12 circuits, each with its own court of appeals, each entitled to reach an interpretation of federal law binding within the circuit, until corrected nationally by the U.S. Supreme Court if it decides to take an appeal. Some unity of interpretation exists in patent and trade-mark matters because the Court of Appeals for the Federal Circuit alone hears appeals from the U.S. Patent and Trademark Office and also from the federal trial courts in patent matters. But, on matters outside that court's purview, conflicting interpretations among the circuits is not uncommon.³⁰

COPYRIGHT

PRELIMINARY

CANADIAN AND U.S. COPYRIGHT LAWS are presently quite similar, despite developing along different paths since the 19th century to reflect each country's perception of its economic and political welfare.³¹ Thus, both countries treat copyright as personal property, capable of division, transfer, licensing or bequest, by territory or worldwide. Both protect expression only and leave a work's ideas free for all to use; both have equal difficulty in drawing the line between *ideas* and *expression*. Short of egregious anti-competitive behaviour, a copyright owner in either country may license or transfer the rights or not as he thinks fit, and at such prices as he thinks fit. Both countries have roughly comparable provisions on the core subject-matter they protect, on the need for the work to be fixed in some material form, on registration, on what rights copyright owners may exercise, and on remedies available for infringement.

Provisions on ownership, book distribution, user rights, and duration exhibit greater differences. For example, the rights held by sole book distributors to maintain their margins, by treating unauthorized parallel imports of books as copyright infringements, have no counterpart in U.S. law. Nor has the blank audio recording media levy, designed to compensate right holders for private audio recording.

Canadian law also encourages the formation of collecting societies to hold and collectively administer copyrights for the benefit of authors, right holders, performers and record companies. Thus, a single performing right society, SOCAN, administers musical performing rights, and a single reprographic collective, CANCOPY, issues and administers photocopying licences. The Copyright Board fixes rates for musical performing and telecommunication rights and for cable retransmission of television and radio programs, sets the blank audio recording media levy, and also sets rates in other cases where collecting societies cannot reach agreements with users. In so doing, the Board has clarified many important legal issues surrounding public performance and telecommunication

rights, including the liability of website operators and Internet service providers for distribution of music over the Internet.

SUBJECT-MATTER

Traditional Works

THE VAST MAJORITY OF ORIGINAL literary, artistic, dramatic and musical works and of compilations of any interest or value — all sorts of books, poems, anthologies, artwork, music, drama, computer programs, motion pictures, architecture — is protected by copyright in Canada, as it is in the United States.

However, the techniques for protection differ. In Canada, while the Berne Convention definition of “literary and artistic works” appears almost verbatim in the *Copyright Act*, the separate categories — literary work, artistic work, etc. — are defined and often sub-defined. One might expect the occasional item to fall between the cracks but this occurs rarely, partly because Parliament has progressively defined the categories more broadly and partly because courts interpret the categories liberally (more so than in the past). Thus, the courts protected computer programs as literary works well before the *Copyright Act* was amended to similar effect.³²

By contrast, in the United States, copyright protects all original “works of authorship”, giving some non-exhaustive Berne Convention-like illustrations. One might therefore expect more works to be protected in the United States than in Canada, because the whole — “original works of authorship” — looks greater than the sum of its parts.³³ In fact, the reverse is true: more works get protected — and more intensively — in Canada than in the United States. Whether this feature is the result of any conscious policy — and, if so, what the object of that policy might be — is an intriguing question.

Anomalies

The following anomalies are worth noting:

Blank Forms and Sports Schedules

Canada extends copyright to original blank forms — e.g. diaries; accounting, tax and order forms — either as literary works or compilations. To obtain protection, these items need not impart ideas, information or knowledge, so long as they “functionally assist[...], guid[e] or point[...] the way to some end.”³⁴ Similarly, original sports schedules are protected.³⁵

U.S. copyright law may, somewhat controversially, deny protection to “schedules of sporting events”,³⁶ as well as “[b]lank forms, such as time cards, graph paper, account books, diaries, bank checks, scorecards, address books,

report forms, order forms and the like, which are designed for recording information and do not in themselves convey information.” Whether protection is sought for individual forms as literary works or for a suite of forms as a compilation is apparently irrelevant.³⁷

Unauthorized Derivative Works

Derivative works — works that recast, transform or adapt a pre-existing work: e.g. translations, musical arrangements, dramatizations, film versions, abridgments — do not have their own special category in Canada, but are nevertheless protected if the resulting transformation of the source work is original.

In the United States, derivative works form a special category, in which copyright does not extend to “any part of the work in which [pre-existing] material has been used unlawfully”.³⁸ An unauthorized translation, condensation, or musical arrangement may thus lack copyright protection in that country.

Some thoughtless Canadian *dicta* parrot the U.S. position,³⁹ but the better view is that an unauthorized derivative work can have a Canadian copyright. The unauthorized work nevertheless remains at the mercy of the source work copyright owner, who can claim the usual infringement remedies against it.⁴⁰

Neighbouring Rights

Canada extends copyright protection to *non-traditional* matters: performers’ performances, sound recordings, and broadcasts. Internationally, these rights are classified as *neighbouring*, *related* or *entrepreneurial* rights rather than copyrights. Copyright, strictly speaking, applies only to traditional *works* and *authors*, who supposedly differ vocationally from those who perform, fix or distribute works.

Neighbouring rights typically depend on and flow from copyright and traditional works. Performers perform works, sound recorders record the performances, and broadcasters broadcast them. These performers’, recorders’ and broadcasters’ rights gained recognition much later than copyrights and are generally less intensive: their duration is shorter, they may not attract moral rights (although the *WIPO Performances and Phonograms Treaty* of 1996 would change that for performers), and they sometimes are rights to receive remuneration rather than full rights to bar exploitation altogether.

U.S. law protects sound recordings as traditional works (as, indeed, Canada did until 1997) but otherwise protects neighbouring rights in only one instance, to comply with the TRIPs Agreement: live musical performances cannot be fixed without authority.⁴¹ In the United States, unauthorized reproductions or fixations of broadcasts and non-musical performances are protected, if at all, only under state law.

Government Works

Works produced by federal, provincial and municipal government employees as part of their duties, and works “prepared or published by or under the direction or control of Her Majesty or any government department” are subject to copyright owned by the respective level of government. Some vague category of works falling under the ancient Crown prerogative to control printing also comes under perpetual federal or provincial government control.

The starting point in the United States is quite different. Since the late 19th century, U.S. courts firmly denied copyright to federal and state laws and court decisions as a matter of democratic public policy. Congress extended this policy by excluding from copyright all works produced by federal employees as part of their official duties.⁴²

In Canada, the idea that everything emanating from the legislative, judicial and executive arms of government can be used by the citizen only by leave — which, if granted, may be on such terms as the government thinks fit — is one of the less attractive relics of colonialism and monarchical government. State control through the mechanism of copyright may perhaps be justifiable for items such as the currency, postage stamps, admiralty charts and computer programs, but such control over the laws of the land (bills, statutes, regulations, decisions of courts and tribunals, etc.) and every government report and document — from a ministerial letter to a parking ticket — is surely indefensible in a modern democracy. Nor has the federal government been shy in asserting its rights, as when it closed down an unauthorized abridgment of a government publication, refusing to accept reasonable royalty payments in lieu.⁴³

Some leaven comes from the 1997 blanket permission issued by the Canadian government, allowing anyone to copy federal statutes and regulations, as well as the decisions of federal courts and tribunals, so long as the copy is accurate and is not held out as official.⁴⁴ Some provinces have followed suit, but these initiatives are no substitute for relinquishing government copyright altogether. To be morally justifiable, censorship should be exercised transparently under censorship laws, not through the guise of protecting or encouraging the literary creativity of the civil service.

Despite its different starting point, the U.S. position has, perhaps surprisingly, moved closer to the Canadian position in key respects. Thus, work produced by government employees may fall outside their official duties: the copyright in many public speeches and in private diaries, even those relating to public matters, may belong to the employee. The U.S. federal government may also hold or acquire copyright in works produced under procurement contracts. So a work that, if done in-house by federal officials, would have been open to all can, if outsourced, be enclosed by copyrights held by the government or the private sector.⁴⁵

This last development may spur the re-enclosure of public legislation that has been privately drafted. This phenomenon was hinted at in a Prince Edward Island case, where a person charged with violation of a provision of the National Fire Prevention Association Code was denied a copy of the document because of copyright *privileges* presumably asserted by the Association. While the defendant was given access to the Code in the fire marshal's office, the reviewing court was nevertheless critical of the government's attitude: it was "unreasonable for a public authority to inhibit access to the rule book by those persons who are expected to follow it", and the fire marshal's "copyright concern is an internal matter which should be remedied by the [provincial government] so that it does not in future adversely affect those whom it regulates."⁴⁶ The suggestion that reasonable access to the law involves an obligation to make copies of those laws freely available, whoever drafted them, has not been taken up. Thus, a non-profit informational U.S. website was recently barred from displaying an industry-drafted building code widely adopted by municipalities. The court which issued this order naively assumed that, without copyright, industry would lack any incentive to draft the standardized laws from which it benefited; "state and local governments would have to fill the void directly, resulting in increased governmental costs as well as loss of the consistency and quality to which standard codes aspire."⁴⁷ Along similar lines, the Los Angeles County is reported to have licensed the copyright in *its* jury instructions to other Californian courts for substantial royalty payments (\$2.5 million over ten years). The County has also denied other agencies, including the state's judicial council, the right to base state-wide model instructions on those of Los Angeles: the agencies have had to start their drafts from scratch.⁴⁸

Such a view of IP law would hardly have appealed to those 19th century U.S. courts that denied copyright on democratic public policy grounds to freelance court reporters and private sector law compilers alike.⁴⁹

ORIGINALITY

COPYRIGHT EXISTS IN TRADITIONAL works only if they are *original*⁵⁰ — a seemingly simple concept that, in practice, yields erratic results. For originality is really a proxy for answering the question: Has the author done enough to justify preventing the world from copying from his or her output for a century or more? What is *enough* varies among places and types of work. Canadian courts usually apply a very low threshold test of originality, perhaps partially to compensate for the lack of a common law tort of unfair competition or misappropriation. In this, they follow a consistent century-old line of U.K. case law: to be original, the work must emanate from the author, must not be copied from someone else, and must involve some undefinable quantum of time, labour,

skill and/or judgment. Novelty is unnecessary: two independently created works may each have copyright without mutually infringing.⁵¹

Under this test, short phrases (*Expo 86*)⁵² and titles (*The Man Who Broke the Bank at Monte Carlo*, or *The Guinness Book of Olympic Records*) are excluded from copyright; their protection is left to passing-off law.⁵³ Corporate logos involving quite modest artistic skill — the Motel 6 cloverleaf enclosing a “6”, the Canadian Tire triangle, the sloping letters of Visa on the credit card, and the Michelin Man drawing — have, however, all been routinely protected,⁵⁴ as has a series of colour-coded labels for file folders.⁵⁵ These decisions track the U.K. approach, which has found originality in a three-sentence piece of commercial correspondence,⁵⁶ and in simple line drawings of screws and washers in a spare parts catalogue: little short of “a single straight line drawn with the aid of a ruler” is excluded from copyright, said the court in the latter case.⁵⁷

The U.S. threshold for originality is nominally higher but equally opaque: some *creative spark* is said to be constitutionally essential.⁵⁸ In practical terms, the application of these tests results in more works — virtually every squiggle, scribble or squawk — gaining copyright in Canada than in the United States. Thus, the transcription of an oral speech (such as a judge’s *ex tempore* opinion or remarks),⁵⁹ an ordinary snapshot taken by an amateur,⁶⁰ a simple corporate logo,⁶¹ and the translation of a word list⁶² will more likely be found original in Canada than in the United States, where they may well be branded uncreative drone work.⁶³

Three *caveats* should be made:

Compilations – Since compilations are specially defined in NAFTA in language borrowed from the U.S. *Copyright Act*, the same standard of originality ought, in theory, to apply in both countries to this category, that is some creativity in selecting or arranging the material into a composite whole, leaving any facts compiled free for all to use. Thus, in both countries, a white pages telephone directory is unprotected — no *creative spark*, just *sweat of the brow*⁶⁴ — but yellow pages and other specialized business directories (e.g. of Chinese- or Italian-owned businesses)⁶⁵ and used car price guides⁶⁶ have passed muster.

In practice, the theory of homogeneity breaks down, if only because the question of how rigorously to test compilations for originality is itself a source of continuing disagreement within the United States. The same work might be protected in one circuit but denied protection in another.⁶⁷ Canada’s historically low threshold of originality suggests that its courts will range themselves alongside the more relaxed U.S. holdings on this spectrum.

Canadian Law Post-*Tele-Direct* – The case that imposed NAFTA’s creativity standard on Canadian compilations, *Tele-Direct (Publications) Inc. v. American Business Information Inc.*,⁶⁸ left unclear whether the same standard applied to other works. Since the court did not refer to a long line of Canadian case law applying the low-threshold U.K. test of originality elsewhere, those

cases presumably retain their authority,⁶⁹ although that position is not yet entirely stable.⁷⁰

Forget Originality, Remember Infringement – Judge Jerome Frank once called decisions on obviousness in patent law “the adventures of judges’ souls among inventions”, and this dictum seems equally true of originality in literary and artistic works. Judicial close encounters of the original kind have “tended to divert attention from other possibly more critical issues, such as when ... and how far copyright should be asserted.”⁷¹

The latter issues are particularly critical in Canada, where the lax test of originality lets almost anything into the pantheon and where the range of defences to infringement is tightly circumscribed. Consider the recent exposition by the Federal Court of Appeal in *Édutite Inc. v. Automobile Protection Assn.*⁷² A plaintiff compiling a used car price guide claimed originality in his idea to juxtapose a column indicating private sale prices alongside the column indicating retail prices — a classic situation where *idea* might be thought to merge with *expression*, given the few ways in which the idea could be executed. Yet, calling the compilation original — nay, “brilliant” and “innovative” — the court unanimously held that a defendant that copied that juxtaposition infringed the copyright, even though its own price data were independently generated.⁷³

If correct, this holding effectively creates a patent on this method of presenting vehicle (and other?) prices for the duration of the copyright (perhaps another century), as most intending entrants in the price guide market would first research all available guides and so would render themselves vulnerable to a copyright infringement suit if their guide later came to contain the same columns. The court’s preoccupation to find some copyright on the plaintiff’s work led it to protect the wrong aspect of that work — a feature that, however innovative, should have been left free for all to use.

DURATION

TRADITIONAL COPYRIGHTED WORKS in Canada are generally protected for the Berne Convention standard term of the author’s life plus 50 years, even where the first copyright owner is the author’s employer. Where the author is the first owner and has assigned or exclusively licensed his copyright, the grant automatically reverts to his estate 25 years after his death, ostensibly to allow the estate to renegotiate any deals now thought to be unfavourable. Neighbouring rights are protected for a straight 50 years, typically from when the performance occurred, the record was first fixed or the broadcast took place.

Following the European Union’s move to a copyright term of life of the author plus 70 years in 1995, the United States in 1998 added 20 years retrospectively to all its copyright terms. So, the U.S. standard term is now the author’s life plus 70 years. The author (or his estate) has a statutory power

(roughly comparable to the Canadian provision on reversion noted above) to terminate any copyright grant, on following a strict set of procedures within 35 to 40 years after the grant.

A special U.S. term applies to works made for hire, where the hirer (typically a corporation) is deemed to be the author. The copyright lasts for the shorter of 120 years from creation or 95 years from first publication, and is not subject to the statutory power to terminate.

Canada and the United States usually apply their copyright terms to foreign works without discrimination. This holds true for Canadian works in the United States, and *vice versa*.⁷⁴

INFRINGEMENT

THROUGH COPYRIGHT, THE RIGHT HOLDER — the author, the author's employer or whoever the author has transferred the right to — can exploit and profit from the work by various means stated in the Act: reproducing, translating, publicly performing or telecommunicating, controlling imports, etc. The holder can do these acts itself or can stop others doing them without its consent or a licence.

The rights have always needed interpretation as new technologies have appeared. Questions that agitated the earlier part of the 20th century — Was a piano roll a *copy* of the music encoded on it? Did a radio or television broadcast constitute a public performance? Could a right holder control cable retransmission? — receded into the background at the end of the old millennium as computer technology and the Internet raised new questions. Was merely to switch on and run a computer program equivalent to *reproduce* it? Was uploading, downloading, linking to, or even merely viewing an Internet site an act that the right holder could legally control? Or should these activities be treated merely as the digital counterparts of reading and book-marking, long permitted in the world of *hard copy*?

On such dry and apparently simple questions rest issues of control and access. Do the greater statutory rights won by IPR owners over digital use and distribution mean that users have easier access to works but less control over the terms of access and over how they may use the material they see or hear? Or will users fight back with strategies of avoidance and disregard that will ultimately thwart IPR owners' hegemonic desires? Napster as a device for freely exchanging copyrighted material may be dead, but will its ideal shape practice, if not law, on the Internet?

The way in which courts interpret the rights that legislatures grant to owners can be critical. Take, for example, the rule that copying may occur even if the defendant did not know he was copying something which he saw long ago and which now resides only in his subconscious memory. A well-known example

is the infringement verdict against George Harrison in 1976 for subconsciously copying a Chiffons' hit song when Harrison composed *My Sweet Lord*. Harrison had heard the Chiffons' song eight years previously when it was on the charts and getting regular airplay. A U.S. court held that he must have unwittingly copied the few notes making up the tune when he was stringing *My Sweet Lord* together nearly a decade later. The infringement verdict was upheld by a U.S. appeals court, which approved the doctrine of subconscious copying by saying that any other rule "as a practical matter [would] substantially undermine" copyright protection.⁷⁵

This ruling blurs the line between copyright and patents. Patents stop anybody from stepping within the fence of the patent claims, whether they know the fence is there or not. But then the patent runs for 20 years, not for over a century, as is the case for copyright. As more music becomes instantly accessible to more people, as copyright comes to protect smaller and smaller bits, and as fewer differences between simple works come to exist, only luddites and hermits may be able to avoid charges of subconscious copying.

USER RIGHTS, INCLUDING FAIR USE AND FAIR DEALING

SINCE 1924, VARIOUS ACTIVITIES IN CANADA — denoted *exceptions*, *exemptions*, *defences* or *user rights*, depending on the speaker's taste or propensity — have been permitted without infringing copyright, sometimes without charge, sometimes against payment.⁷⁶ The list of exemptions has been periodically supplemented to cope with new technologies and demands, most recently in the 1997 overhaul of the *Copyright Act*. Thus, miscellaneous exemptions exist for copying done by or in non-profit educational institutions, libraries, archives and museums; for people with perceptual disabilities; for those using music for charitable or educational purposes; for ephemeral recording by broadcasters and for other incidental uses; for filming or taking pictures of public buildings or sculpture; for imports of used books or of up to two copies for personal use; and so on.

Fair dealing for research, private study, review, criticism and news reporting is also allowed; but in the last three instances, a precondition is the observance of strict (and sometimes unworkable) requirements to acknowledge sources and the authors, performers, sound recording makers or broadcasters of the material used.⁷⁷

Little unites this ragbag of single instances, save that they supposedly fall within the language of the TRIPs Agreement (article 13) as limitations or exceptions confined to "certain special cases which do not conflict with a normal exploitation of the work and do not unreasonably prejudice the legitimate interests of the right holder."

Significantly, the Canadian list is not open-ended: anything not falling strictly within a stated exemption infringes copyright. A court may be able to enforce copyright on *public interest* grounds, but this common law power has rarely been exercised in Canada, and the British courts, which invented this defence, recently narrowed its application from any “just cause or excuse” to a closed set of egregious circumstances.⁷⁸

The contrast with U.S. law is striking. The U.S. *Copyright Act* contains a list of specific exemptions that target some of the situations found in the Canadian statute, but a single exemption overshadows them all: *fair use*. The fair use of a copyrighted work “for purposes *such as* criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research” does not infringe copyright [emphasis added]. The decision on whether a particular use is *fair* requires consideration, *inter alia*, of the following factors:

- (1) the purpose and character of the use, including whether such use is of a commercial nature or is for non-profit educational purposes;
- (2) the nature of the copyrighted work;
- (3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and
- (4) the effect of the use upon the potential market for or value of the copyrighted work.⁷⁹

Canadian courts may apply similar criteria when determining whether a dealing is *fair*, but U.S.-style fair use potentially applies to any situation, not merely uses for the presumptively worthy purposes set out above in the U.S. Act. The U.S. approach continues a tradition, dating from 19th century U.S. and British practices, of letting judges set and monitor a reasonable balance of rights between copyright holders and users as different technologies and usages arise and develop. On this theory, while specific targeted exceptions serve a purpose, legislatures can neither anticipate new developments nor respond to them effectively and quickly; so courts are assigned the role of creating appropriate boundaries between private rights and the public domain in the course of deciding concrete disputes.

Thus, in recent years, U.S. litigation has wrestled with whether and, if so how far, copyright is infringed when computer programs are repaired or dissected by competitors, third parties supply enhancements for videogames, musicians sample and use extracts from recorded music, Internet files are downloaded or linked, Internet search engines display and collect information, Internet service providers transmit and display infringing material, etc. The question is whether an activity that, at first sight, constitutes infringement should at second sight, when scrutinized through the lens of fair use, be permitted and, if so, under what conditions. The court decision may later be examined

by Congress and confirmed, modified, reversed or generalized — as occurred, for example, with court decisions on computer program repair (repairer's liability reversed) and Internet service provider liability (liability for passive carriage confirmed, with additional procedural requirements). Quite often, however, the court ruling on fair use has stood because U.S. legislators were unable or unwilling to attempt or achieve a better balance of interests.

Canadian and U.S. decisions dealing with the same fact pattern will sometimes produce the same result, either because the courts reason similarly or because a specific provision covers the activity that is treated under *fair use* in the United States. Thus, fair dealing/use analysis in both countries has exonerated newspapers for using third party photographs to illustrate a news story⁸⁰ but has held university course-pack compilers liable for reproducing journal articles and book chapters.⁸¹ By contrast, in both countries artwork cannot be used without authority as a backdrop for a television or movie set, but for different reasons: in the United States because the use has been held unfair, in Canada because it falls outside a narrowly-drawn exception covering incidental non-deliberate uses of copyright works.⁸²

A significant number of uses that may be inoffensive in the United States may infringe copyright in Canada. For example, parodies that infringe in Canada may pass muster as fair uses in the United States.⁸³ Similarly, home video-taping of television programs for time-shifting purposes has long been legitimate in the United States but may theoretically be unlawful in Canada⁸⁴ — a ridiculous result that would make most Canadians wrongdoers on a regular basis. The application of the fair use doctrine to allow or even encourage economically or socially beneficial uses of copyrighted material, e.g. for comparative advertising or political campaigning,⁸⁵ has no counterpart in Canadian law.

The discrepancy between Canadian and U.S. approaches is magnified by the following factors:

- (i) more works qualify for copyright in Canada,
- (ii) Canadian exceptions do not reach many everyday situations where an activity is widely assumed to be unobjectionable (for example friends scanning or faxing newspaper cartoons to one another, or lawyers copying material in the course of giving legal advice or pursuing legal proceedings), and
- (iii) while new technologies automatically fall under copyright, exceptions typically are technology-specific and are not interpreted to include cognate uses.

Contractual and Technological End-runs

Increasingly, copyright holders have sought to use contract law and technology to do what copyright law fails to achieve for them.

Contracts

Hard on the heels of *shrinkwrap* agreements for prepackaged computer software have come *click-on* agreements on Internet web pages and electronic databases. In the first case, software makers seek to make the mass of small print on the wrapping binding on buyers who proceed to install and use the program. In the second case, webpage and database operators seek to make similar boilerplate on the website bind users who proceed after clicking an “I agree” icon or who simply proceed to use the site after seeing some boilerplate to the effect that “use of this facility constitutes acceptance of the terms set out above.”⁸⁶

Traditionalists may be repelled by the idea that such reflex actions have anything in common with arm's-length contracts dickered with the aid of lawyers, but relentless pressure to equate the two activities has been largely successful in the United States and may also ultimately prevail in Canada.⁸⁷ What copyright fails to do for right holders is thus accomplished through *agreement*.

The potential clash with copyright policy is obvious. Suppose the agreement purports to restrict a user beyond what fair dealing or fair use strictures would require. Which prevails: the copyright rule or the *agreed* rule? Mediating the clash by the application of some vague doctrine such as unconscionability concedes that the public domain may be yet further retrenched by subordinating copyright policy to a simulacrum of agreement.⁸⁸

Technology

Technology may accomplish what agreement cannot. Works can be encrypted to prevent copying even for purposes the *Copyright Act* would otherwise allow, including fair dealing or fair use. The Canadian *Copyright Act* does not explicitly forbid this practice; nor does the U.S. legislation. Indeed, the anti-circumvention provisions enacted by the *Digital Millennium Copyright Act* of 1998 have allowed encryption to trump fair use, although their consistency with First Amendment free speech guarantees is currently under challenge, so far unsuccessfully.⁸⁹

MORAL RIGHTS

CANADA HAS HAD EXPLICIT PROVISIONS for authors' “moral rights” (*droits moraux*) since 1916. Tracking the Berne Convention's article 6*bis*, the rights were extended in 1931 to apply to all copyrighted works and were further expanded and clarified in 1988. They are co-terminous with, but independent of, copyright, and are similarly enforced. These rights supplement the patchwork

of common law and civil law actions available to authors to control how their works are perceived on the market, in order to ensure that

- (i) the work is properly attributed, or the author's anonymity or pseudonymity is respected; and
- (ii) the work is not mutilated, deformed or otherwise modified to the prejudice of the author's honour or reputation.⁹⁰

In one well-known case, the operators of Toronto's Eaton Centre shopping mall had to remove Christmas decorations tacked on to a naturalistic sculpture of Canada geese displayed in the mall's concourse, because of the author's reasonable fear of prejudice to his honour or reputation.⁹¹ Not all suits have been this successful. Claimants have lost because they could not prove either prejudice or monetary loss where damages were sought.⁹² So a town could, with impunity, finish off the job that vandals had started, and completely destroyed public sculptures by throwing them into a local river to break up on rocks. Out of sight meant out of mind, and beyond prospect of prejudice to the sculptors' reputation.⁹³

At least this last result would not occur in the United States, where the *Visual Artists Rights Act* of 1990 includes "destruction" of an artwork among its prohibited acts.⁹⁴ But the U.S. statute is limited to original, or limited edition signed and numbered, artworks; it requires evidence of the "recognized stature" of such works and of harm to artistic reputation; it applies only during the artist's life; it does not apply to works made for hire; and these rights may be waived in writing. These shortfalls may be partly avoided in complementary state legislation, e.g. California's *Art Preservation Act* of 1980, which grants full moral rights to works "of fine art" until 50 years after the artist's death.

The United States has not explicitly extended moral rights beyond the visual arts field. It nevertheless claims to comply with its Berne Convention obligations, mainly through the protection extended to all authors by the common law and by state and federal false advertising laws. Were this true, it is hard to see why enactment of the *Visual Artists Rights Act* was thought necessary and why it was not made applicable to all works.

Still, the U.S. assertion is not entirely frivolous. Thus, in 1976 the British comedy group Monty Python stopped the ABC television network from broadcasting versions of its shows that ABC had edited to make room for commercials and to remove the naughty bits that might offend the network's sensitive viewers. The court noted the lack of any explicit moral rights provisions in U.S. law but thought the shortfall could be made up by contract or unfair competition law. ABC was found to have infringed Monty Python's copyright by ignoring the requirements of its licence that forbade changes without the copyright owner's consent, and also to have breached the false labelling provisions of

§43(a) of the *Lanham Act* by its presentation of the garbled broadcast as Monty Python's authentic work.⁹⁵

Despite the disparate approaches existing in the two countries, outcomes in moral rights cases may be rather closer, for moral rights can be waived, often informally or even impliedly, and boilerplate written waivers are common in standard form contracts. Anomalies may arise where parties do not know their rights, slip up in their contracting practices (as ABC did with Monty Python), or try to enforce waivers in a foreign jurisdiction such as France, which does not let the moral rights of even U.S. authors be trumped there by Hollywood's *contrats d'adhésion*.⁹⁶

PATENTS

PRELIMINARY

INVENTIONS ARE PATENTABLE IN CANADA under the *Patent Act*.⁹⁷ The inventor files an application with the Patent Office, accompanied by a specification disclosing the invention and containing claims staking out the exclusive rights sought. A 20-year patent backdated to the priority date (the Canadian filing date or the foreign date for an application made under the Paris Convention) is then granted if the application is found to comply with the Act — the invention is new, useful and unobvious, and it is adequately disclosed and fairly claimed.⁹⁸ A substantive examination and the consequent grant of a patent may be deferred for up to five years, but the specification is laid open for public inspection 18 months after its priority date unless the application is withdrawn earlier.

The modern Canadian position took effect in 1987 and was designed to approximate and dovetail with European law. Before then, the Canadian term was 17 years from the date of the patent grant, and the patent went to the first inventor, not the first to file a patent application. Similar provisions existed in the United States until the TRIPs Agreement caused it to move towards a more European-style system closer to Canada's. Still, U.S. law differs from Canadian law in significant respects, including:

- The United States continues to grant patents to the first-to-invent, not the first-to-file. Disputes about first inventorship (and thus entitlement) are not uncommon. They are resolved through adjudication by the Patent Office after it declares an interference between competing applications. The Office's decision can be appealed to a federal court.⁹⁹

- A U.S. patent's 20-year term may now be extended by the Patent Office for delays caused by prolonged examination, interferences, and court reviews or appeals.
- U.S. applications are laid open after 18 months, but only for applications made after November 2000 for which a foreign application has also been filed. Earlier applications remain secret until patent grant.
- U.S. law has no counterpart to Canada's deferred examination procedure. U.S. applications are examined in the order they are filed.

SUBJECT-MATTER

SINCE THE IDEA OF INVENTION suggests the unexpected or unforeseeable, attempts at a more precise definition might seem foolhardy. From the start, however, Canadian law, using U.S. law as its model, has sought to define invention. Currently, the definition, little changed from the 19th century, is "any new and useful art, process, machine, manufacture or composition of matter, or any new and useful improvement in any art, process, etc."¹⁰⁰ By contrast, the *Statute of Monopolies* of 1624 (Eng.) referred simply to "any manner of new manufactures," an expansively interpreted formula used even now in Australia and New Zealand. The *European Patent Convention* of 1973 equally does not define invention, except by saying what is out rather than what is in. The European model is followed by the TRIPs Agreement: patents must be available for "any inventions, whether products or processes, in all fields of technology" if new, not obvious, and "capable of industrial application"; states may then enact specific circumscribed exceptions.

What, then, is and is not patentable in Canada?

"Anything under the Sun that Is Made by Man"?

The Congressional reports accompanying the enactment of the U.S. *Patent Act* of 1952 asserted that "anything under the sun that is made by man" is patentable under U.S. law, and that *dictum* has become the rallying cry of the U.S. courts and the U.S. Patent Office over the last 20 years, especially with the rapid growth of computer and biotechnology industries.¹⁰¹ Lacking a similar flamboyant declaration of parliamentary intent, Canadian courts have kept closer to the language of the definition of "invention" rather than relying on some supposed radiation flowing from it. Developments have, however, been erratic. On the one hand, the Supreme Court has come up with its own expansive interpretation of "art" to include "methods of applying skill or knowledge provided they produce effects or results commercially useful to the public." Known chemical compounds applied to a new use have qualified under this test;¹⁰² a new way of playing poker has not.¹⁰³ Nor has a new hybrid soybean

variety qualified as a manufacture or composition of matter: it was only metaphorically “produced from raw materials” or “a combination of two or more substances united by chemical or mechanical means,” said the Federal Court of Appeal, unmoved by contrary U.S. precedents.¹⁰⁴

A significantly broader approach was applied in 2000 when that litigious rodent, the Harvard mouse, appeared before the Federal Court of Appeal to claim the patentability hitherto denied it by the Canadian Patent Office and the court's Trial Division. A 2:1 majority of the Court of Appeal held that a genetically modified mouse was as much a “composition of matter” as the man-made oil-eating bacterium that a 5:4 majority of the U.S. Supreme Court had found to be patentable 20 years earlier. While U.S. decisions on patentability did not automatically extend to Canada, the Court said they would not be ignored if their reasoning was “persuasive”.¹⁰⁵ If this approach is generally accepted, even fewer man-made things under the Canadian sun will be held unpatentable. The result will be greater, though not complete, unity between Canadian and U.S. standards. The 1997 U.S. patent for a one-handed method of swinging a golf club notwithstanding,¹⁰⁶ no Canadian patent will likely issue for the ultimate slapshot, however new, unobvious and useful that move may be for hockey or the world. The Canadian Patent Office has yet to embrace the present U.S. tendency for instant patent gratification: issue first and ask subject-matter questions later.

Public Policy

The grant of patents under the *Statute of Monopolies* of 1624 was discretionary. Patents that were “mischievous to the state by raising prices of commodities at home, or hurt of trade, or generally inconvenient” could be refused. This approach, which applied a rough social or utilitarian calculation, case by case, to new technology, gradually fell out of vogue.

The TRIPs Agreement and NAFTA also allow patents to be refused where preventing “commercial exploitation ... is necessary to protect *ordre public* or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to [nature or] the environment.”¹⁰⁷ The Canadian *Patent Act* contains no such provision. A narrower exception, excluding patenting for inventions with an “illicit object in view”, disappeared in 1994 just before the NAFTA amendments were implemented. For good or ill, the turn-around from the *Statute of Monopolies* is complete.

A European exception preventing patenting where exploitation would be “contrary to ‘*ordre public*’ or morality”¹⁰⁸ has proved of small practical effect there. Yet, the presence of the provision emphasizes that patenting is not a morally neutral act: “[t]he state, as granting authority, cannot disclaim responsibility for the inventions for which it grants protection.”¹⁰⁹ Nor can inventors

claim any natural right to benefit from immoral or socially disruptive activity, however ingenious. So the decision to patent the Harvard mouse had explicitly both a legal and a moral dimension in Europe. The European Patent Office examiner's view that the

provision of a type of test animal useful in cancer research and giving rise to a reduction in the amount of testing on animals together with a low risk connected with the handling of the animals by qualified staff can generally be regarded as beneficial to mankind [...]¹¹⁰

may not, in syntax or substance, be to everyone's taste. But at least the point was not dismissed, as it was in Canada, by a curt: "policy questions ... are to be addressed by Parliament and not the Court." The minority judge in the Canadian Harvard mouse case (Isaacs JA) would have factored public policy considerations into the patenting decision. The majority view probably accurately reflects the present U.S. legal position, and also Canadian law too — at least until the Supreme Court speaks differently.

Industrial Applicability

The requirement that an invention be "useful" excludes written material and fine art, already adequately protected under the *Copyright Act*. Similarly excluded is the exercise of professional arts and skills, which are said not to be part of trade, industry or commerce. Thus, architectural and engineering plans and schemes are unpatentable in Canada.¹¹¹ Patenting is sometimes also impossible because the invention involves the exercise of personal judgment or discretion, and so does not enable the precise replication that is necessary for industrial application.

Similar views are, broadly, held in the United States, although their application there may be less rigorous than in Canada.¹¹²

Methods of Medical Treatment

In Canada, therapeutic devices or drugs are patentable but methods of surgical or therapeutic treatment of living humans or animals are not. The limits of this exclusion are unclear: thus, patents have issued for new therapeutic uses for known compounds, for example AZT to treat AIDS.¹¹³ On the other hand, patents for cosmetic treatment with an added medical benefit — e.g. whitening teeth and simultaneously eliminating bacteria — have been refused.¹¹⁴ Whether improved psychological health constitutes a medical benefit is unclear: the perfect nose job may be a doubtful contender for a Canadian patent.

The United States lacks a comparable exception, presumably because (Hippocrates notwithstanding) the practice of medicine is now more a business than a public service. So a mid-19th century U.S. decision invalidating a patent

for administering ether as an anaesthetic — just a “secret ... wrung from the bosom of Nature” — was discredited a century later by the U.S. Patent Office.¹¹⁵ The corresponding U.S. AZT/AIDS patent thus has, as its first claim, a method for treating humans with AZT — an unacceptable form of claim in Canada.¹¹⁶ The validity of such claims in the United States was confirmed by the 1996 amendments to the U.S. *Patent Act*, denying any patent infringement remedy against licensed medical practitioners and their institutions for operating on humans, or on animals in human-related medical research or instruction. This amendment does not protect anyone other than doctors and their affiliated institutions; nor does it exempt the use of patented machines or substances, practicing the patented use of a new or old substance (for example, the AZT/AIDS patent) or practicing a patented biotechnological process.¹¹⁷

Biotechnology

The acceptance of the Harvard mouse patent application by the Federal Court of Appeal follows a worldwide trend favouring the patentability of biotechnological and genetically engineered products and processes. Thus, in 1982 the Canadian Patent Office quickly applied the 1980 U.S. decision to patent genetically engineered bacteria by approving the patentability of all new human-made life forms having uniform properties and characteristics: at least “all micro-organisms, yeasts, moulds, fungi, bacteria, actinomycetes, unicellular algae, cell lines, viruses or protozoa”.¹¹⁸ The Commissioner of Patents suggested that even higher life forms — e.g. a genetically engineered insect that could take on the pestilent spruce bud worm — were patentable. Second thoughts, perhaps influenced by significant global resistance to the patenting of genetically engineered higher life forms (including possibly humans), nevertheless caused the Canadian Patent Office to withhold such grants, at least until the Harvard mouse's border crossing was blessed by the courts. On the other hand, the Office granted patents for genetic engineering methods, but not for traditional cross-breeding (“essentially natural”) methods of breeding plants or animals.

The controversy over patenting higher life forms is far from over. Pressures from the drug industry and the promise of economic and material benefits have moved many lawmakers and courts to favour such patenting, but significant opposition continues within both the developed and developing world, especially where spiritual and religious views about the sanctity of life outweigh pressures for commodification. The desire for ready access to genetic information has moved even sectors of the drug industry to attack attempts to patent the entire output of the human genome mapping projects, although the industry universally supports patents for recombinant DNA and protein mapping with some predicted utility.

Computer Programs

Computer programs must, under the TRIPs Agreement, be protected by copyright as if they were literary works. Cumulative patent protection is nevertheless often sought and obtained. Programs that merely crunch numbers better have the greatest difficulty passing muster: under Patent Office guidelines issued in 1995, they are treated as algorithms or “unapplied mathematical formulae” equivalent to “mere scientific principles or abstract theorems”.¹¹⁹ If, however, the program is connected with a process or apparatus that effects some physical change — rings a bell or blows a whistle — the process or apparatus is patentable. In the words of the 1995 Guidelines, the program is then “integrated with another practical system that falls within an area which is traditionally patentable.” Thus, a patent for curing rubber that depended on the computerized application of a known algorithm, granted in the United States, should be equally acceptable in Canada.¹²⁰

U.S. patents may now be granted to protect computerized business methods, and even more broadly for any sort of program by claiming the programmed computer as a patentable apparatus.¹²¹ The Canadian Patent Office has so far not followed suit.¹²² How Canadian courts might react is unclear. Will the reasoning of the U.S. Federal Circuit be persuasive enough for them? It has been for an Australian court, which allowed a patent on operating a smart card system to promote loyalty programs in retailing. Despite the wider technical chasm between Australian and U.S. patent law, compared to that existing between Canadian and U.S. law, the Australian court approved of the recent U.S. developments.

[T]he social needs the law has to serve in that country are the same as in Canada. In both countries, in similar commercial and technological environments, the law has to strike a balance between, on the one hand, the encouragement of true innovation by the grant of a monopoly and, on the other, freedom of competition.¹²³

Whether striking the balance at a different point would have been better social policy for Australia was not canvassed. One could easily imagine a similarly placed Canadian court choosing the path of least resistance and uttering comparable solipsisms.¹²⁴

OWNER’S RIGHTS

A PATENT’S CLAIMS MARK THE BOUNDARIES of its owner’s exclusive rights. Anyone may make, use or sell anything falling outside the claims. Making, using, selling or importing anything inside the claims for these purposes — including using unpatented products made onshore or offshore by a patented

process — infringes the patent. Unlike copyright, patent infringement occurs irrespective of copying: ignorance of the patent is no excuse.

Since the boundaries of a claim are marked by language, their scope becomes first a question of interpretation — a matter of law for the court.¹²⁵ In Canada, this is interpretation with a twist. The idea is to be “neither benevolent nor harsh, but rather [to] seek [...] a construction which is reasonable and fair to both patentee and public.”¹²⁶ In practice, this flummery means, more often than not, a construction favouring the patent holder. Canadian courts interpret patents supposedly just as they construe statutes, going beyond the literal words to the perceived purpose of the language.¹²⁷ They approve the U.K. approach, under which the interpretation of a claim referring to a load-bearing structure that extended vertically was held to include structures that leaned eight degrees off the vertical: any reasonable builder reading the claim in context would understand “vertically” to include such tolerances, said the court.¹²⁸ Of course, no reasonable real-life builder would spend time reading patent claims, especially one comprising a single 198-word sentence with two commas. And, if the builder did bother to read, one may doubt that he or she would have read the claim in a way that enables the Leaning Tower of Pisa to be renamed the Vertical Tower of Pisa.¹²⁹

U.S. courts act comparably under their doctrine of equivalents for similar reasons. The *unscrupulous copyist* cannot be allowed to evade a patent by making “unimportant and insubstantial changes and substitutions” and so turning the grant into “a hollow and useless thing”.¹³⁰ Thus, the defendant who does substantially the same thing in substantially the same way as the patent, to obtain the same result, may infringe.

These approaches pose similar dilemmas in both countries. Not knowing whether or how far a court will retrospectively broaden claims by interpretation or by finding equivalence creates a murky penumbra of monopoly that affects not only the unscrupulous, but also the honest competitors and follow-on developers.¹³¹

Some subtle but important differences nevertheless exist between Canadian and U.S. practices:

- Canadian courts judge equivalence as of the date the patent application is laid open. U.S. courts judge it as of the date the patent is infringed.
- Canadian courts ask just one question: what the claim means purposively by reference to the inventor’s supposed intention. U.S. courts ask two questions: whether the defendant infringes (1) literally or, if not, then (2) under the doctrine of equivalents.
- U.S. courts may limit the meaning of claims according to concessions or representations made by the applicant during prosecution of the application in the Patent Office. Canadian courts cannot.¹³²

The same defendant, sued in both Canada and the United States for the same activity for infringing identically worded claims, may therefore be liable in one country but not in the other. This result is unsurprising, at least to patent lawyers. Even the same European patent can be differently interpreted by different European courts using an identical test of claim construction and infringement. The more purposive claim construction becomes, or the more the doctrine of equivalents builds on the literal wording of claims, the greater the degree of uncertainty for those wishing to work in the public domain in any country. Whether such results are good for business or the public, in Canada or the United States, is an open question.

USER RIGHTS

VARIOUS USES FALL OUTSIDE THE PATENT MONOPOLY. For example, repairs of a patented product are allowed because the patent grant does not expressly include repairs. At some point, however, repair may become reconstruction and so will come within the prohibition against making or constructing the invention.

Alternatively, the *Patent Act* may exempt particular uses, for example those done solely for experiment, or private uses occurring on a non-commercial scale or for a non-commercial purpose.¹³³ However, the power to create exceptions is not unlimited, as Canada learned in 2000 when the WTO handled a European Union complaint that provisions in Canada's *Patent Act* did not comply with the TRIPs Agreement. A trade panel, upheld by the WTO, was unconcerned by the Canadian provision that allows seeking and obtaining, during the term of a patent, third party regulatory approval to exploit the invention once the patent has expired. The panel found, however, that the provision for making or stockpiling such products — particularly pharmaceuticals — in the last six months of the patent term did conflict with the TRIPs Agreement. Protecting the integrity of the patent system was more important than upholding the desire of WTO states to advance the health care policies they thought most suited to their needs. A Bill to repeal the offending Canadian provision was passed in 2001 and awaits proclamation.

Given the U.S. approach to fair use in copyright, one might perhaps have expected U.S. courts to have developed, and Congress to have enshrined, a doctrine of fair use for patents as well. This has not happened. A common law exception for private non-commercial or experimental use has long existed,¹³⁴ but no broader fair use doctrine appears except as an exhortation in academic writings.¹³⁵ Instead, the U.S. approach is similar to the Canadian approach: a combination of bounded interpretation of the rights granted to the patentee and of limited exceptions to the grant, for example in the pharmaceutical field, for generic drug companies to clear the necessary U.S. Food and Drug

Administration and Health Canada regulatory hurdles so as to be ready to manufacture and market as soon as possible after a drug patent expires.

TRADE-MARKS

COMMON LAW AND STATUTORY PROTECTION

TRADE-MARKS EXIST PRIMARILY TO IDENTIFY the trade source of products and services to potential customers. “Ivory” identifies a particular soap coming from a particular maker, although few buyers may know or even care who the maker is; when buying Ivory soap they are assumed simply to want assurance that its trade source is the same — or is controlled by the same entity — as before. Similarly, if they see a dishwashing liquid branded “Ivory”, they may assume it comes from the same trade source as Ivory soap and may wish to buy it because of their good experience with the soap.¹³⁶

Traders may adopt and promote as their trade-marks not only words, but also virtually any symbol or design they wish. “Anything under the sun that is sensed by man” is trade-mark law’s counterpart to patent law’s embrace of “anything under the sun that is made by man.” Even though *mark* suggests visibility as a precondition, sounds have been registered as trade-marks in Canada, and smells have been registered in the United States: why not *taste* and *feel* as well?¹³⁷ The only marks not free for appropriation are those which are the same as, or which may give rise to confusion with, an existing registered mark or a mark with a market reputation, or marks that fall within a prohibited list set out in the *Trade-marks Act* — governmental symbols, official marks, offensive symbols, generic words, and the like.¹³⁸

Trade-mark law protects investment in brand creation and maintenance by preventing the adoption and use of similar marks that have the effect of deliberately or even unintentionally attracting business away from an earlier mark owner. The *Trade-marks Act* supplements and to some extent supplants common law and delictual protection by providing a national registry to regulate the adoption, use, transfer and licensing of marks and to strengthen nationwide protection. Applications to register are examined in the Trade-marks Office and advertised, and may be opposed typically by a person or firm with a similar mark or name who feels threatened by a potential registration. Once registered, a mark is entitled to remain registered so long as it continues to be used, renewal fees are regularly paid, and there is no reason to expunge the registration because it was wrongly made initially or the mark has later become non-distinctive and thus invalid.

Although commonly grouped with copyright and patents as intellectual property, trade-marks are categorically different. Their protection does not depend upon their being new, original, unobvious or creative: a common word

plucked from a dictionary can be a perfectly good trade-mark if it does not clearly describe or deceptively misdescribe its target: e.g. “iguana” is, legally speaking, a good mark for beer. Even if the word is initially clearly descriptive — “hoppy” for beer made from hops — continued use may give it a secondary meaning, linking it exclusively within a single source, and transform a doubtful contender into a valid trade-mark. So trade-mark rights depend on use and reputation and attach to the person behind the use or creation of public recognition, who may not be the mark’s creator or selector.¹³⁹

DOMAIN NAMES

INTERNET DOMAIN NAMES MAY BE REGISTERED as trade-marks but only if they have been used as such. A domain name is essentially an electronic address or phone number, and addresses and phone numbers are not in themselves trade-marks. But such indicia can become trade-marks if used to distinguish a firm’s product or service from that of other firms, and the same is true of domain names.

Even if they do not formally qualify for registration, domain names may, through use, acquire a reputation that is protectible at common law or in delict. Their use may also infringe the rights of others at common law or in delict, or under the *Trade-marks Act*. Cybersquatters should find no more solace in Canada than elsewhere, even without legislation such as the U.S. *Anti-Cybersquatting Consumer Protection Act* (“ACCPA”) of 1999. Thus, a Saskatchewan court recently granted an injunction, substantial general damages and solicitor-client costs against a cybersquatter for committing the tort of passing-off.¹⁴⁰

Canadian cybersquatters may face even greater potential liability and inconvenience from lawsuits under the ACCPA if their domain name has been registered in the United States. U.S. courts have been quick to exercise personal jurisdiction over not only United States but also foreign defendants whose websites target local users (e.g. Internet gambling sites) or who are even temporarily in the jurisdiction. U.S. courts may even take hold of disputes between two wholly foreign enterprises with no connection with the United States, other than that the domain name in contention has been registered locally. A U.S. court has allowed a Montreal firm to sue a Toronto dot.com cybersquatter on this basis.¹⁴¹

Domain names highlight the sort of problems that many marks face today. Given the worldwide nature of the Internet, a domain name can be registered in any country, be accessed from any another, and may harm third party interests anywhere, sometimes innocently, sometimes deliberately. Pursuing conflicting registrations across various jurisdictions can be expensive and risky. Cheap and quick dispute resolution mechanisms through bodies such as WIPO

have only partly corrected these difficulties. Take a recent parody case. PETA, an animal rights group called “People for Ethical Treatment of Animals”, has sued an opponent who mocks it as “People Eating Tasty Animals” and who has registered the domain name “peta.org” to wage his campaign. Should the animal rights group or the mocker, who got there first, be entitled to the domain name? So far, the group has prevailed but the case is under appeal.¹⁴² Conflicts such as this arise regularly worldwide.

OWNER'S RIGHTS

THE OWNER OF A REGISTERED MARK can stop others from using an identical mark for the same goods or services for which it is registered. The owner can go further and stop a different mark from being used for the same goods or services, or the same mark from being used for different goods or services, if the use would likely be confusing according to a statutory checklist of criteria.¹⁴³

Owners of heavily advertised or otherwise well-known marks would rather have a perpetual copyright in their mark than go through the aggravation of proving likely confusion. They could then stop the use of the same or very similar mark in virtually any line of business, anywhere in the world, even if they were not anywhere near that line and would never think of going into it. So the owners of the Rolls-Royce trade-mark could stop the use of the mark on, say, chicken feed simply by showing that the same mark was being used on such feed, however remote that a business may be from car making.

As written, trade-mark law does not give copyright-like rights to trade-marks — unless, of course, the mark is artistic enough to qualify as a protectible work under the *Copyright Act*. As practiced, however, trade-mark law is constantly being pushed in the copyright direction through two theories: remote confusion and dilution.

Remote Confusion

Under the theory of remote confusion, the use of the Rolls-Royce mark on chicken feed can, arguably, be confusing because everyone knows that corporations diversify into all sorts of remote fields these days and, since the Rolls-Royce mark is so distinctive and well-known, chicken feed buyers would naturally assume that the car maker had somehow become commercially connected with animal feed supply. It does not matter whether the mark is applied in a territory where Rolls-Royce cars are rarely seen, so long as the mark is well-known there.

The *different territory* point is demonstrated by holding that a U.S. mark may be so well-known to Canadians that a third party is not allowed to register a similar mark in Canada. Whether the U.S. firm does any Canadian business is irrelevant. Knowledge of the U.S. mark renders the second mark undistinctive

of the Canadian applicant.¹⁴⁴ Similarly, a U.S. pest control firm has stopped a Canadian firm from adopting the U.S. firm's name for a similar business: Canadian snowbirds happy with the U.S. firm's services in the United States might, on return, think the Canadian firm was an affiliate and be drawn to its services accordingly.¹⁴⁵ Conversely, a U.S. retailer who targeted the Canadian market from its website was found to infringe Canadian trade-mark law by listing goods on its website for sale under a mark registered in Canada to a third party.¹⁴⁶

The *different business* point has been applied in Canada to find "Sunlife" fruit juice to be confusing with the well-known "Sunlife" insurance mark.¹⁴⁷ The underlying approach leading to such a decision has, however, been implicitly rejected recently by a majority of the Federal Court of Appeal. The court allowed the word mark "Pink Panther" to be registered for beauty products, over the strenuous opposition of the movie company which had released the Pink Panther series of films and television programs. The company held a registration on the mark for entertainment services and had licensed all sorts of Pink Panther *bric-a-brac* for 30 years. The court nonetheless said that "the whole world is not barred forever from using words found in the title of a Hollywood film to market unrelated goods" just because the words are well-known.¹⁴⁸ The court maintained its approach two years later in allowing the registration of "Lexus" for canned goods over the opposition of the maker of "Lexus" cars. The *gaping divergence* between the two products was no less than in *Pink Panther*.¹⁴⁹

Whether this line can be maintained despite the enormous pressure, in Canada and internationally, to widen the circle of protection around well-known trade-marks remains to be seen. Many decisions take a contrary approach from *Pink Panther* and *Lexus* based on not dissimilar facts. A strong dissent in *Pink Panther* itself favoured upholding the trial judge's view against registration and deprecated the majority tipping the balance in favour of "the copycat artist seeking to profit financially from someone else's creative fortune." What precisely is "creative" in ascribing the name "Pink Panther" to a pink-coloured animated panther was not elaborated. The dissenter also darkly warned that famous marks may now be protected "in only the very clearest of cases," leaving one again to wonder why this result was such a bad thing. Ultimately, of course, courts can distinguish *Pink Panther* and *Lexus* by saying that confusion depends very much on what evidence is presented, how it is perceived and weighed, and whether the court will conclude that the second entrant is an enterprising competitor or a villainous free-rider. *Pink Panther* and *Lexus* tell courts not to leap too quickly for the latter label, but do not bar them from leaping at all.

The problem has naturally been around the United States for a long time. A striking example is the case where a seller of insect repellent advertised the product under the slogan "Where there's life, there's bugs," spoofing the heavily

marketed Budweiser beer slogan “Where there’s life, there’s Bud.” A U.S. court found confusion between the two commercials and stopped the repellent marketing.¹⁵⁰ The finding of confusion was a stretch. Nobody would buy insect repellent instead of beer, and nobody thought that brewery had extended its brand into flyspray. What agitated the court was the second firm’s free-riding, which undermined the long-term effectiveness of the Budweiser slogan and commercial. This dislike translated into a finding of confusion, since the court could find no better theory. Now it has one: dilution.

Dilution

Canadian trade-mark law has, since 1953, had a provision forbidding the use of a registered trade-mark “in a manner that is likely to have the effect of depreciating the value of the goodwill attaching thereto.”¹⁵¹ This goodwill, which includes the trade-mark’s affect built up through advertising, may depreciate “through reduction of the esteem in which the mark itself is held or through the direct persuasion and enticing of customers who could otherwise be expected to buy or continue to buy goods bearing the trade mark.”¹⁵² The intent was to introduce into Canadian law the concept of trade-mark dilution, allowing registered trade-mark owners to stop the imagery surrounding their marks from being tarnished, blurred or altered. The intent has been at least partially frustrated. Matters seemed to start well, at least for proponents of dilution theory, with an early decision that determined that comparative advertising using a competitor’s registered mark was forbidden. The value of the mark was said to be depreciated because customers might be diverted from buying goods bearing it. However, the same decision produced some bad news: on a technical interpretation of the Act, the only potentially depreciating uses, at least where goods were concerned, were those where the competitor’s mark appeared at point of sale — i.e. on the packaging of the goods or on the shelves where the goods were displayed. Advertising that used the competitor’s mark in the media was not caught.¹⁵³ The provision thus had only a limited operation, especially since dilution theory has not been applied by analogy to unregistered marks.

In the United States, dilution theory has also had a patchy history. Many state trade-mark statutes included it, ostensibly to stop third-party registration of famous marks for remotely connected products. The somewhat fanciful examples of Buick for aspirin (in Canada, acetylsalicylic acid) or Kodak for pianos were trotted out. Yet, the courts seemed unimpressed and tended to interpret the statutes grudgingly as adding little beyond the ordinary test of confusion. The passage of the *Federal Trademark Dilution Act* of 1995 was meant to change all that. The owners of famous trade-marks, whether registered or unregistered, can now stop others from lessening the capacity of their marks to identify and distinguish goods or services, even if the products are non-competing and no

confusion or deception is likely. Decisions under the Act have so far been mixed, but the legal ability of Rolls-Royce to stop its mark from being applied to chicken feed, or of Budweiser to stop spoof commercials from using similar versions of its marks and slogans, seems more imminent than ever before. Trade-mark owners are naturally pressing worldwide for such rights. Whether they really need or deserve them is an open question. Once upon a time, one could confidently predict that no copyright could exist in a word. Now that prediction is less sure, since what cannot be directly gained through the law of copyright looks as if it is coming through the law of trade-marks.

REMEDIES

SUCCESSFUL IP CLAIMANTS are usually awarded an injunction, damages or the infringer's profits, delivery up of infringing goods or labels (typically for destruction or to be rendered non-infringing), pre- and post-judgment interests, and costs of the action (attorney's fees). Registers may also be corrected and declarations of infringement or non-infringement may be made.

INJUNCTIONS¹⁵⁴

Preliminary Injunction

CANADIAN COURTS MAY GRANT interlocutory injunctions to stop possible IP infringements pending trial.¹⁵⁵ To obtain such an order, the plaintiff must show:

- (a) a serious question to be tried,
- (b) irreparable harm, i.e. injury that cannot be adequately compensated in damages, and
- (c) a balance of convenience in its favour, i.e. that it would suffer more from the injunction being denied than the defendant would suffer from its grant, and that the public interest — i.e. how third parties may be affected — favours grant;¹⁵⁶
- (d) no *inequity* on its part, e.g. undue delay or lack of clean hands.

The claimant must usually undertake to compensate the defendant if the order later proves to have been wrongly granted.

Over the last couple of decades, courts have emphasized the drastic and extraordinary nature of such relief, and have grown more cautious in granting it — so much so that few interlocutory injunctions are granted in IP cases in Canada these days.

The difficulty is not usually with the first hurdle. Most legally advised IPR claimants can demonstrate that they have a fairly arguable and unfrivolous case.¹⁵⁷ A few fall at the third or fourth hurdle: they cannot show a balance of convenience in their favour, or their dithering or bad behaviour toward the defendant disqualifies them. But the most difficult hurdle is generally the second. The point of interlocutory relief is said to be to prevent claimants from suffering irreparable harm pending trial. So claimants have to provide clear, not merely speculative evidence, of such harm. They have to show that denying the injunction will cause them losses that they will be unable to recover if they win. Even proving an undisputed right, probable infringement and a probable award of damages at trial may not be enough: clear evidence that the defendant will be judgment-proof or that the losses will be impossible to calculate may be required. The response to the argument that the value of IPRs is consequently weakened is that a wrongly enjoined defendant may suffer as much loss during the years he is kept out of business as a wrongly denied IPR holder may suffer if the defendant really is infringing. No reason exists why allegedly aggrieved claimants should, as a class, be preferred over allegedly aggrieved defendants.¹⁵⁸

It is nonetheless seriously arguable that the current formulaic Canadian approach to the grant of interlocutory injunctions is rather worse than the flexible approach prevalent just a decade ago, and also prevalent now in the United Kingdom, whence, ironically, the current Canadian position supposedly derives.¹⁵⁹ Take an all-too-common case where a Canadian business adopts the name of a well-known similar foreign business to attract customers familiar with the latter. Such petty deceptions should be stamped out quickly, at least where the foreign business has a Canadian registered trade-mark or a local repute and the taking is deliberate.¹⁶⁰ And so they were a decade ago: a Vancouver restaurant that took for itself the unregistered name of a well-known Hong Kong restaurant quickly had an interlocutory injunction granted against it by a B.C. court.¹⁶¹ But a similar trick recently played on consumers by a Victoria restaurateur, at the expense of a U.S. restaurant chain with a Canadian trade-mark registration, was not foiled by the Federal Court, which cited a lack of clear evidence of irreparable harm to the U.S. chain's goodwill.¹⁶² The result presumably encourages a forced foreign buyout of the local trickster's *rights*, but at a price reflecting the advantage to the buyer of a solution now rather than one years later when the dispute would be finally tried. Cases like this underscore the need for a flexible approach to the grant of interlocutory injunctions. A rigid formula milled from the statutory requirement that injunctions be issued where "just and convenient" may promote neither justice nor convenience but instead sharp dealing and public deception.

U.S. courts also emphasize the extraordinary and drastic nature of pre-trial relief but nevertheless manage to grant injunctions more readily than do Canadian courts. While similar legal hurdles appear, their height and spacing is

different and the courts are willing, where Canadian courts are not, to conduct mini-trials on the merits. For example, the Ninth Circuit, which handles many copyright cases, grants preliminary injunctions to claimants who demonstrate “either (1) a combination of probable success on the merits and the possibility of irreparable injury or (2) the existence of serious questions going to the merits and that the balance of hardships tips sharply in [the claimant’s] favor.”¹⁶³ A stricter test used by the Federal Circuit for patents and trade-marks, and often mirrored elsewhere for other IP cases, looks more like the Canadian test. It requires the claimant to establish:

- (a) a reasonable likelihood of success on the merits, i.e. a right that is probably valid and infringed despite any defences raised;
- (b) irreparable harm if preliminary relief is denied,
- (c) a balance of hardships in the claimant’s favour, and
- (d) the public interest favouring grant.¹⁶⁴

But even this superficially stricter test, seemingly as formulaic as the Canadian one, favours claimants more than in Canada, for a strong, not just a reasonable, case on the merits may cross not only the first hurdle, but also the second one of irreparable harm. And if actual proof of irreparable harm — lost market share or business relations — is shown, the last two hurdles quickly fall.¹⁶⁵

Final Injunction

Final injunctions are usually granted in infringement cases to vindicate the treatment of IPRs as *property*. The remedy is nevertheless discretionary. What justifies withholding it, other than standard equitable defences such as long delay or acquiescence in the infringement, can be contentious. The Federal Court of Appeal said in a copyright case that an injunction should be issued even where the right holder would suffer no damage were the order refused. Reversing a trial court’s decision to award reasonable royalty damages instead of an injunction, the Court said that (a) the court had no power to do what was “tantamount to the imposition of a compulsory licence,” and (b) only something “in the conduct of the [IP] owner, not in the conduct or motives of the infringer” justified refusal.¹⁶⁶ These statements are contradictory and, in any event, both wrong. The first negates the discretionary nature of equitable remedies: the result of any refusal of an injunction is tantamount to imposing a compulsory licence. The second statement is too narrow: equity always looks at the whole case, not just the conduct of one party, to determine whether an injunction is more “just and convenient” than the usual money remedy.

An injunction may be the right remedy for infringement — but only presumptively. Just as the punishment should fit both crime and criminal, so civil remedies should fit both wrong and wrongdoer. Trivial infringements warrant trivial remedies.¹⁶⁷ Canadian and U.K. courts are rightly reluctant to encourage the idea that an IP holder's choice to license can be eliminated simply by paying money but they will, if pressed, say just that. So a music publisher discovered that the making of increasingly extravagant claims for compensation against an inadvertent infringer was not a costless exercise. A U.K. court refused the publisher a summary injunction, saying that "it is arguable that if [the publisher] seeks to exploit this right [viz. to charge whatever price he wishes] unreasonably so as to take advantage of the defendant's weak position (albeit one of his own making) his conduct may be regarded as oppressive."¹⁶⁸

U.S. practice is comparable. Injunctions against infringement are normal but may exceptionally be refused at the court's discretion. Thus, an appeals court said, in endorsing the *flexible approach* taken by a trial court, which had awarded damages in lieu of an injunction to a patentee who preferred practicing law to practicing his invention:

An injunction ... is not intended as a club to be wielded by a patentee to enhance his negotiating stance. [cite] Here ... the defendant manufactures a product; the appellant does not. In the assessment of relative equities, the court could properly conclude that to impose irreparable hardship on the infringer by injunction, without any concomitant benefit to the patentee, would be inequitable. [cites] Instead, the District Court avoided ordering a cessation of business to the benefit of neither party by compensating appellant in the form of a compulsory license with royalties.¹⁶⁹

Similarly, in another patent infringement case, a U.S. appeals court refused an injunction that would have closed down a sewage treatment plant: "where the health and the lives of more than half a million people are involved, we think no risk should be taken".¹⁷⁰

DAMAGES

INFRINGEMENT OF AN IPR ENTITLES the claimant to recover, as for any other tort or delict, damages to compensate for foreseeable losses caused by the infringement. The claimant should get lost profits on the sales it would have made but for the infringement, and a reasonable licence fee on sales the infringer made but which the claimant would not have secured. *Guesstimates* can be made for intangible losses such as lost goodwill or mental suffering caused by a particular infringement. On the other hand, the discretionary language in which some statutes are cast — the court "may" award damages¹⁷¹ — encourages

the denial of substantial damages where losses are speculative or a grant would be unconscionable, e.g. to a claimant who lets an innocent defendant detrimentally change his position without demur.¹⁷²

The court may, at its discretion, also award punitive damages for particularly bad conduct — e.g. against an infringer who thinks it can get away with deliberate wrongdoing — if the compensation awarded is not enough to tell the defendant and the world that infringement does not pay. Punitive awards have usually been moderate, usually between \$5,000 and \$50,000, but can go higher. The Federal Court of Appeal discharged a record award of \$15 million in a patent infringement case against an oil company that had chosen to ignore an inconvenient interlocutory injunction. The court took this action, however, only because the trial judge had not yet awarded compensatory damages. The appeal judges could not tell how much exemplary damages, if any, were needed to teach the oil company some good manners in business. Something below \$15 million might do; then again, something higher might be needed.¹⁷³

U.S. rules on damages are superficially similar to Canadian rules, but in practice are less flexible because — unlike Canada — damages awards are frequently made by a lay jury, which needs precise direction. To illustrate, the following extract from a judgment on damages for infringing copyright in building plans is unexceptionable in Canada, but would probably be considered “speculative and uncertain”¹⁷⁴ under U.S. law:

There is evidence here that on occasion [the plaintiff] would grant a licence to erect the [house] at a cost of \$60. This sum I regard as being inadequate. The damages being at large, I assess them at \$650, and I must confess that I have been unable to find any satisfactory measuring rod in so doing but follow the example [of a 1911 U.K. judge] where he said that the matter before him (the measure of damages in a patent action) “is to be dealt with in the rough — doing the best one can, not attempting or professing to be minutely accurate.” He said later that “such matters should be dealt with broadly and as best we can as men [sic] of common sense.”¹⁷⁵

It is partly to avoid problems of proof of loss that the U.S. *Patent Act* prescribes “in no event less than a reasonable royalty” to compensate a prevailing claimant patentee, and adds that damages may be multiplied only up to three times against a “wilful” infringer.¹⁷⁶

ACCOUNT OF PROFITS

THE COURT HAS THE DISCRETION, on request by a claimant, to order an infringer to account for its profits from the infringement and pay its net gain to the claimant. This order is available as an alternative to compensatory damages

in all IP cases in Canada — except for copyright, where, as in the United States, an account of profits and damages can both be awarded so long as double counting is avoided. Jurisdiction exists to add an award of punitive damages to an account of profits.

The remedy of account was virtually unknown before the 1960s in Canadian IP cases, but it resurged in the mid-1970s to become quite popular, especially in patent cases. The claimant avoids the need to prove its lost profits; the defendant has to lay open its books and to prove its deductions from revenue; and awards of compound prejudgment interests have become common. However, a major disadvantage is the time and cost of isolating and apportioning deductions to reach the net amount attributable to the infringement.¹⁷⁷ The costs of taking the account can be more than the amount recovered. A court which suspects that result may deny the remedy at its discretion and leave the claimant with his damages remedy.¹⁷⁸

An account of profits is also available in the United States for all IP cases except those involving the infringement of utility patents.

COPYRIGHT

SINCE 1999, COPYRIGHT HOLDERS have had the right to choose, instead of the standard set of damages and account remedies, a special remedy of statutory damages borrowed from U.S. law. A right holder can elect to recover between \$500 and \$20,000 in a single action for all infringements in respect of each work involved in a single proceeding. The remedy is much like a civil fine: the court fixes a figure after considering all the circumstances: the good or bad faith of the parties, their conduct before and during the proceedings, deterrence, and presumably any losses or gains resulting from the infringement.

The Canadian remedy differs from the U.S. one in some respects. The latter is available only where the copyright was registered at the time of infringement; in Canada, non-registration is at most a discretionary factor in assessing the sum. The range of damages also differs: when exchange rates are taken into account, the U.S. range of between \$US 750 and \$30,000 is about double the Canadian minimum and maximum, and could rise to \$US 150,000 for deliberate infringements. In both countries, the statutory award may drop to \$200 for innocent infringements, but in Canada, a particularly egregious infringement may attract a separate, theoretically uncapped, punitive award.

Canadian courts can also multiply awards to collecting societies against defaulters on blank audio recording media levies or musical performing right royalties: up to 5 times the levy owing, and between 3 and 10 times the royalty.

ANCILLARY ORDERS, COSTS AND ATTORNEY'S FEES

ORDERS TO SEIZE AND DESTROY infringing goods and labels are standard in both countries. In Canada, the successful party also usually recovers its reasonable costs (i.e. attorney's fees) and disbursements from the losing party. In practice, costs awards cover only part (perhaps only a third) of actual expenditures. Sometimes, an unsuccessful party who has run an obviously losing case, who has made unsubstantiated allegations or who has otherwise behaved particularly badly during the case in or out of court may be ordered to pay a larger share — sometimes even the whole — of the other side's costs. Exceptionally, too, a winning party may have behaved so badly either before or during the litigation that the court will exercise its discretion to issue no order for costs in its favour.

By contrast, in the United States each side usually bears its own costs. Thus, in patent cases, an award of attorney's fees is made only exceptionally, e.g. against a wilful infringer or a party who has misbehaved in the litigation. However, copyright legislation allows courts a wider discretion to award attorney's fees. Such awards have become more common recently, although they are available only if the claimant has registered its right in a timely manner.¹⁷⁹

CONCLUSION

IN THEORY, IP PROTECTION IS A GOOD IDEA but its current configuration is hard to agree with. Certainly, far more is protected far longer and far more vigorously today than was the case 50 or even 25 years ago: *maius, longius, irritandius* could serve as IP's version of the Olympic motto. Members of the public — businesses, follow-on inventors and creators, other users, you and I — can do fewer things, including creating new IP, without first seeking permission or paying for the privilege of using earlier IP-protected work. New technology, while providing fresh opportunities and liberties in one direction, may have constrained opportunity and liberty in other directions, or may have driven them underground. Whether the overall result is positive may be doubted.

Thus, in Canada, nobody can copy virtually anything longer than a few sentences, or any squiggle more elaborate than a straight line that has been produced within the last century, or any collocation of sounds — e.g. morning birdsong — that has been recorded in the last 50 years, without risking copyright infringement. Nothing on the material need say that the work is protected, nor does checking the copyright registry help since comparatively little material is registered there. It does not matter that the earlier work is simple and took hardly any time, money or skill to create. However, much as one may admire minimalism as an art form, one need not espouse such a system of protection for these sorts of periods.

The same holds true for patents. Few patents issue for breathtaking inventions. Most are for humdrum improvements, which would be made and marketed anyway. The patent system commonly claims to draw out innovations that would not have occurred without its lure. But the one time a U.S. appeals court openly applied such an incentive-based test to invalidate a trivial improvement in the art of making spanners, it was soundly reversed by the full appeals bench. The first court thought that the invention was of “the sort that was likely to be made, and soon”; patenting was therefore redundant and the invention should be held obvious. The full appeals bench disagreed. The real, more technical and supposedly more meaningful, question was whether the differences between the claims and the prior art made the improvement obvious to an ordinary skilled worker in that art. In answering that question, the tribunal had to remember that (1) something may be simple without being obvious, (2) something may be obvious to try without being obvious to complete, (3) persistence counts as much as Eureka!-type discoveries, for patient plodders need encouragement as much as — perhaps more than — the flashy geniuses, and (4) a host of other far-from-obvious factors may intervene.¹⁸⁰

Not only are IPRs easily acquired, but today they are more easily infringed. Broad claim construction and the doctrine of equivalents catch those who tread too closely to the wording of a patent's claims. Trade-mark owners catch not only those who confuse but also those who simply use a mark in a way that might lessen the mark's advertising value or brand extension potential. Copyright owners find it easier to prove infringement as smaller and smaller units are called substantial parts of a work, and subconscious copying of any such part is called infringement.

How has all this occurred? The very use of the nomenclature *intellectual property* is partly at fault. It muddies clear thought and analysis. Much of the trivia that gets protected by copyright and patent laws has little intellect behind it, certainly not enough to warrant the broad and long protection it gets.¹⁸¹ Calling IP “property” too obscures the fact that there is property and property. What is desirable legally or economically for land or goods does not necessarily follow for ideas, information or trade symbols. Yet, the equation tends to be made automatically, perhaps even subconsciously. Internationally, IP has now become a *thing* and principles are deduced from its *thing-ness*.¹⁸² Attempts to trim back its excesses are attacked as an interference with property or even unconstitutional *takings*. Competing arguments — that to create a right may be to take some *thing* from the public; that to retrench a right may be to return some *thing* to the public which it, until recently, possessed anyway — are dismissed as unthinkable or subversive.

IP is supposed to represent a balance of interests, but that balance itself is upset by property nomenclature. Take the case of parody. A few years ago, the Michelin Tire Co. sued a union for infringing Michelin's copyright by using a

caricature of the Michelin Man logo on the leaflets the union handed out during a labour dispute. Lacking a specific parody defence in the *Copyright Act*, the union defended by claiming that it was exercising its freedom of expression, guaranteed by the *Canadian Charter of Rights and Freedoms*. The Federal Court disagreed. It said that free speech does not entitle anybody to tread on a property right, here copyright. The union could have found some non-infringing way to express itself. The fact that way may have been less effective did not matter.¹⁸³ Once copyright is classified as property, it acquires the *gravitas* it lacks as a mere exclusive right. Balancing two rights, or a freedom against a right, is one thing; balancing a freedom against property (a right not even mentioned in the *Charter*) is apparently quite another.¹⁸⁴

The argument that IP already has its own internal set of checks and balances is only superficially plausible. User rights — exceptions — are typically written and interpreted narrowly, while subject-matter and the rights attaching to it are typically written and interpreted broadly. So, as a new technology appears, the courts quickly extend protection to it, often placing it beyond the balance of user exceptions drawn narrowly with earlier technology in view. Later attempts to widen the exceptions are then resisted as interferences with vested rights — as attempts to upset, rather than redress, the balance. That mindset is written into international law through the TRIPs Agreement: States can easily provide “more extensive protection” than the minima imposed by the TRIPs Agreement, but creating exceptions to existing or future rights is far more constrained, as Canada and the United States discovered from the recent WTO rulings upsetting exceptions in Canada’s patent law and in the United States’ copyright law.¹⁸⁵

I have disapproved elsewhere of these tendencies:¹⁸⁶

The recent expansion of intellectual property has come to be more an end in itself than a means to the end of stimulating desirable innovation. The question whether existing protections should be scaled back or re-contoured, because the activities that they supposedly foster would occur anyway and would be more widely distributed throughout society, is hardly asked any more. If intellectual property were seen as a form of subsidy — a willingness by society at large to provide economic benefits to one sector in return for the prospect of larger benefits to all — then few would question the need to keep intellectual property under constant review to ensure the scheme was working well. It would not be enough to say that intellectual property *as a whole* was returning social benefits that outweighed its costs *as a whole*. As with any other subsidy, each element within the scheme would need to be examined... A strong case for such systematic reviews must surely exist.

...[I]ntellectual property cannot be treated as an absolute value. ...[A]gainst it are ranged values of at least equal importance: the right of people to imitate others, to work, compete, talk, and write freely, and to

nurture common cultures. The way intellectual property should be reconciled with these values — or vice versa — has changed much over time and continues to vary among countries and among legal systems. The adjustments occur for social and economic reasons; they are not preordained by natural law. Where a particular line should be drawn can certainly not be answered by circularities like “intellectual property is property...”.

The pressure for greater intellectual property protection suggests the suppression of other values and a drift toward an economic system where the protection under the aegis of IP of any investment of time, money or labour is fast becoming the norm and competition is becoming the exception.

Finally, the TRIPs Agreement may have imposed standardized IP norms on much of the world, but it has not made believers in the new faith out of everyone. The IP system was developed in the West to serve the needs of the industrialized world. It does not necessarily fit with other cultures and other economies at different stages of development. To many countries who became WTO members, believing that access to world markets would benefit them overall, the TRIPs section of the Agreement seems presently to be delivering more detriments than benefits. The future challenge for IP may thus be to make itself more coherent and persuasive, not only domestically but internationally as well. To achieve that goal may mean a movement away from the present insistence on rigid standardized norms towards greater toleration of diversity and flexibility.

ENDNOTES

- 1 Incidental reference is also made to other IP rights, e.g. over designs, integrated circuit topographies (semiconductor chips), plant breeders rights, geographical indications, trade secrets and unfair competition.
- 2 Given time and space constraints, I make two confessions and avoidances:
 - This is a conference paper, not a treatise. I have selected some features of Canada's IP system which seem interesting to me, especially for comparative purposes. Others may have chosen differently. Trade-marks are covered more briefly, not because they are less important but for the more mundane reason that the paper was already inordinately long when I came to deal with them.
 - The law is stated only in general terms. It would, for example, be foolhardy to rely on the brief statement in the text below on copyright duration to figure out the present Canadian or U.S. copyright expiry date of a foreign work made in 1949. A striking feature of both Canadian and U.S. IP laws is their inordinate complexity.

- 3 A point made by Professor Michael Geist at the Conference in his commentary on this paper. Domain names are discussed below in notes 139-140.
- 4 *Constitution Act, 1867*, ss. 91(22), 91(23) (Canada).
- 5 *United States Constitution*, Art. I, § 8, cl. 8.
- 6 *Feist Publications Inc. v. Rural Telephone Service Co. Inc.*, 499 U.S. 340, 350 (1991), following a long line of similar rhetoric in U.S. Supreme Court case law.
- 7 A U.S. appeal judge experienced in IP admitted that she viewed natural rights theory “as fundamental to our national ethic” and as “underl[y]ing much of the ensuing construct of intellectual property”, although the theory “doesn’t get much attention from economists”; see Newman (1994). For other theories, see Penrose (1951), pp. 20-41; see also Vaver (1997), pp. 3-13.
- 8 For federal power, see *Constitution Act, 1867*, s. 91(2) (Canada), (“Regulation of Trade and Commerce”). For provincial power, see *Constitution Act, 1867*, s. 92(13) (“Property and Civil Rights in the Province”) and s. 92(16) (“Matters of a Merely Local or Private Nature”).
- 9 *United States Constitution*, Art. I, § 8, cl. 3.
- 10 Or in Louisiana, the civil law.
- 11 Some consider antitrust law to be virtually constitutional law, especially in the United States. In Canada, the anti-competitive exercise of IPRs may come under the *Competition Act*. For recently formulated rules to guide Competition Bureau intervention, see Industry Canada, 2000. In the United States, the anti-competitive exercise of IPRs has sometimes attracted the attention of the Justice Department and has also caused the occasional IP holder to lose its infringement suit and face a counterclaim for damages because of a misuse of IPRs; see Roberts, 1995. As to Canada, see note 18.
- 12 *Florida Prepaid Postsecondary Education Expense Board v. College Savings Bank*, 527 U.S. 666 (1999). The United States may not be TRIPs-compliant in this respect.
- 13 Other more interstitial IP or IP-containing treaties common to both countries include:
 - the *Universal Copyright Convention*, 1952, (the United States, but not Canada, adhered to the 1971 revision), mandating national treatment and moderate minimum standards of protection with minimal formality;
 - the *International Convention for the Protection of New Varieties of Plants*, 1961, as amended to 1991 (United States adhering to 1991, Canada to 1978), creating rights for plant breeders;
 - the *Patent Co-operation Treaty*, 1970, streamlining the filing and processing of patent applications internationally;
 - the *Strasbourg Agreement Concerning the International Patent Classification*, 1971, as amended in 1979, standardizing the classification of patents;
 - the *Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the purposes of Patent Procedure*, 1977, as amended in 1980, establishing recognized depositories; and
 - the *United States-Canada Free Trade Agreement*, 1988, providing for copyright in cross-border television and radio broadcasts and committing the parties to international IP co-operation.

- 14 Among the more significant of recent treaties to which the United States has, but Canada has not, acceded, are the following:
 - the *Nice Agreement concerning the International Classification of Goods and Services for the purposes of the Registration of Marks*, 1957, as amended to 1979;
 - the *Geneva Convention for the Protection of Producers of Phonograms against Unauthorized Duplication of their Phonograms*, 1971; and the *Geneva Trademark Law Treaty*, 1994.

The United States has already acceded to and implemented the *WIPO Copyright Treaty 1996* and the *WIPO Performers and Phonograms Treaty*, 1996 (both to come into force on 30 accessions), designed to strengthen the protection of copyright holders in the digital environment.
- 15 The United States has actively pursued TRIPs complaints under the dispute settlement procedures. It has been the subject of a successful TRIPs complaint over broad exemptions for the public performance of music, passed as amendments to the U.S. *Copyright Act* in 1998. Canada has also been the subject of successful TRIPs complaints over its *Patent Act*, R.S.C., c. P-4 (Canada) provisions on pharmaceutical drug stockpiling and over the duration of patent rights. See:
 - WTO. Report of the Panel. *United States Section 110(5) of the US Copyright Act*. Available at: http://www.wto.org/english/tratop_e/dispu_e/1234da.doc (accessed on April 22, 2005).
 - WTO. Report of the Appellate Body. *Canada: Term of Patent Protection*. Available at: http://www.wto.org/english/tratop_e/dispu_e/170abr_e.pdf (accessed on April 22, 2005).
 - WTO. Report of the Panel. *Canada—Patent Protection of Pharmaceutical Products*. Available at: http://www.wto.org/english/tratop_e/dispu_e/7428d.pdf (accessed on April 22, 2005).
- 16 Similar reasoning and results apply *mutatis mutandis* where the work is unprotected in Canada but protected in the United States.
- 17 Witness the U.S. doctrine under which a patentee cannot prevent the resale of a patented product anywhere in the United States; see *Keeler v. Standard Folding-Bed Co.*, 157 U.S. 659 (1895). Trade-marks may be less effective in barring the parallel import of genuinely branded goods; see *Smith & Nephew, Inc. v. Glen Oak, Inc.* (1996), 68 C.P.R. (3d) 153 (F.C.A.).
- 18 The transfer and exercise of copyright to prevent parallel imports of car parts bearing the copyright logo is arguably an anti-competitive practice that prevents the right holder from obtaining an injunction; see *Volkswagen Canada Inc. v. Access International Automotive Ltd.*, 2001 (F.C.A.) 79. For Europe, see Anderman, 1998.
- 19 This section draws on Vaver, 2000a, pp. 16-18.
- 20 E.g. *Apple Computer Inc. v. Mackintosh Computers Ltd.* (1986), 10 C.P.R. (3d) 1 (F.C.T.D.), aff'd [1988] 1 F.C. 673 (C.A.), aff'd [1990] 2 S.C.R. 209. Further on computer programs, see note 118.
- 21 *Thomas & Betts Corp. v. Panduit Corp.*, 138 F.3d 277 (7th Cir. 1998); *Thomas & Betts Ltd. v. Panduit Corp.*, [2000] 3 F.C. 3 (C.A.).
- 22 Cf. *Monsanto Canada Inc. v. Schmeiser*, 2001 Fed. Ct. Trial LEXIS 174, 2001 FCT 256 (patent for genetically modified seed enforced against farmer who saved seed;

- exemptions under *Plant Breeders' Rights Act*, S.C. 1990, c. 20, irrelevant to patent suit).
- 23 *Copyright Act*, R.S.C. 1985, c. C-42, ss. 64.1(1)(a), (d), 64(1), (2) (Canada).
 - 24 *Matrox Electronic Systems Ltd. v. Gaudreau*, [1993] R.J.Q. 2449, 2457 (S.C.). To similar effect, see *Tennessee Eastman Co. v. Commissioner of Patents*, [1974] S.C.R. 111; *Cuisenaire v. South West Imports*, [1968] 1 Ex. C.R. 493, aff'd [1969] S.C.R. 208; *Rucker v. Gavel's Vulcanizing Ltd.* (1985), 7 C.P.R. (3d) 294 (F.C.T.D.).
 - 25 See, for example, *TraFFix Devices Inc. v. Marketing Displays Inc.*, 120 S. Ct. 2715 (2001), barring trade dress protection for a functional design feature covered by the claims of an expired patent.
 - 26 See *Apple Computer Inc. v. Mackintosh Computers Ltd* (1986), 10 C.P.R. (3d) 1 (F.C.T.D.), aff'd [1988] 1 F.C. 673 (C.A.), aff'd [1990] 2 S.C.R. 209; *Roland Corp. v. Lorenzo & Sons Pty. Ltd.* (1991), 105 Aust. L.R. 623, aff'd (1992), 23 I.P.R. 376 (Full Aust. Fed. Ct.); *Krueger International Inc. v. Nightingale Inc.*, 915 F. Supp. 595 (S.D.N.Y. 1996) (stacking chair cannot be exactly copied after expiry of design patent); cf. see Zimmerman, 2000.
 - 27 Unlike U.S. federal courts, the Federal Court of Canada lacks pendent or diversity jurisdiction. A plaintiff complaining of copyright infringement in the latter court cannot validly join any related common law or delictual passing-off claim to its complaint; nor may he or she go to Federal Court merely because the defendant is domiciled in a different province.
 - 28 For example, the common law of Georgia differs from that of New York State. Georgia has long recognized a common law right of privacy, while New York has for almost as long denied the existence of any such right.
 - 29 The opportunity in Canada for the Federal Court and the provincial courts to develop discrepant approaches in IP cases exists in theory, but rarely appears or persists in practice.
 - 30 Thus, the test for trade-mark confusion is enunciated differently from one circuit to another; see Halpern, Nard and Port, 1999.
 - 31 Both laws are quite modern. Canada's law, though still bearing the heavy imprint of the *Copyright Act*, 1921(Canada) (itself based on the *Copyright Act*, 1911 (United Kingdom)), was radically transformed by a series of amendments between 1988 and 1997. U.S. law is centered on the *Copyright Act* of 1976, updated by amendments such as the *Sonny Bono Copyright Term Extension Act* and the *Digital Millennium Copyright Act* of 1998.
 - 32 *Apple Computer Inc. v. Mackintosh Computers Ltd.*, [1990] 2 S.C.R. 209, note 20 above, rejecting the majority view of Australia's highest court in *Computer Edge Pty. Ltd. v. Apple Computer Inc.* (1986) 65 Aust. L.R. 33 (Aust. H.C.).
 - 33 Indeed, one of the examples, sound recordings, is classified as a traditional work of authorship and is protected for the duration of other copyrighted material. In Canada, sound recordings are protected as "neighbouring right" copyrights, more intensely (e.g. public performance rights attach to them) but for a shorter duration (straight 50 years) than traditional works.
 - 34 *Bulman Group Ltd. v. "One Write" Accounting Systems Ltd.* (1982), 132 D.L.R. (3d) 104 (F.C.T.D.); *Caron v. Assoc. de Pompiers de Montréal Inc.* (1992), 42 C.P.R.

- (3d) 292 (F.C.T.D.); *U & R Tax Services Ltd. v. H & R Block Canada Inc.* (1995), 62 C.P.R. (3d) 257 (F.C.T.D.).
- 35 *British Columbia Jockey Club v. Standen* (1985), 22 D.L.R. (4th) 467 (B.C.C.A.); *University of London Press Ltd. v. University Tutorial Press Ltd.*, [1916] 2 Ch. 601.
- 36 Copyright Office Regs. 37 C.F.R. § 202.1(d), as an example of a work “consisting entirely of information that is common property containing no original authorship”.
- 37 Copyright Office Regs. 37 C.F.R. § 202.1(c), endorsed in *Bibbero Systems Inc. v. Colwell Systems Inc.* 893 F.2d 1104 (9th Cir. 1990); *Advanx Behavioral Management Resources Inc. v. Miraflor* 21 F. Supp. 2d 1179 (C.D. Cal. 1998).
- 38 Copyright Act, 17 U.S.C. § 103(a) (United States).
- 39 For example, in *Compo v. Blue Crest Music Inc.*, [1980] 1 S.C.R. 357, 374.
- 40 The U.S. position, taken before the United States acceded to the *Berne Convention for the Protection of Literary and Artistic Works*, 1886, appears to contravene *Berne*, and thus both NAFTA and TRIPs; see Vaver, 1995. In the United Kingdom, see *ZYX Music GmbH v. King*, [1995] 3 All E.R. 1, 9-11 (Ch.).
- 41 Copyright Act, § 1101 (United States). U.S. law may not comply with TRIPs art. 14 to the extent that it protects only one class of performances. Oddly too, the U.S. legislation contains no provision that specifies how long this musical performance right lasts or what statute of limitation applies.
- 42 Copyright Act, §§ 105 and 101 (United States) (definition of “Work of the United States Government”).
- 43 *R. v. James Lorimer & Co.*, [1984] 1 F.C. 1065 (C.A.). Other Commonwealth governments have been no less reticent in this respect than Canadian governments. It is a sound adage that power given will inevitably be used as and when its bearer thinks opportune.
- 44 *Reproduction of Federal Law Order*, SI/97-5 (1997).
- 45 See generally, Vaver, 1996.
- 46 *McKenna's Furniture Store v. Prince Edward Island (Fire Marshal)*, [1997] P.E.I.J. No. 33, ¶ 28 (QL) (T.D.).
- 47 *Veeck v. Southern Building Code Congress International Inc.*, 241 F.3d 398 (5th Cir. 2001).
- 48 See Liu, 2000.
- 49 Starting from *Wheaton v. Peters*, 33 U.S. (Pet.) 591, 668 (1834): “The court are [sic] unanimously of opinion that no reporter has or can have any copyright in the written opinions delivered by this court, and that the judges thereof cannot confer on any reporter any such right.”
- 50 No originality requirement applies to neighbouring rights in Canada.
- 51 *University of London Press Ltd. v. University Tutorial Press Ltd.*, [1916] 2 Ch. 601 (routine university examination papers held “original”). The case is cited with approval in virtually every Canadian (and U.K. and Commonwealth) case involving the law of originality.
- 52 *British Columbia v. Mihaljevic* (1989), 26 C.P.R. (3d) 184 (B.C.), aff'd (1991) 36 C.P.R. (3d) 445 (B.C.C.A.).
- 53 *Francis Day & Hunter v. Twentieth Century Fox Corp.*, [1940] A.C. 112 (P.C.); *Canadian Olympic Assn. v. Konica Canada Ltd.*, [1992] 1 F.C. 797 (C.A.).

- 54 *Motel 6 Inc. v. No.6 Motel Ltd.*, [1982] F.C. 638 (T.D.); *Canadian Tire Corp. Ltd. v. Retail Clerks Union, Local 1518 of United Food and Commercial Workers Union* (1985), 7 C.P.R. (3d) 415 (F.C.T.D.); *Visa Int'l Service Assn. v. Auto Visa Inc.* (1991), 41 C.P.R. (3d) 77 (Que.); *Cie Générale des Éts. Michelin v. C.A.W.-Canada* (1996), 71 C.P.R. (3d) 348 (F.C.T.D.).
- 55 *DRG Inc. v. Datafile Ltd.* (1987), 18 C.P.R. (3d) 538 (F.C.T.D.), *aff'd* on other grounds (1991), 35 C.P.R. (3d) 243 (F.C.A.).
- 56 *Tett Bros. Ltd. v. Drake & Gorham*, [1928-35] Macg. Cop. Cas. 492 (Ch. 1934).
- 57 *British Northrop Ltd. v. Texteam Blackburn Ltd.*, [1974] R.P.C. 57, 68 (Ch.).
- 58 *Feist Publications Inc. v. Rural Telephone Service Co. Inc.*, 499 U.S. 340, (1991), itself an innovation not universally admired by U.S. commentators; see, for example, Heald, 1991. For a recent fascinating discussion of authorship, originality and creativity, see Nimmer, 2001.
- 59 *Gould Estate v. Stoddart Publishing Co.* (1996), 30 O.R. (3d) 520, *aff'd* (1998), 161 D.L.R. (4th) 321 (C.A.): the journalist had copyright in his transcript of Glenn Gould's conversation, the court relying, *inter alia*, on *Walter v. Lane*, [1900] A.C. 539 (H.L.). See *Lipman v. Massachusetts*, 475 F.2d 565 (1st Cir. 1973): no copyright in transcript of Mary Jo Kopechne inquest; *Walter v. Lane* not followed.
- 60 *Ateliers Tango argentin Inc. v. Festival d'Espagne et d'Amérique latine Inc.*, [1997] R.J.Q. 3030 (S.C.): *obiter* comment that ordinary photograph "réalisée au hasard, sans recherche et sans cadrage particulier" should have copyright. See also *SHL Imaging Inc. v. Artisan House Inc.*, 117 F. Supp. 2d 301 (S.D.N.Y. 2000): professional photographer's commercial work protectible because of "creative choices" made; *Bridgeman Art Library Ltd. v. Corel Corp.*, 36 F. Supp. 2d 191 (S.D.N.Y., 1999): no U.S. — or U.K. (?) — copyright in photographs of public domain old masters paintings.
- 61 See *Motel 6 Inc. v. No.6 Motel Ltd.*, [1982] F.C. 638 (T.D.); *Canadian Tire Corp. Ltd. v. Retail Clerks Union, Local 1518 of United Food and Commercial Workers Union* (1985), 7 C.P.R. (3d) 415 (F.C.T.D.); *Visa Int'l Service Assn. v. Auto Visa Inc.* (1991), 41 C.P.R. (3d) 77 (Que.); *Cie Générale des Éts. Michelin v. C.A.W.-Canada* (1996), 71 C.P.R. (3d) 348 (F.C.T.D.). Cf. *Muller & Co. v. New York Arrows Soccer Team Inc.*, 802 F.2d 989 (8th Cir. 1986): register's decision to refuse registration of copyright in New York Arrows word and simple design mark affirmed; Madison Avenue's view of creativity was found to be too low for the Copyright Office or the courts.
- 62 *National Film Board v. Bier* (1970), 63 C.P.R. 164 (Ex.): 775 word English/French glossary of motion picture terminology held original. See *Signo Trading International Ltd. v. Gordon*, 535 F. Supp. 362 (N.D. Cal. 1981): translation, for input into a hand-held electronic translator's database, of 850 single words and 45 short phrases from English into phonetically spelt Arabic, held not to be original.
- 63 See notes 58 to 61 above.
- 64 *Feist Publications Inc. v. Rural Telephone Service Co. Inc.*, 499 U.S. 340, (1991).
- 65 *Tele-Direct (Publications) Inc. v. American Business Information Inc.* (1997), 76 C.P.R. (3d) 296 (F.C.A.); *Ital-Press Ltd. v. Sicoli* (1999), 86 C.P.R. (3d) 129 (F.C.T.D.); *Key Publications Inc. v. Chinatown Today Publishing Enterprises Inc.*, 945 F.2d 509 (2nd Cir. 1991).

- 66 *CCC Information Services Inc. v. Maclean Hunter Market Reports Inc.*, 44 F.3d 61 (2nd Cir. 1994); *Édutile Inc. v. Automobile Protection Assn.* (2000), 6 C.P.R. (4th) 211 (F.C.A.).
- 67 *American Dental Association v. Delta Dental Plans Assn.*, 126 F.3d 977 (7th Cir. 1997): taxonomy of dental procedures original. See *Warren Publishing Inc. v. Microdos Data Corp.*, 115 F.3d 1509 (11th Cir. en banc 1997, 8:3 decision): selection of communities listed in a cable systems directory unoriginal.
- 68 *Tele-Direct (Publications) Inc. v. American Business Information Inc.* (1997), 76 C.P.R. (3d) 296 (F.C.A.).
- 69 Accord: *Hager v. ECW Press Ltd.* (1998), 85 C.P.R. (3d) 289 (F.C.T.D.); *Neudorf v. Netzwerk Productions Ltd.* (1999), 3 C.P.R. (4th) 129 (B.C.).
- 70 The contrary view, espoused in *CCH Canadian Ltd. v. Law Society of Upper Canada* (1999), 2 C.P.R. (4th) 129 (F.C.T.D.) (currently under appeal) is not enhanced by the court's view that headnotes in law reports, although involving "extensive labour, skill and judgement", lacked any "creative spark" and hence any copyright — a result reached by no other common law court for quite some time: e.g. *Sweet v. Benning* (1855), 16 C.B. 459 (C.P.); *Banks v. Manchester*, 128 U.S. 244 (1888).
- 71 See Vaver, 2000a, p. 63.
- 72 *Édutile Inc. v. Automobile Protection Assn.* (2000), 6 C.P.R. (4th) 211 (F.C.A.).
- 73 The court approvingly quoted the words "brilliant" and "innovative" from evidence given by the defendant's witness. If this endorsement of hyperbole is correct, the idea in *Édutile* must equally have been new, non-obvious and useful — and thus protectible under the *Patent Act*, were business method patents available in Canada — as they probably are not, at least for the time being; see text accompanying notes 120 and ff. below.
- 74 Duration is, of course, a far more complex subject in both countries than this short exposition implies. Transitional provisions, when new copyright terms are adopted, are particularly elaborate; for Canada, see Vaver, 2000a, pp. 99-118; see also McKeown, 2000.
- 75 *Abkco Music Inc. v. Harrisongs Ltd.*, 722 F.2d 988, 999 (2nd Cir. 1983).
- 76 Consideration of user rights becomes relevant, of course, only once the copyright holder has established a *prima facie* case of infringement — that the defendant has copied (or publicly performed, broadcast, etc.) the whole or a substantial part of the holder's work.
- 77 *Copyright Act*, s. 29 ff. (Canada).
- 78 *Hyde Park Residence Ltd. v. Yelland*, [2000] 3 W.L.R. 215 (C.A.), limiting intervention to where a work is "(i) immoral, scandalous or contrary to family life; (ii) injurious to public life, public health and safety or the administration of justice; (iii) incites or encourages others to act in a way referred to in (ii)." Class (i) may not apply in Canada, which has extended protection to pornography: *Aldrich v. One Stop Video Ltd.* (1987), 17 C.P.R. (3d) 27 (B.C.), following a U.S. precedent.
- 79 *Copyright Act*, § 107 (United States).
- 80 *Allen v. Toronto Star Newspapers Ltd.* (1997), 152 D.L.R. (4th) 518 (Ont. Div. Ct.); *Nunez v. Caribbean International News Corp.*, 235 F.3d 18 (1st Cir. 2001).
- 81 *Princeton University Press v. Michigan Document Services*, 99 F.3d 1381 (6th Cir. 1996); cf. *Boudreau v. Lin* (1997), 150 D.L.R. (4th) 324 (Ont. Gen. Div.).

- 82 *Copyright Act*, s. 30.7 (Canada); *Ringgold v. Black Entertainment Tv. Inc.*, 126 F.3d 70 (2nd Cir. 1997).
- 83 *Cie Générale des Éts. Michelin v. C.A.W.-Canada* (1996), 71 C.P.R. (3d) 348 (F.C.T.D.); *Campbell v. Acuff-Rose Music Inc.*, 114 S.Ct. 1164 (1994).
- 84 Especially since audio-taping of musical recordings for private use was from 1999 specifically exempted as an infringement in return for the establishment of a blank audiotape levy: expression *unius est exclusion alterius*. See further *Tom Hopkins International Inc. v. Wall & Redekop Realty Ltd.* (1984), 1 C.P.R. (3d) 348 (B.C.S.C.), varied (1985), 6 C.P.R. (3d) 475 (B.C.C.A.) (dictum); *Sony Corp. of America Inc. v. Universal City Studios Inc.*, 474 U.S. 417 (1984).
- 85 *Sony Computer Entertainment America, Inc. v. Bleem, LLC* 214 F.3d 1022 (9th Cir. 2000) (frozen frame screen shot may be used in comparative advertising by rival who markets computer program to allow playing of videogames on a computer instead of a Sony PlayStation); *National Rifle Assn. of America v. Handgun Control Federation*, 15 F.3d 559 (6th Cir. 1994) (political lobby group may copy other group's list of legislators to conduct rival lobbying effort).
- 86 *Register.com Inc. v. Verio Inc.*, 126 F. Supp. 2d 238 (S.D.N.Y. 2000), finding a contract in the second situation noted. Use contrary to the stated terms was said to be both a breach of a contract and an actionable trespass to chattels.
- 87 *ProCD v. Zeidenberg*, 86 F.3d 1447 (7th Cir. 1996), reflected in the approach taken in the *Uniform Computer Information Transaction Act* of 1999; see *North American Systemshops Ltd. v. King* (1989), 27 C.P.R. (3d) 367 (Alta. Q.B.).
- 88 See N. Elkin-Koren, 2001.
- 89 *Universal City Studios Inc. v. Reimerdes*, 111 F. Supp. 2d 294 (S.D.N.Y. 2000), currently on appeal.
- 90 *Copyright Act*, ss. 14.1, 14.2, 28.1, 28.2 (Canada). Moral rights attach only to "works" and not — until the *WIPO Performances and Phonograms Treaty*, 1996, is ratified — to any neighbouring rights.
- 91 *Snow v. Eaton Centre Ltd.* (1982), 70 C.P.R. (2d) 105 (Ont. H.C.). Today, the artist's evidentiary burden would be even lighter since prejudice to honour or reputation is presumed where a painting, sculpture or engraving is modified: *Copyright Act*, s. 28.2(2) (Canada).
- 92 *Prise de Parole Inc. v. Guérin Éditeur Ltée.* (1996), 73 C.P.R. (3d) 557 (F.C.A.), aff'ing (1995), 66 C.P.R. (3d) 557 (T.D.).
- 93 *Gnass v. Cité d'Alma* (Que. C.A., 1977, unreported).
- 94 An artist has recovered substantial damages where a city council bulldozed his sculpture off a site bought for urban renewal: *Martin v. City of Indianapolis* 192 F.3d 608 (7th Cir. 1999).
- 95 *Gilliam v. American Broadcasting Companies Inc.*, 538 F.2d 14 (2nd Cir. 1976).
- 96 See Ginsburg and Sirinelli, 1991.
- 97 The Act has a long lineage in Canada. Lower Canada passed the first such law in 1824, modelled on the 1793 U.S. Act, but an earlier grant had been made by the Quebec legislature, in 1791. Interestingly enough, the recipient was an American, Samuel Hopkins, in respect of the same technology — the making of pearl ash and potash — for which he had received the first patent under the U.S. Act of 1790. See Hayhurst, 1996.

- 98 The applicant must file within 12 months of disclosing his invention, or lose the right to file because the invention will no longer be considered new. The United States has a similar one-year grace period, but Europe has a more limited 6-month period for disclosures at trade fairs. *Show and tell* before filing remains a bad idea wherever patenting beyond North America is envisaged.
- 99 Canada had this system before 1987. Astonishingly, an interference appeal dealing with pre-1987 applications, filed in Canada in 1975 and having an earlier U.S. priority date, came to be decided before the Trial Division in the year 2001 from a decision of the Commissioner of Patents made in 1987. The decision was reversed: *Goldfarb v. W.L. Gore & Associates Inc.*, 2001 FCT 45. *Jarndyce v. Jarndyce* lives.
- 100 *Patent Act*, s. 2 (Canada), definition of "invention".
- 101 Starting with different 5:4 majorities in *Diamond v. Chakrabarty*, 447 U.S. 303 (1980) (biotechnology) and *Diamond v. Dehr*, 450 U.S. 175 (1981) (computer programs).
- 102 *Shell Oil Co. v. Canada (Commissioner of Patents)*, [1982] 2 S.C.R. 536.
- 103 *Progressive Games Inc. v. Canada (Commissioner of Patents)* (1999), 3 C.P.R. (4th) 397, aff'd [2000] F.C.J. No. 1829 (F.C.A.). The grant of a corresponding U.S. patent made no difference.
- 104 *Re Application for Patent of Pioneer Hi-Bred Ltd.*, [1987] 3 F.C. 8 (C.A.), aff'd on other grounds *sub nom. Pioneer Hi-Bred Ltd. v. Canada (Commissioner of Patents)*, [1989] 1 S.C.R. 1623.
- 105 *President and Fellows of Harvard College v. Canada (Commissioner of Patents)*, [2000] 4 F.C. 528 (C.A.), leave to appeal granted June 14, 2001 ([2001] S.C.C. Bull. 1096).
- 106 See Simon, 1997.
- 107 *Agreement on the Trade-Related Aspects of Intellectual Property Rights* (TRIPs), art. 28.1; *North American Free Trade Agreement* (NAFTA), art. 1709(1). The words in square brackets are found in NAFTA but not in TRIPs.
- 108 *European Patent Convention*, 1973, art. 53(a).
- 109 See Cornish, 1999.
- 110 *Harvard/Onco-Mouse*, [1991] E.P.O.R. 525.
- 111 *Lawson v. Canada (Commissioner of Patents)* (1970), 62 C.P.R. 101 (Ex. Ct.).
- 112 Thus, in *Lawson*, previous note, the comparable patent for a method of subdividing land was granted in the United States after contested proceedings. The Canadian court refused to follow the U.S. decision.
- 113 *Novopharm Inc. v. Wellcome Foundation Ltd.* (2000), 10 C.P.R. (4th) 65 (F.C.A.), leave to appeal to S.C.C. sought.
- 114 *Imperial Chemical Industries Ltd. v. Canada (Commissioner of Patents)*, [1986] 3 F.C. 40 (C.A.), foll'ing *Tennessee Eastman Co. v. Canada (Commissioner of Patents)*, [1974] S.C.R. 111.
- 115 *Ex p. Scherer*, 103 U.S.P.Q. 107 (PO Bd. App. 1954), distinguishing *Morton v. N.Y. Eye Infirmary*, 17 Fed. Cas. (No. 9,865) 879 (S.D.N.Y. 1862).
- 116 *Burroughs Wellcome Co. v. Barr Laboratories*, 32 U.S.P.Q.2d 1915 (Fed. Cir. 1994).
- 117 *Patent Act*, 35 U.S.C. § 287(c) (United States). The defence applies only to patents with a priority date after September 30, 1996.

- 118 *Re Abitibi Co.* (1982), 62 C.P.R. (2d) 81, applying *Diamond v. Chakrabarty*, 447 U.S. 303 (1980).
- 119 Expressly not patentable under *Patent Act*, s. 27(8) (Canada).
- 120 *Diamond v. Dehr*, 450 U.S. 175 (1981); *Re Tokyo Shibaura Electric Co.'s Pat. App.* (1985), 7 C.P.R. (3d) 555: computerized method of controlling the operation of an industrial plant patentable.
- 121 *State Street Bank & Trust Co. v. Signature Financial Group*, 149 F.3d 1368 (Fed. Cir. 1998); *Re Alappat*, 33 F.3d 1526 (Fed. Cir. 1994).
- 122 Patents were denied in *Re Patent Application No. 178,570* (1983), 2 C.P.R. (3d) 483 (Comm. Pat.) (computerized method of calculating value of investment portfolio) and *Re Patent Application No. 564,175* (1999), 6 C.P.R. (4th) 385 (Comm. Pat.) (computerized method of financial investment), following *Schlumberger Can. Ltd. v. Commissioner of Patents* (1981), 56 C.P.R. (2d) 204 (F.C.A.).
- 123 *Welcome Real-Time SA v. Catuity Inc.*, [2001] FCA 445 (Fed. Ct. Aust.).
- 124 Most practitioners are naturally all in favour; see, for example, Eisen (2001) and Ferance (2000). The comment from the judgment of the four dissenters in *Diamond v. Dehr* 450 U.S. 175 (1981) disapproving of the patenting of computer programs, come to mind:

The broad question whether computer programs should be given patent protection involves policy considerations that this Court is not authorized to address. ... [T]hat question is not only difficult and important, but apparently also one that may be affected by institutional bias. In each of [the prior cases touching the point], the spokesmen for the organized patent bar have uniformly favoured patentability and industry representatives have taken positions properly motivated by their economic self-interest. Notwithstanding fervent argument that patent protection is essential for the growth of the software industry, commentators have noted that 'this industry is growing by leaps and bounds without it'.
- 125 Whether infringement has occurred in fact may be decided in the United States by a jury. In Canada, the judge decides both questions of claim construction and infringement as there are no juries in IP cases.
- 126 *Consolboard Inc. v. MacMillan Bloedel (Sask.) Ltd.*, [1981] 1 S.C.R. 504, 520-521, approved in *Whirlpool Corp. v. Camco Inc.*, 2000 SCC 67.
- 127 The claims, being approved by the Patent Office, have even been equated with statutory regulations for interpretative purposes: *Whirlpool Corp. v. Camco Inc.*, 2000 SCC 67, para. 49, citing s. 2(1) of the *Interpretation Act*, R.S.C. 1985, c. I-21. The prospect that counsel may now start citing from statutory interpretation treatises in patent cases is surely a gloomy one.
- 128 *Catmic Components Ltd. v. Hill & Smith Ltd.*, [1982] R.P.C. 183 (H.L.).
- 129 Purposive construction may, of course, narrow the literal meaning of a claim; more often, it expands it. A narrow interpretation sometimes helps patentees, for example by avoiding the prior art and overcoming invalidity challenges on grounds of obviousness or lack of novelty.
- 130 *Graver Tank v. Linde Air Products Co.*, 339 U.S. 605 (1950).
- 131 As the dissenters (Black and Douglas JJ.) in *Graver Tank* (see previous note) recognized.

- 132 *Free World Trust v. Électro Santé Inc.*, 2000 SCC 66; *Warner-Jenkinson Co. Inc. v. Hilton Davis Chemical Inc.*, 520 U.S. 17 (1997); *Festo Corp. v. Shoketsu Kogyo Kogyo Dabushiki Co. Ltd.*, 234 F.3d 558 (Fed. Cir. en banc 2000).
- 133 Recognized indirectly by Patent Act, s. 55.2(6) (Canada); *Micro-Chemicals Ltd. v. Smith Kline & French Inter-American Corp.*, [1972] S.C.R. 506; see Vaver, 1997, pp. 161-162.
- 134 *Intermedics Inc. v. Ventritex Inc.*, 775 F. Supp. 1269 (N.D. Cal. 1991), aff'd, 991 F.2d 808 (Fed. Cir. 1993).
- 135 See, for example, O'Rourke, 2000.
- 136 See *Mishawaka Rubber & Woolen Mfg. Co. v. S.S. Kresge Co.*, 316 U.S. 203 (1942).
- 137 Taste is included as a possible mark under New Zealand's trade-mark law. How one goes about accurately describing taste in a way that fairly binds third parties is an interesting question. Presumably, "finger-lickin' good" as a written description fails the grade. As to smells, see the varying approaches in Europe: *Venootschap onder Firma Senta Aromatic Marketing's Application*, [1999] E.T.M.R. 429 (Eur. Comm. Trade Marks Office, Second Board of Appeal), registering the smell of freshly cut grass for tennis balls; *John Lewis of Hungerford Ltd.'s Trade Mark Application*, [2001] R.P.C. 575 (Trade Marks Registry Appeal), denying registration of cinnamon smell for furniture. See, generally, Lyons (1994) and McGrath (2001).
- 138 *Trade-marks Act*, R.S.C. 1985, c. T-13, ss. 9(1), 10, 11, 12(1) (Canada).
- 139 The *Trade-marks Act* allows rights to arise even from an application to register an unused mark; the mark will have to be used before it is registered but will have priority as from the application date.
- 140 *Saskatoon Star Phoenix Group Inc. v. Noton*, 2001 SKQB 153 (Sask. Q.B.). See also *Itravel2000.com Inc. v. Fagan*, [2001] OJ No. 943 (Ont. Super. Ct.), following *Panavision Int'l v. Toepfen*, 141 F.3d 1316 (9th Cir. 1998) to grant interlocutory injunction to travel agent with reputation under "itravel" against cybersquatter who had acquired "itravel.ca" as a domain name.
- 141 *Heathmount AE Corp. v. Technodome.com*, 106 F. Supp. 2d 860, further proceedings 2000 U.S. Dist. LEXIS 20316 (E.D. Va. 2000); *Northern Light Technology Inc. v. Northern Lights Club*, 236 F.3d 57 (1st Cir. 2001) (U.S. firm vs. Canadian dot.com cybersquatter); see Greenfield, 2001. One must still file in the right U.S. judicial district: *Mattel Inc. v. Barbie-Club.com*, 58 U.S.P.Q.2d 1798 (S.D.N.Y. 2001).
- 142 *People for the Ethical Treatment of Animals Inc. v. Doughney*, 113 F. Supp. 2d 915 (E.D. Va. 2000).
- 143 *Trade-marks Act*, s. 6 (Canada). Oddly, the U.S. trade-marks law, the *Lanham Act*, lacks a comparable set of criteria, resulting in widely varying formulations of the test for confusion among the various circuits.
- 144 *E. & J. Gallo Winery v. Andres Wines Ltd.*, [1976] 2 F.C. 3 (C.A.)
- 145 *Orkin Exterminating Co. v. Pestco Co. of Canada* (1985), 50 O.R. (2d) 726 (C.A.), applying analogous U.S. precedents and disapproving contrary U.K. case law.
- 146 *Pro-C Ltd. v. Computer City* (2000), 7 C.P.R. (4th) 193 (Ont. Super. Ct.), currently under appeal.
- 147 *Sun Life Assurance Co. of Canada v. Sunlife Juice Ltd.* (1988), 65 O.R. (2d) 496 (H.C.). The now almost *de rigueur* marketing survey was trotted out, revealing

- that 24 percent of the respondents polled in a shopping mall, when shown a fitness-promoting brochure published by the insurance company and a bottle of Sunlife fruit juice, thought the two items were associated with the same company. The result recalls the U.S. case where 12 percent of respondents, who viewed a t-shirt labelled “Mutant of Omaha - Nuclear Holocaust Insurance” and carrying a distinctive Mutual of Omaha’s design trade-mark, thought that the insurance company went along with the anti-nuclear message of the shirts: *Mutual of Omaha Insurance Co. v. Novak*, 836 F.2d 397 (8th Cir. 1987), a 2:1 majority finding infringement. Presumably similar percentages of such respondents would respond affirmatively to a question asking them whether they believed the earth to be flat.
- 148 *Pink Panther Beauty Corp. v. United Artists Corp.*, [1998] 3 F.C. 584 (C.A.), Linden JA for the majority.
- 149 *Lexus Foods Inc. v. Toyota Jidosha Kabushiki Kaisha* (2000), 9 C.P.R. (4th) 297 (F.C.A.), Linden JA for a unanimous court. Toyota presumably chose conveniently to ignore the decision in which Lexus was allowed its U.S. registration for cars over the opposition of the Lexis legal database operator: *Mead Data Cent. Inc. v. Toyota Motor Sales Inc.*, 875 F.2d 1026 (2nd Cir. 1989).
- 150 *Chemical Corp. of America v. Anheuser-Busch Inc.*, 306 F.2d 433 (5th Cir. 1962).
- 151 *Trade-marks Act*, s. 22(1) (Canada).
- 152 *Clairol International Corp. v. Thomas Supply & Equipment Co.*, [1968] 2 Ex.C.R. 552, 573.
- 153 A view recently confirmed by *BCAA v. Office and Professional Employees’ Int. Union*, 2001 B.C.S.C. 156.
- 154 See generally, Berryman, 2000.
- 155 *Ex parte* orders to seize allegedly infringing goods and other evidence of infringement may be made without prior notice against defendants who would otherwise hide the material if they had advance warning of the claimant’s intention to sue: *Anton Piller KG v. Manufacturing Processes Ltd.*, [1976] Ch. 55 (C.A.); *Pulse Microsystems Ltd. v. Safesoft Systems Inc.* (1996), 134 D.L.R. (4th) 701 (Man. C.A.); *First Technology Safety Systems Inc. v. Depinet*, 11 F.3d 641 (6th Cir. 1993); Berryman, 2000, chapter 5.
- 156 *RJR-MacDonald Inc. v. Canada (Attorney General)*, [1994] 1 S.C.R. 311.
- 157 The pre-1975 requirement to show a prima facie case — i.e. that one’s chances of winning at trial were over 50 percent — no longer prevails.
- 158 *Signalisation de Montréal Inc. v. Services de Béton Universels Ltée* (1992), 46 C.P.R. (3d) 199 (F.C.A.) (patent); *A. Lassonde Inc. v. Island Oasis Canada Inc.*, 2000 Fed. Ct. Appeal LEXIS 431 (trade-mark); *Teklogix Inc. v. Zaino* (1997), 79 C.P.R. (3d) 1(Ont. G.D.) (copyright).
- 159 For the U.K. approach in IP cases, see *Series 5 Software Ltd. v. Clarke*, [1996] F.S.R. 273, 286 (Ch.).
- 160 As established by Orkin, note 146 above.
- 161 *Coin Stars Ltd. v. K.K. Court Chili & Pepper Restaurant Ltd.* (1990), 33 C.P.R. (3d) 186 (B.C.S.C.).
- 162 *Viewpoint International Inc. v. On Par Enterprises Inc.*, 2001 FCT 629 (T.D.).
- 163 *GoTo.com Inc. v. The Walt Disney Co.*, 202 F.3d 1199, 1204 (9th Cir. 2000).
- 164 *Genentech, Inc. v. Novo Nordisk, A/S* 108 F.3d 1361 (Fed. Cir. 1997).

- 165 *Hybritech Inc. v. Abbott Labs.*, 849 F.2d 1446 (Fed. Cir. 1988); *Schawbel Corp. v. Conair Corp.*, 122 F. Supp. 2d 71 (D. Mass. 2000) (patents); *Suntrust Bank v. Houghton Mifflin Co.*, 136 F. Supp. 2d 1357 (N.D. Ga. 2001) (copyright).
- 166 *R. v. James Lorimer & Co.*, [1984] 1 F.C. 1065 (C.A.).
- 167 *Sony Computer Entertainment Inc. v. Connectix Corp.*, 203 F.3d 596, n. 11 (9th Cir. 2000).
- 168 *Ludlow Music Inc. v. Robbie Williams*, [2001] F.S.R. 271, 283 (Ch.).
- 169 *Foster v. American Machine & Foundry Co.*, 492 F.2d 1317, 1324 (2nd Cir. 1973).
- 170 *City of Milwaukee v. Activated Sludge Inc.*, 69 F.2d 577, 593 (7th Cir. 1934). Whether that order would, in Canada, have been labelled as “tantamount to a compulsory licence” is an interesting question.
- 171 For example, for an infringement of moral rights or of trade-marks.
- 172 *Habib Bank Ltd. v. Habib Bank AG Zurich*, [1981] 2 All E.R. 650 (C.A.).
- 173 *Imperial Oil Ltd. v. Lubrizol Inc.* (1996), 67 C.P.R. (3d) 1 (F.C.A.).
- 174 E.g. *Frank Music Corp. v. Metro-Goldwyn-Mayer*, 772 F.2d 505 (9th Cir. 1985).
- 175 *Hay v. Sloan* (1957), 12 D.L.R. (2d) 397 (Ont.), citing old U.K. appellate authority.
- 176 *Patent Act*, § 284 (United States).
- 177 For other calculation complications, see Stack, Davidson and Cole, 2000.
- 178 *Monsanto Canada Inc. v. Schmeiser*, 2001 Fed. Ct. Trial LEXIS 174, 2001 FCT 256.
- 179 *Fogerty v. Fantasy Inc.*, 510 U.S. 517 (1994).
- 180 *Roberts v. Sears, Roebuck & Co.*, 723 F.2d 1324 (7th Cir. 1983, en banc), Posner and Eshbach JJ. dissenting. A comparable set of platitudes is deployed in Canadian law; see *Beloit Canada Ltd. v. Valmet Oy* (1986), 8 C.P.R. (3d) 289 (F.C.A.).
- 181 To similar effect, see Jacob, 1997: “To call [the general area of law now called ‘intellectual property’] ‘intellectual’ is misleading. It takes one’s eye off the ball. ‘Intellectual’ confers a respectability on a monopoly which may well not be deserved. A squirrel is a rat with good public relations. ‘Intellectual property’ is perhaps a phrase coined by the same public relations agent for monopolies!”
- 182 See Vaver, 2000b, pp. 633-635.
- 183 *Cie Générale des Éts. Michelin v. C.A.W.-Canada* (1996), 71 C.P.R. (3d) 348 (F.C.T.D.).
- 184 The first U.K. decision, where copyright met free speech as protected under article 10 of the *European Convention for the Protection of Human Rights and Fundamental Freedoms*, 1953, is even more radical. The court thought that copyright and, it seems, every other piece of IP legislation was already optimally balanced: there was “no room for any further defences outside the code which establishes the particular species of intellectual property in question”: *Ashdown v. Telegraph Group Ltd.*, [2001] 2 W.L.R. 967, 975 (Ch.).
- 185 See TRIPs art. 1.1, with arts. 13 (copyright), 17 (trade-marks) and 30 (patents).
- 186 See Vaver, 2000b, p. 621, 636. See McLachlin C.J.C.: “We must stop thinking of intellectual property as an absolute and start thinking of it as a function — as a process, which, if it is to be successful, must meet diverse aims: the assurance of a fair reward to creators and inventors and the encouragement of research and creativity, on the one hand; and on the other hand, the widest possible dissemination of the ideas and products of which the world, and all the individuals in it, have

such great need; see “Intellectual Property – What’s it all About?”, in Henderson (ed.) *Trade-Marks Law of Canada* (1993), p. 397, cited in *Pink Panther Beauty Corp. v. United Artists Corp.*, [1998] 3 F.C. 584 at 547 (C.A.), Linden JA for the majority.

ACKNOWLEDGMENTS

MY THANKS TO WILLIAM L. HAYHURST Q.C. for reading and providing helpful comments on a draft of the manuscript. My thanks also to Patrick Masiyakurima (then at Oxford IP Research Centre, St Peter’s College, now Lecturer in Law, University of Northumbria, Newcastle) for checking the endnotes.

BIBLIOGRAPHY

- Anderman, Steven D. 1998. *EC Competition Law and Intellectual Property Rights*. Clarendon Press.
- Berryman, Jeffrey Bruce. 2000. *The Law of Equitable Remedies*. Irwin Law.
- Cornish, William Rodolph. 1999. *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights*. 4th ed., p. 228.
- Eisen, Mark B. 2001. “Arts and Crafts: The Patentability of Business Methods in Canada.” *Canadian Intellectual Property Review* 17: 279.
- Elkin-Koren, N. 2001. “A Public-Regarding Approach to Contracting over Copyrights.” In *Expanding the Boundaries of Intellectual Property: Innovation Policy for the Knowledge Society*. Edited by Rochelle Cooper Dreyfuss, Diane Leenheer Zimmerman and Harry First. Oxford University Press, Ch. 8.
- Ferance, Stephen J. 2000. “Debunking Canada’s Business Method Exclusion from Patentability.” *Canadian Intellectual Property Review* 17: 493.
- Ginsburg, Jane C., and Pierre Sirinelli. 1991. “Author, Creation and Adaptation in Private International Law and French Domestic Law: Reflections on the Huston Case.” *Revue internationale du droit d’auteur* 150: 3.
- Greenfield, Neal. 2001. “The Interaction between Trade-marks and Domain Names in the United States.” *Canadian Intellectual Property Review* 17: 311.
- Halpern, Sheldon W., Craig Allen Nard and Kenneth L. Port. 1999. *Fundamentals of United States Intellectual Property Law*. Kluwer, pp. 340-343.
- Hayhurst, William. 1996. “Intellectual Property Laws in Canada: The British Tradition, the American Influence and the French Factor.” *Intellectual Property Journal* 10: 265.
- Heald, Paul J. 1991. “The Vices of Originality.” *Supreme Court Review*: 143.
- Industry Canada, Competition Bureau (2000). *Intellectual Property Enforcement Guidelines*. Available at: <http://strategis.ic.gc.ca/epic/internet/inch-bc.nsf/en/ct01992e.html> (accessed on April 22, 2005).

- Jacob, Robin. 1997. "Industrial Property – Industry's Enemy." *Intellectual Property Quarterly* 1: 3.
- Liu, Caitlin. 2000. "Say What, Your Honor?" *Los Angeles Times* (September 7th).
- Lyons, Debrett. 1994. "Sounds, Smells and Signs." *European Intellectual Property Review*: 540.
- McGrath, Jacey K. 2001. "The New Breed of Trade Marks: Sounds, Smells and Tastes." *Victoria University of Wellington Law Review* 32: 277.
- McKeown, John S. 2000. *Fox Canadian Copyright Law*, chapter 16.
- McLachlin, Beverley, Chief Justice of Canada. 1993. "Intellectual Property 'What's it all About?'" In *Trade-Marks Law of Canada*. Edited by Gordon F. Henderson, p. 397.
- Newman, Pauline. 1994. "Legal and Economic Theory of Patent Law." Speech to American Bar Association – Intellectual Property Law Section (July 21).
- Nimmer, D. 2001. "Copyright in the Dead Sea Scrolls." *Houston Law Review* 38: 5.
- O'Rourke, Maureen A. 2000. "Toward a Doctrine of Fair Use in Patent Law." *Columbia Law Review* 100: 1177.
- Penrose, E. 1951. *The Economics of the International Patenting System*.
- Roberts, R.J. 1995. "Technology Transfer Agreements and North American Competition Law." *Intellectual Property Journal* 9: 247.
- Simon, Christopher. 1997. "Man with a Patented Putt Hopes Someone Shows Him the Green." *Wall Street Journal* (August 18).
- Stack, Alexander J., A. Scott Davidson and Stephen R. Cole. 2001. "Accounting of Profits Calculations in Intellectual Property Cases in Canada." *Canadian Intellectual Property Review* 17: 405.
- Vaver, David. 1995. "Abridgments and Abstracts: Copyright Implications." *European Intellectual Property Review*, p. 225.
- . 1996. "Copyright and the State in Canada and the United States." *Intellectual Property Journal* 10: 187.
- . 1997. *Intellectual Property: Copyright, Patents, Trade-marks*.
- . 2000a. *Copyright Law*, Toronto: Irwin Law.
- . 2000b. "Intellectual Property: The State of the Art." *Law Quarterly Review*: 116.
- Zimmerman, Gordon J. 2000. "Extending the Monopoly? The Risks and Benefits of Multiple Forms of Intellectual Property Protection." *Canadian Intellectual Property Review* 17: 345.



Sandra Charles, Gilles McDougall & Julie Tran
Industry Canada

2

The Importance of Intellectual Property Industries in the Canadian Economy

INTRODUCTION

KNOWLEDGE HAS EMERGED as a leading factor of production in ensuring the success of both firms and nations in the global economy. Innovation — the creation and dissemination of new knowledge — is now recognized as a major engine of economic growth, enhancing both productivity and quality of life. In contemporary economies, knowledge plays an important role in several aspects of economic activity. For instance, industries engaged in the production of high-technology intensive goods are correctly identified as part of the knowledge-based economy. These industries produce new goods and services that embody new knowledge, and these new intermediate products may be used in turn by other firms or industries to enhance the efficiency of their production processes and generate productivity gains for the economy as a whole. One example of such new intermediate outputs is the new information technologies.

Industries that produce knowledge are not, however, the only ones that must be regarded as an integral part of the knowledge-based economy. Industries adopting the new technologies must also have a high level of technological capacity in order to adapt these technologies to their production processes, as well as a skilled work force in order to benefit fully from them. One example of is service activities such as finance and communications.

A recent Organisation for Economic Co-operation and Development (OECD) report¹ describes the growth of knowledge-based industries in the OECD countries, based on a definition that includes high-technology manufacturing industries, communications, finance, insurance and real estate, business services and personnel services, and social and community services. The report estimates that these industries accounted for 50 percent of total value added in

the OECD in the mid-1990s, an increase from the 45 percent observed in the mid-1980s. Overall, finance, insurance and business services industries comprised the largest portion of knowledge-based industries in OECD countries.

Among the G7 countries, Germany (58.6 percent) and the United States (55.3 percent) were at the top of the list for the proportion of the economy represented by knowledge-based industries. Canada lags behind the leading somewhat, at 51 percent, putting it in fifth place among the G7 countries. However, the growth of knowledge-based industries in Canada was relatively strong during the 1985-96 period, which suggests that their share of the economy could continue to rise.

What is certain is that both in Canada and worldwide, knowledge has emerged as a major growth factor. That being said, knowledge has always been at the root of economic growth. A comparative study of the 43 OECD countries using data from 1820 to the present concluded that the primary source of economic growth has been advances in knowledge and technological progress. In other words, for new knowledge — which is intangible — to contribute to economic growth, it must be given at least concrete expression in new goods and services or new production processes that will enhance a firm's productivity and reduce its production costs.² In addition, the firm's work force must acquire the new knowledge and become *skilled* in order for the firm to fully realize the potential of the new technologies, that is, the new knowledge.

It is precisely the intangible nature of knowledge that explains the existence of intellectual property (IP) rights: knowledge has the characteristics of a public good. It is non-excludable (in production) and non-rivalrous (in consumption). If there were no clearly defined property rights, the market would not allow individuals and firms to exclude potential competitors from using the new knowledge, and this would prevent them from appropriating their fair share of the related benefits. This is what is meant by 'non-excludable.' In addition, a firm's use of knowledge in no way diminishes the utility of the knowledge to other firms, and this is what is meant by 'non-rivalrous.'

These two features make private markets inefficient for ensuring optimal creation of new knowledge, or innovation. Firms that cannot capture all the returns from their innovative activities tend to underinvest in these activities.

The purpose of IP legislation is to remedy these market imperfections by granting property rights that make knowledge excludable and rivalrous in the same way as private or tangible goods. These rights are conferred not on the knowledge itself, but on its manifestations which, for example, take the form of an invention, the expression of an idea, a design or a symbol. This enables inventors or creators to more easily appropriate the benefits resulting from their activities, thereby creating a greater incentive for firms or individuals to engage in knowledge-creation activities.

While the IP system stimulates innovation and creation, it also facilitates its dissemination. For example, there are exceptions in the *Copyright Act* that give specific users access to certain types of works. As well, in return for a period of limited market exclusivity, the owner of a patent must disclose technical information regarding its invention. This dissemination of new knowledge can play an important role in innovative activities within an economy. The pool of available information relating to existing innovations and creations facilitates the activities of subsequent creators and inventors in that it enables them to improve previous discoveries and avoid costly duplication of research efforts.

A balanced IP system that maximizes welfare arising from the creation and dissemination of new knowledge may be a significant source of growth for an economy, if it is used effectively. But the costs associated with using IP rights may be substantial enough to discourage such effective use. For example, the cost of obtaining a patent may be very high, as it is often necessary to seek the services of experts in the field such as lawyers and patent agents in order to complete a patent application. Some IP rights are also granted conditional on payment of a variety of fees, which are added on to the costs already incurred. In addition, enforcing these rights can also contribute significantly to costs, especially when disputes have to be settled before the courts.

The costs of obtaining and enforcing property rights may be relatively high, and it is up to each firm or industry to assess the corresponding benefits before taking this route. It might be expected, though, that some sectors of economic activity will make more intensive use of IP rights than others. For example, industries for which innovation is costly, requires long periods of time, or generates substantial income will be inclined to devote the necessary resources to use those rights. The pharmaceutical and biotechnology industries are leading examples of this group. Industries where income generated by IP is significant relative to total income, for example the cultural industries, will also tend to base their business strategies on IP rights.

The various economic sectors or industries will therefore vary in the intensity with which they use various types of IP rights, depending on their assessment of the costs and benefits involved. The objective of the present study is to identify those sectors, for each type of IP right, and to assess their importance in the Canadian economy — and to the knowledge-based economy. It is important to note at the outset that this study does not constitute an analysis of causality between various types of IP rights and economic activity. The study will not attribute any particular causal role to IP rights in determining the growth of the innovative effort of a particular industry. What it will do is establish correlations between the use of different types of IP rights and a set of economic activity variables.

In the following sections, we analyze the intensity of use, first, of patents, and then of copyright and trade-marks. We conclude the study with an overview of the intensity of use of IP rights, attempting to identify industries that make complementary use of the various types of rights.

PATENTS

UNDER THE *PATENT ACT*, a patent gives the author of an invention the exclusive right of making, constructing and using the invention and selling it to others to be used, for a maximum of 20 years from the date the application is filed. An invention is defined in the Act as “any new and useful art, process, machine, manufacture or composition of matter, or any new and useful improvement in any art, process, machine, manufacture or composition of matter”. This definition clearly establishes two important criteria that every invention must meet in order to be patentable: novelty and utility, as well as a third criterion, non-obviousness. Scientific principles or theoretical concepts are expressly excluded from what is patentable: a patent may be obtained only for the physical embodiment of an idea, and not for the idea itself. Despite these specific exclusions, the actual definition of what is an invention is relatively broad, and has left the field open for heated debates as to the eligibility of new technologies for patent protection. For example, business methods, software and complex life forms are among the emerging issues in the field of IP, and no consensus has yet been reached among experts in the profession regarding their patentability.

As in the case of other types of IP rights — with the exception of copyright, which does not require registration — an inventor who wants the protection offered by a patent must file an application in the prescribed form to the Canadian Intellectual Property Office (CIPO), more specifically to the Patent Office. An inventor who wants to file a patent application must include in the application a specification and one or more claims defining the boundaries of patent protection. In order for the application to be examined, the inventor must then make a request for examination and pay the appropriate fee, within five years from the date on which the application is filed in Canada. The examination may take from two to three years, and this makes it a long and complex process. It may also be very expensive, in that the inventor must pay three different fees in order to obtain a patent (a filing fee, an examination fee and a patent issuance fee), plus an annual maintenance fee once the patent is granted. Accordingly, of all the forms of IP protection, patents are undoubtedly the most difficult and expensive to obtain, and this makes the protection afforded by trade secret relatively attractive.

The Act also requires that patent applications be made public eighteen months after filing. Publication facilitates dissemination of new knowledge to

the public and stimulates subsequent innovations. The specification must therefore be clear and detailed, so that society may benefit from the inventor's incremental discovery of knowledge.

DEFINITION OF THE PATENT SECTOR

FIRST, WE NOTE THAT THE DESCRIPTION of patent-intensive Canadian industries depends on our ability to identify them using an objective indicator of intensity in respect of patents. The complexity of this kind of analysis results partly from the size of the Canadian patent database, and partly from the lack of consistency between the International Patent Classification (IPC) used by CIPO³ to register patent applications and the system used by Statistics Canada. As well, the need to use the Statistics Canada industrial classification reflects the fact that only the data indexed in Statistics Canada's CANSIM database are available for creating an economic profile of patent-intensive industries.

Accordingly, the following section describes the methodology used in constructing an index of patent intensity, while recognizing the limitations of that index as a result of available patent data. The final part of the section deals with the limitations inherent in the intensity indicator selected.

Methodology and Data

The first step was to obtain data concerning, first, patent applications (hereinafter "application") filed by Canadian inventors⁴ with CIPO, and second, patents issued to Canadians by CIPO (hereinafter "patent"). In terms of applications, the database contained the name of each inventor, the inventor's address, and the number of applications filed, for the 1990 and 1999 reference years. In terms of patents issued, CIPO provided us with the name of each inventor who was granted a patent, its address, and the number of patents issued to him/her, for the 1989 and 1999 reference years.⁵

Second, each application and each patent from a given population⁶ was given a code taken from the 1980 Standard Industrial Classification (SIC). The names of the firms in our database were matched with the appropriate SIC codes using the Statistics Canada business register. Despite the additional loss of observations, this exercise enabled us to determine the industrial classification of over two-thirds of patents issued to firms in 1999 (68 percent) and 1989 (66 percent) and of applications filed by firms in 1999 (78 percent). Only 57 percent of applications filed by firms in 1990 were assigned an industrial classification. The impossibility of coordinating all applications or patents with SIC codes may be explained by the fact that our original database had incomplete or incorrect firm addresses and, similarly, by the fact that firms may have subsequently closed or simply changed names or merged with other firms. As well, the somewhat lower rate of success in matching applications filed in 1990

with SIC codes may be result from the fact that the data were matched using the 1999 business register. In fact, it is likely that in 10 years a higher proportion of firms ceased to exist, merged or simply changed names.

In order to be able to classify Canadian industries according to the relative extent of their use of the Canadian patent system, we chose to construct an index of relative patent intensity based on 1999 patent applications. There were two reasons for this choice, the first, practical, and the second, conceptual. First, we are aware of the fact that the methodology formerly used meant that we had to consider only a limited sample of observations, and this also led to a number of limitations to which we shall return later. For instance, the variable for which we have the most observations relates to patent applications filed with CIPO in 1999 by Canadians. In this case, SIC matching allowed for 2,044 applications to be coded, representing 42 percent of total applications filed by Canadians that year⁷. In contrast, SIC code matching allowed only 759 applications to be matched for 1990, and 572 and 620 patents to be matched for 1989 and 1999, respectively. Based on this result, we selected the 1999 *applications* variable for constructing an index of patent intensity because we believe that of the four samples, this one was the most representative of the Canadian situation in terms of use of the patent system by Canadian industries.

Conceptually, the selection of this variable is quite consistent with a majority of empirical studies conducted about innovation. In fact, patent applications are very often used as an indicator of innovation, rather than patents granted. The distinction between the sources from which these applications and patents are produced is therefore crucial in justifying our choice. For one thing, the firms involved in the innovation process invest significant amounts in research and development (R&D) activities, with the aim of discovering new products or production processes, or of improving existing products or processes. A firm that has developed a new product or process that meets the usual criteria for patentability (novelty, utility, non obviousness) then files a patent application with CIPO. It falls to CIPO to examine the application and determine whether to issue a patent to protect the invention that is the subject of the application. It is clear that while the applications are made by the firms themselves, the patents are issued by the agency responsible for regulating IP in Canada. Because one of the objectives of our study involves the desire to identify Canadian industries that make relatively intensive use of the Canadian patent system, it is our view that patent applications are a better indicator.

Patent Intensity Index

In order to construct an index of patent intensity, we took the number of patent applications from each industry, which we then divided by the value of their gross domestic product (GDP), to correct for industry size⁸. We calculated

the value of the index for all Canadian industries defined by the two-digit SIC codes. However, we had to aggregate certain industries further in order to obtain an industrial classification consistent with the R&D data published by Statistics Canada (2001). Once the index was calculated for all industries, we ranked these in descending order, and then divided them into three equal groups, based on their relative propensity to patent: high (1), moderate (2) or low (3). Table 1 presents the ranking of Canadian industries, from most intensive to least intensive.

TABLE 1			
RELATIVE PROPENSITY TO PATENT, 1999			
(NUMBER OF PATENT APPLICATIONS PER \$1 BILLION GDP)			
INDUSTRIES	INDEX	GROUP	NUMBER OF APPLICATIONS
Electrical and Electronic Products	42.11	1	560
Refined Petroleum and Coal Products	31.42	1	34
Machinery	20.24	1	125
Other Manufacturing Industries	14.05	1	103
Plastic Products	8.32	1	34
Primary Textiles and Textile Products	7.29	1	20
Business Services	6.98	1	315
Furniture and Fixtures	4.87	1	17
Chemical Products	4.51	1	49
Transportation Equipment	4.25	1	109
Fabricated Metal Products	3.77	2	37
Primary Metals	3.75	2	24
Mining and Oil Wells	2.31	2	57
Non-metallic Mineral Products	1.88	2	7
Other Services Industries	1.75	2	299
Wholesale Trade	1.67	2	80
Wood Products	1.42	2	9
Food	1.34	2	18
Other Public Services Industries	1.19	2	30
Printing, Publishing and Allied Industries	1.16	2	8
Beverage and Tobacco Products	0.93	3	1
Paper and Allied Products	0.86	3	6
Agricultural and Related Services Industries	0.60	3	8
Finance, Insurance and Real Estate Services	0.43	3	52
Rubber Products	0.40	3	1
Construction	0.34	3	14
Retail Trade	0.33	3	16
Communications	0.26	3	7
Forestry Services	0.22	3	1
Transportation and Warehousing	0.09	3	3

To ensure the objectivity of our indicator of patent intensity, we did the same exercise over again using the data on 1990 applications and patents issued in 1989 and 1999, despite the somewhat limited number of observations for those variables. We also found that 70 percent of industries with a high relative propensity to patent [those ranked (1) using our relative patent intensity indicator] also fell into the same category for at least two of the three other indexes that we calculated.⁹ Textile, furniture and fixture industries ranked twice as having a high (1) relative propensity to patent, and also twice as having a moderate (2) propensity to patent. The only industry that ranked (1) for the number of patent applications per \$1 billion GDP in 1999, with the three other indicators giving it a moderately intensive (2) rank, was business services.

Patent-intensive Industries

As indicated earlier, by using the patent intensity index we were able to define a patent-intensive industry as one in which the number of patent applications is high in relation to the size of the industry. Table 1 in the preceding section identifies 10 Canadian industries that may be characterized as patent-intensive. For the rest of the study, we shall refer to this group of industries as the patent sector. Industries in this sector include business services and a number of manufacturing industries, including electrical and electronic products, refined petroleum and coal products, machinery, other manufacturing industries and chemical products.

Table 1 reveals also that the Canadian patent sector consists of a combination of industries that are well integrated in the knowledge-based economy, such as business services and electric and electronic products, and of more traditional ones, such as refined petroleum and coal products, furniture and fixtures, and machinery. While some high-technology industries are actively involved in patenting activity, Canada continues to innovate and patent in traditional fields. This observation, based on patenting activity by Canadian firms in Canada, can also be drawn from data on patenting activity by Canadian firms in the United States. Using highly detailed data on patents granted in the United States to Canadian inventors, Trajtenberg (2000) addresses the question of the technological composition of Canadian innovations.¹⁰ Whereas the main trends in patenting activity worldwide reflects the crucial technological developments of the last two decades — the share of computers and communications (C&C) patents in all U.S. patents doubled from 1979 to 1994, that of drugs and medical patents raised significantly, while that of electrical and electronics (E&E) patents increased slightly — the authors' assessment of the Canadian situation reveals that the share of C&C patents in Canada barely changed during this period, while that of E&E was much lower for Canada

than for the rest of the world. In addition, the shares of two of the three traditional categories (other patents, and mechanical patents) were high.

Analyzing the data at a more detailed level, Trajtenberg (2000) finds that Canadian inventors patent relatively much more than U.S. inventors in the following fields: transportation, and furniture and house fixtures. By contrast, Canadians patent much less than their U.S. counterparts in computer hardware and software, surgery and medical instrumentation, resins, and power systems.

Also of interest is that all of the industries that make up the patent sector were also identified by Nadeau (2000) as highly or moderately innovative. In that study, the author used factor analysis to construct an innovation index based on five sets of indicators, all connected with innovative activity in an industry (R&D expenditures, international R&D spillovers, patent-related activities, openness to international trade, and industry structure). The value of that index was calculated for 44 Canadian industries (using two- or three-digit SIC codes),¹¹ which allowed industries to be ranked in descending order from the most to the least innovative. All of the industries were then divided into three groups using cluster analysis based on whether they were highly, moderately or weakly innovative (groups 1, 2 and 3, respectively).

Four industries within the patent sector were identified by Nadeau (2000) as being highly innovative: electrical and electronic products, machinery, chemical products and other manufacturing industries (including scientific and professional equipment). The six other industries in the patent sector also seem to have high innovation performance in that they all fell within the group of moderately innovative industries (group 2). In fact, the transportation equipment, plastic products, and textile industries were at the top of group 2. Business services are also ranked relatively high on the innovation index.

Limitations of the Relative Patent Intensity Index

The preceding discussion inevitably leads to the question of estimating the bias introduced into our data by the methodology used to associate an industrial classification with firms in our database. To assess the representativeness of our sample, we did two separate verifications. First, we compared the average number of patent applications per firm in our original database to the figure for our sample. The average observed in our sample was slightly higher (2.8 applications per firm, compared to 2.3 applications per firm in the population),¹² indicating that a higher proportion of firms that made more than two patent applications was included in the sample. That phenomenon results from the fact that in assigning SIC codes, we paid particular attention to firms that had filed at least three applications in 1999.¹³ Accordingly, a majority of firms that could not be associated with an industrial classification were firms that had filed one or two patent applications in 1999. Consequently, our sample is biased

slightly upward, but we are of the opinion that the advantages gained by including a larger number of firms in our sample outweigh the disadvantages caused by introducing this bias.

Second, we had to verify whether the SIC codes assigned to the firms favoured certain industries at the expense of others. In other words, does the relative size of our sample industries reflect their relative contribution to innovation in the Canadian economy? In order to measure the relative contribution to innovation made by various industries, we used data on the number of firms performing R&D provided in Statistics Canada (2001). In fact, a degree of consensus emerged from the economic research devoted to the technological innovation process: there is a positive correlation between R&D and firms' innovative capacity. From that observation, the number of R&D performers is a good indication of the relative size of an industry in terms of innovation.

Therefore, to ascertain that our sample is representative, we compared the relative share of each of six sectors of the economy — these include all of the industries identified in Table 1 — out of the total of all firms identified in our sample, with the relative share of the number of R&D performers working in each sector out of the total of all R&D performers in the Canadian economy.

Table 2 shows that our sample of firms that applied for a patent in Canada in 1999 seems to be representative of the Canadian situation. While 45.3 percent of all firms that perform R&D belong to the manufacturing sector, that sector includes 46.6 percent of the firms in our sample that filed at least one patent application in 1999. We also observe that the relative size of the public services industry and of services industries in our sample is the same as in the Canadian economy. On the other hand, industries related to agriculture, fishing and forestry, and construction seem to be underrepresented in our sample, while the reverse seems to be true for mining and oil wells.

TABLE 2				
REPRESENTATIVENESS OF THE SAMPLE				
INDUSTRIES	FIRMS IN SAMPLE THAT APPLIED FOR A PATENT (NUMBER)	FIRMS IN SAMPLE THAT APPLIED FOR A PATENT (%)	R&D PERFORMERS (NUMBER)	R&D PERFORMERS (%)
Agriculture, Fishing and Forestry	9	1.3	230	3.2
Mining and Oil Wells	15	2.1	78	1.1
Manufacturing Industries	336	46.6	3,234	45.3
Construction	13	1.8	162	2.3
Public Services Industries	4	0.6	29	0.4
Services Industries	344	47.7	3,412	47.8
Total	721	100.0	7,145	100.0

ECONOMIC PROFILE OF THE CANADIAN PATENT SECTOR

WE USED THE RELATIVE PATENT INTENSITY INDEX constructed and described in the preceding section to identify the group of Canadian industries that uses the Canadian patent system relatively more intensively than other industries, correcting for size of industry, as measured by the value of their GDP. This section thus responds to the second objective of the study, which is to create an economic profile of the patent sector. First, we shall examine the contribution of that sector to overall Canadian production and to Canada's economic growth between 1992 and 2000. The second part of the section deals with its contribution to industrial employment in Canada. The third one focuses on patent sector productivity and its contribution to the overall productivity growth in Canada. Finally, we analyze the behaviour of the patent sector in terms of its openness to international trade.

GDP of the Patent Sector

In 2000, gross domestic production in the patent sector amounted to nearly \$147 billion, representing 16.6 percent of Canada's GDP; in 1992, it was \$73.7 billion, or only 12.2 percent of the Canadian economy. Industries that make up this sector have experienced strong economic growth over the last decade: they grew at a steady pace between 1992 and 2000, as evidenced by their 7 percent average annual rate of real growth, more than double the growth rate of the economy as a whole for the same period (3.4 percent). This sector also made a significant contribution to Canada's economic growth, at 36.5 percent.

Nonetheless, it should be noted that some industries deviated markedly from this pattern, even within the patent sector, as seen in Table 3, which shows the GDP of each of the industries that make up this sector. Accordingly, the exceptional performance exhibited by the patent sector over the period under consideration results from the strong economic growth of electrical and electronic products (12.2 percent), transportation equipment (8.5 percent), furniture and fixtures (11.3 percent), and business services (7.5 percent). It is also not surprising to find that the electrical and electronic products industry is at the top of this list of winners, given the strong growth experienced by high-technology industries over the last decade.

TABLE 3**GDP OF THE PATENT SECTOR**

PATENT SECTOR	GDP (\$MILLION) (2000)	AS A PERCENTAGE OF CANADIAN GDP (2000)	AVERAGE ANNUAL RATE OF REAL GROWTH (1992-2000)	CONTRIBUTION TO CANADA'S ECONOMIC GROWTH (1999-2000)
Electrical and Electronic Products	20,141	2.3	12.2	8.2
Refined Petroleum and Coal Products	1,235	0.1	1.5	0.1
Machinery	7,253	0.8	6.8	1.7
Other Manufacturing Industries	8,144	0.9	2.6	0.7
Plastic Products	4,652	0.5	6.9	1.1
Primary Textiles and Textile Products	3,053	0.3	3.5	0.4
Business Services	55,990	6.3	7.5	14.2
Furniture and Fixtures	4,358	0.5	11.3	1.7
Chemical Products	12,469	1.4	3.7	1.6
Transportation Equipment	29,663	3.4	8.5	8.5
Patent Sector	146,959	16.6	7.4	36.5

Employment in the Patent Sector

In terms of industrial employment, the patent sector is responsible for one fifth of all jobs in Canada (20 percent), or slightly more than 2.4 million people. Moreover, more than three quarters of those jobs are found primarily in the business services industry, as well as in the transportation equipment and other manufacturing industries, which have, generally speaking, grown at a rapid pace over the period studied.

Between 1992 and 2000, employment generated by the patent sector grew at an average annual rate of 4.5 percent, or nearly two and a half times the rate of total employment in Canada (1.85 percent). While that performance might be regarded as exceptional, a few disparities within the sector itself should be noted: some industries experienced much steadier employment growth than others, notably in business services (7.5 percent), plastic products (7.0 percent) and machinery (5.1 percent). As well, over the 1992-2000 period, the sector as a whole contributed to the creation of nearly half of all new industrial jobs in Canada. Table 4 presents figures on industrial employment for each industry.

TABLE 4**INDUSTRIAL JOBS IN THE PATENT SECTOR**

PATENT SECTOR	INDUSTRIAL JOBS (2000)	AS A PERCENTAGE OF TOTAL EMPLOYMENT IN CANADA (2000)	AVERAGE ANNUAL RATE OF GROWTH (1992-2000)	CONTRIBUTION TO EMPLOYMENT GROWTH IN CANADA (1992-2000)
Electrical and Electronic Products	139,656	1.2	2.0	1.2
Refined Petroleum and Coal Products	15,407	0.1	(1.5)	(0.1)
Machinery	95,717	0.8	5.1	2.1
Other Manufacturing Industries	662,695	5.5	2.4	7.0
Plastic Products	72,748	0.6	7.0	2.3
Primary Textiles and Textile Products	54,667	0.5	2.8	0.7
Business Services	957,409	7.9	7.5	32.1
Furniture and Fixtures	67,287	0.6	4.8	1.4
Chemical Products	95,680	0.8	1.3	0.6
Transportation Equipment	255,467	2.1	3.6	3.8
Patent Sector	2,416,733	20.0	4.5	48.3

Labour Productivity in the Patent Sector

Throughout the 1989-98 period, the patent sector experienced a relatively high labour productivity growth, at 1.53 percent, compared to the Canadian economy's labour productivity growth of 1.28 percent. As shown in Table 5, the patent intensive industries displayed varying productivity growth rates throughout the period, as the pace of technological change differs from one industry to the other. Overall, manufacturing industries included in the patent sector exhibited strong productivity performance. Industries such as refined petroleum and coal products, electrical and electronic products, as well as furniture and fixtures were among the leaders in terms of productivity gains. By contrast, other manufacturing industries and business services witnessed low or negative efficiency gains.

The relative contribution of productivity growth in patent intensive industries to overall aggregate productivity growth is also presented in Table 5 for the period 1989-98. The contribution to aggregate productivity growth is measured by weighting the productivity growth of each industry by its share of output. The patent sector contributed nearly one fifth of Canada's labour productivity growth, or 19.81 percent. Within the sector, electrical and electronic products made the most important contribution to aggregate productivity growth over the entire period (9.85 percent), followed by the transportation

TABLE 5**INDUSTRY LABOUR PRODUCTIVITY**

	LABOUR PRODUCTIVITY GROWTH (1989-98) (%)	PATENT SECTOR CONTRIBUTION TO CANADA'S LABOUR PRODUCTIVITY GROWTH (%)
PATENT SECTOR		
Electrical and Electronic Products	5.55	9.85
Refined Petroleum and Coal Products	5.71	0.62
Machinery	1.80	1.15
Other Manufacturing Industries	0.32	0.23
Plastic Products	1.35	0.55
Primary Textiles and Textile Products	3.66	0.97
Business Services	(1.05)	(5.18)
Furniture and Fixtures	5.20	2.00
Chemical Products	2.67	2.93
Transportation Equipment	2.56	6.69
Patent Sector	1.53	19.81

equipment industry (6.69 percent), though it should be noted that both industries account for quite large shares of value added. Other high productivity growth industries made less of an overall contribution to productivity growth simply because they are relatively smaller — namely refined petroleum and coal products, furniture and fixtures, and primary textiles and textile products.

Foreign Trade

In 2000, the value of total exports of goods and services in the patent sector was \$230 billion, while imports totalled \$271 billion. Although the balance of trade declined over the period, rising from an estimated deficit of \$28 billion in 1992 to a deficit of \$42 billion in 2000, growth was steadier for exports than for imports: exports grew at an average annual rate of 13.7 percent between 1992 and 2000, while the rate of growth of imports was only 11.8 percent.

The data relating to export intensity¹⁴ indicate that the patent sector is heavily oriented toward external markets as nearly 64.8 percent of manufacturing shipments from this sector were exported in 1998, compared to 54.2 percent for all goods produced in Canada. For services, the trade balance showed a slight surplus of \$511 million in 2000.

An analysis of trade flows originating in the patent sector also leads us to assess the value of trade with our principal trading partner, the United States. It reveals that the Canadian patent sector is very substantially integrated to the U.S. economy: 91 percent of exports went to the United States, while 66.2 percent of imports came from that country. Table 6 sets out the figures for international trade in the Canadian patent sector.

TABLE 6
INTERNATIONAL TRADE IN GOODS IN THE PATENT SECTOR

	EXPORTS (2000) (\$MILLION)	IMPORTS (2000) (\$MILLION)	BALANCE OF TRADE (2000) (\$MILLION)	EXPORT INTENSITY (1998) (AS A % OF MANUF. SHIPMENTS)
Goods, Total	218,882	260,879	(41,996)	64.77
Electrical and Electronic Products	42,093	64,651	(22,558)	75.10
Refined Petroleum and Coal Products	8,461	3,030	5,431	19.12
Machinery	16,034	33,972	(17,938)	67.95
Other Manufacturing Industries	11,838	28,764	(16,926)	53.82
Plastic Products	5,379	5,986	(607)	37.94
Primary Textiles and Textile Products	3,330	6,465	(3,135)	39.42
Furniture and Fixtures	6,937	2,734	4,203	80.65
Chemical Products	17,373	27,398	(10,025)	43.41
Transportation Equipment	107,439	87,879	19,560	82.58
Services, 1999				
Business Services	11,120	10,609	511	n.a.

INTEGRATION TO THE KNOWLEDGE-BASED ECONOMY

R&D Expenditures

BECAUSE OUR OBJECTIVE WAS NOT to review the abundant economic literature that has considered the connections between R&D and innovation, or between R&D and firms' patent-related activity, we simply point out that there is some consensus in the empirical research done in the field on the existence of a positive correlation between R&D expenditures and firms' inventive activity as measured by patents. Table 7 below shows figures on R&D expenses for each industry in the patent sector. An analysis of the data demonstrates the importance of R&D activities in the patent sector: it accounts for 78.7 percent of all expenditures on R&D in Canada, or nearly \$7.8 billion, the equivalent of 6 percent of the sector's GDP. In addition, those expenditures are concentrated in electrical and electronic products (35.1 percent), business services (16.7 percent), transportation equipment (12.7 percent) and chemical products (8.0 percent).

TABLE 7**R&D EXPENDITURES IN THE PATENT SECTOR**

PATENT SECTOR	R&D EXPENDITURE (\$MILLION) INTENTIONS (2000)	AS A PERCENTAGE OF TOTAL R&D EXPENDITURES (2000)	AVERAGE ANNUAL RATE OF GROWTH (1996-2000)
Electrical and Electronic Products	3,478	35.1	10.4
Refined Petroleum and Coal Products	66	0.7	(12.6)
Machinery	215	2.1	4.3
Other Manufacturing Industries	219	2.2	7.3
Plastic Products	30	0.3	(6.9)
Primary Textiles and Textile Products	67	0.7	3.7
Business Services	1,654	16.7	5.8
Furniture and Fixtures	6	0.1	(9.6)
Chemical Products	795	8.0	4.8
Transportation Equipment	1,258	12.7	7.4
Patent Sector	7,788	78.7	7.5

Source: Statistics Canada, 2001.

R&D Performers

The figures on the number of R&D performers, set out in Table 8, confirm the leading position of the patent sector in R&D activities in Canada. A majority of firms (61.1 percent) involved in these activities are operating in one of the industries of the patent sector. However, it must be noted that specific industries deviate significantly within that sector, as is apparent from the number of R&D performers in business services, electrical and electronic products, machinery, and other manufacturing industries.

TABLE 8**R&D PERFORMERS IN THE PATENT SECTOR, 1998**

PATENT SECTOR	NUMBER OF R&D PERFORMERS	AS A PERCENTAGE OF TOTAL R&D PERFORMERS
Electrical and Electronic Products	525	7.3
Refined Petroleum and Coal Products	21	0.3
Machinery	443	6.2
Other Manufacturing Industries	458	6.4
Plastic Products	148	2.1
Primary Textiles and Textile Products	27	0.4
Business Services	2,207	30.8
Furniture and Fixtures	61	0.9
Chemical Products	307	4.3
Transportation Equipment	184	2.6
Patent Sector	4,381	61.1

Personnel Assigned to R&D

In addition to R&D expenditures and the number of firms engaged in R&D activities, personnel assigned to R&D is a third variable that indicates the key role played by the patent sector in the knowledge-based economy. This sector accounts for more than three quarters of total R&D-related employment.

TABLE 9

PERSONNEL ENGAGED IN R&D IN THE PATENT SECTOR, 1998

PATENT SECTOR	PERSONNEL ENGAGED IN R&D (PERSON-YEARS)*	AS A PERCENTAGE OF TOTAL PERSONNEL ENGAGED IN R&D
Electrical and Electronic Products	22,972	30.0
Refined Petroleum and Coal Products	252	0.3
Machinery	2,137	2.8
Other Manufacturing Industries	2,521	3.3
Plastic Products	378	0.5
Primary Textiles and Textile Products	485	0.6
Business Services	17,480	22.9
Furniture and Fixtures	128	0.2
Chemical Products	4,050	5.3
Transportation Equipment	6,993	9.1
Patent Sector	57,396	75.0

Note: * Because R&D may be performed either by people who work only on that activity or by people who devote only part of their time to it, it is necessary to estimate the full-time equivalent of R&D performed by people who work only part-time on it, to determine total R&D effort in terms of person-years.

COPYRIGHT

THE EMERGENCE OF THE KNOWLEDGE-BASED economy has led to a considerable increase in the importance given to various types of IP. Copyright is no exception. As a result of the new technologies made available to creators and the general public, opportunities to create and disseminate copyrighted works have expanded greatly, thereby creating new challenges in enforcing copyright law. New technologies have also had the effect of considerably expanding the range of products and services protected by copyright, to incorporate new forms of production, manufacture and distribution. This evolution in technology not only transformed the business model used by firms, by introducing new ways of doing things, but also compelled the most traditional among them to redefine themselves in order to withstand increased competition from the new markets.

Economic activity associated with copyright is of primary importance because of the commercial potential of the goods and services protected by copyright. Nonetheless, few studies have explored the economic significance of copyright in Canada, or tried to identify industries associated with it. The scarcity of data related to copyright may also explain the lack of studies on this economic sector. Unlike patents, for example, which require registration, the protection afforded by the *Copyright Act* in Canada is acquired automatically, once an idea is fixed, without the need for a formal registration.

This section starts with a novel definition of copyright industries. It then identifies the industries whose production consists primarily of copyrighted goods and services, assesses the economic importance of this sector in Canada, and finally measures the extent to which these industries are integrated to the knowledge-based economy.

DEFINITION OF THE COPYRIGHT SECTOR

The Copyright Act

“COPYRIGHT, IN RELATION TO A WORK, means the sole right to produce or reproduce the work or any substantial part thereof in any material form whatever, to perform the work in public, if the work is unpublished, to publish the work or any substantial part thereof, and includes the sole right to produce or reproduce, perform or publish any translation or adaptation of the work, to make any sound recording and to communicate or present the work to the public.” (Mackaay and Gendreau, 2001). In Canada, copyright is granted under the *Copyright Act*, the purpose of which, like that of other IP legislation, is to encourage innovation and intellectual creativity, and facilitate the dissemination of the works that result from them.

The *Copyright Act* protects the original, fixed expression of an idea, for example the screenplay for a cinematographic work, an engineering plan or a sound recording. Any good or service protected by the Act is generally intangible in nature, since it represents the expression of an idea, despite the fact that it may have been fixed in a material form, such as paper, a CD-ROM, a diskette or another support. The Act protects artistic, dramatic, literary and musical works, as well as sound recordings, public performances and communication signals. Table 10 gives a brief list of the goods, services and activities protected by the *Copyright Act*. The Act also covers original compilations.

Goods and services protected by copyright have become more diverse with the advent of technological developments. As a result, new technologies on the market have transformed the ways in which information is produced and disseminated. In the context of copyright, the impact of these technologies has been both to intensify the phenomenon of digitalization of traditional works

TABLE 10
LIST OF WORKS AND ACTIVITIES PROTECTED BY THE COPYRIGHT ACT

TYPE OF WORK OR ACTIVITY	DESCRIPTION
Literary	Books, newspapers, tables, computer programs, brochures, poems and compilations of literary works
Artistic	Paintings, drawings, sculptures, architectural works, engravings or photographs, works of artistic craftsmanship, drawings, maps, charts, plans and compilations of artistic works
Musical	Any work of music or musical composition, with or without words, and any compilation thereof
Dramatic	Any piece for recitation, choreographic work or mime, the scenic arrangement or acting form of which is fixed in writing or otherwise, cinematographic works and compilations of dramatic works
Sound Recordings	Recording, fixed in any material form, consisting of sounds, whether a performance of a work
Performer's Performances	Performance of an artistic work, dramatic work or musical work; recitation or reading of a literary work, and an improvisation of a dramatic work, musical work or literary work, whether based on a pre-existing work
Communication Signals	Activity associated with the use of radio waves transmitted through space without any artificial guide, for reception by the public
Source: Mackaay and Gendreau, 2001.	

(e-books, MP3 files, DVDs) and to expand the volume of digital products protected by copyright that are distributed on the market. These products are still literary works (e-books, software), dramatic works (multimedia games, DVDs) and musical works (MP3 files) and are protected by copyright in Canada.

Copyright is normally granted to creators, while neighbouring rights are granted to the following groups of agents: makers of sound recordings, radio and television broadcasters, and performers. The Act gives these groups a protection similar to copyright, the subject-matter of that protection being the derivative products resulting from their initiatives. It is this set of economic rights, copyright and neighbouring rights, that is traded in return for payment on Canadian and foreign markets. Table 11 shows a list of economic rights granted to the owners of these rights under the *Copyright Act*. The Act also gives creators moral rights¹⁵ which, unlike the economic rights sold and transferred in exchange for income, may not be transferred. They belong to the creator, although the creator may waive them, if he/she wishes. Given that there is no pecuniary gain to be made from moral rights, except where a dispute

TABLE 11**LIST OF COPYRIGHT AND NEIGHBOURING RIGHTS CONFERRED BY THE COPYRIGHT ACT**

OWNERS	TYPE OF RIGHTS	DESCRIPTION
Authors and Creators	Copyright	▪ Right to reproduce, record and fix ▪ Right to perform in public ▪ Right to publish ▪ Right to translate ▪ Right to communicate ▪ Right to retransmit ▪ Right to communicate to the public ▪ Right to rent out ▪ Right to remuneration for reproduction of sound recording for private use
Exclusive Distributors	Copyright	▪ Exclusive right to import, for books
Broadcasters	Neighbouring rights	▪ Right to record ▪ Right to reproduce authorized recordings ▪ Right to rebroadcast ▪ Right to remuneration for pay TV performances
Sound Recording Makers	Neighbouring rights	▪ Right to publish ▪ Right to reproduce ▪ Right to rent out ▪ Right to remuneration for performance in public and communication to the public ▪ Right to remuneration for reproduction of sound recordings for private use
Performers	Neighbouring rights	▪ Right to communicate, for unfixed works ▪ Right to fix ▪ Right to reproduce ▪ Right to rent out ▪ Right to remuneration for reproduction of sound recordings for private use ▪ Right to remuneration for performance in public and communication to the public of published sound recordings ▪ Right residuals, for actors

Source: Mackaay and Gendreau, 2001.

arises, we shall not make any further reference to this type of rights, although it is important to note that they exists.

These various rights entitle their owners to receive royalties every time a commercial use is made of their works. For example, the author of a song may grant a performer a licence for his or her work to be communicated (right to communicate) and performed in public (right to give public performances).

An author may also sell his right to fix and reproduce his work to a maker of sound recordings, or the right to communicate to a broadcaster, the right to retransmit to a cable distributor, and the right to publish to a publisher. In addition, under the Canadian private copying regime,¹⁶ the author receives a royalty for the reproduction of a sound recording for personal use. Performers, radio and television broadcasters and makers of sound recordings are given neighbouring rights in their new derivative products, such as a musical adaptation or compact disk, for which they, in turn, may claim payment from various users.

Economic Activity Associated with Copyright

The economic activity associated with the existence of copyright results from the sale of copyrighted goods and services for consumption. It includes buying and selling the copyright and neighbouring rights that are needed for the commercialisation of copyrighted works. Copyright and neighbouring rights are generally purchased by specialized industries, at various stages of the production and commercialisation process, while copyrighted goods and services are generally bought and sold on the final consumer market. In the latter case, the purchaser does not own the copyright and is merely the owner of the merchandise intended for his or her personal consumption.

The supply of the economic rights conferred under the Act and of copyrighted products is generated by the firms and individuals who conceive and produce copyrighted works: they are the creators. They are the ones who permit other commercial entities to reproduce, publish or communicate their works, by selling them directly or by allowing them to be used under licences. To facilitate the transfer of various economic rights, there are a number of intermediary agents on the market, whose services are generally retained by creators to administer their rights and grant licences to use their works. Their functions may also be performed by the creator, by the firm owning the copyright, by a specialized firm or by collective societies.¹⁷

The demand for copyright and neighbouring rights comes from users: individuals and firms who need those rights in the course of their commercial activities. These users are generally found at the commercialisation and diffusion stages and must obtain appropriate permission to operate legally. Some of them are also major creators of protected works: for instance, radio and television stations produce programs broadcast over airwaves and purchase some copyrighted works from other industries, such as cultural industries. Other users in industries such as wholesale trade, distribution or public performances, must also purchase appropriate rights from creators in order to disseminate and distribute certain protected works. Movie houses, for instance, must purchase appropriate licences in order to communicate cinematographic works to

the public; other examples are licensed distributors of computer software programs or literary works.

We also note that the protected products are generally intended for consumers. To reach them, there are, in addition to firms that use economic rights, other major industries in the commercialisation and distribution process for copyrighted works that are not required to purchase rights. These include manufacturing and printing industries and some specialized retailers. The latter are closely associated with industries that create these works and are dependent on the protection afforded by the *Copyright Act*.

The Copyright Sector

We noted earlier that the rights conferred by the Act may be obtained and traded at various stages of the production and commercialisation process. We also described the close business relationships between creators and other firms that do not create works but constitute links in the distribution chain. For these reasons, we believe that the set of industries associated with copyright cannot be limited merely to those that create the works. This means that the copyright sector should include all the industries involved in the creation, production, reproduction, distribution and sale of works protected under the *Copyright Act*. To distinguish industries that create the works from other industries, the sector will be divided into two sub-groups: the principal industries, which create works, and the peripheral industries, which are involved in the commercialisation of copyrighted works regardless of whether they purchase economic rights.

Principal Industries

The principal industries create, conceive, produce and publish the works that make their way to the goods and services market. Firms engaged in activities related to creation, such as post-production activities for cinematographic works, are also included. Principal industries represent the core activity of innovation and intellectual creativity. The *Copyright Act* protects their products, whose conception and development require considerable investment in intellectual capital and time. The promotion and sale of their copyrighted products are their primary commercial activities; consequently, their income and their capacity to properly protect their intellectual capital are directly related to the existence of the *Copyright Act* and the enforcement of the Act. Principal industries are engaged in the various creative activities described in Table 12.

TABLE 12		
LIST OF PRINCIPAL ACTIVITIES AND INDUSTRIES		
TYPE OF WORK	ACTIVITY	INDUSTRY
Literary	▪ Creation and publication of newspapers, periodicals, books, collections of texts and other literary works ▪ Creation and publication of software and computer programs ▪ Creation and publication of original databases	▪ Newspaper, periodical, book and data base publishing industry ▪ Software publishing industry ▪ Computer system design industry and related services ▪ Advertising and related services ▪ Independent artists, authors and performers
Artistic	▪ Creation and publication of architectural and engineering plans ▪ Creation and publication of models, maps, graphics, photos ▪ Creation of objets d'art, sculptures, paintings and other artistic works	▪ Industries specializing in design and graphics ▪ Architecture, engineering and related services ▪ Photographic services ▪ Craftspeople and arts and crafts ▪ Independent artists, authors and performers ▪ Advertising and related services
Musical	▪ Creation and publication of musical works	▪ Musical groups and musicians ▪ Independent artists, authors and performers
Dramatic	▪ Creation and publication of motion pictures and videos ▪ Creation and scenic arrangement of theatrical plays or other dramatic productions	▪ Motion picture and video industries ▪ Performing arts industry (theatres, dance, opera, musical comedy) ▪ Advertising and related services ▪ Independent artists, authors and performers
Sound Recordings	▪ Making of sound recordings	▪ Sound recording industries ▪ Independent artists, authors and performers
Performer's Performances	▪ Production of performances, plays, dance performances, festivals ▪ Improvisations, readings of literary works and other artistic, literary or musical performances	▪ Performing arts industry ▪ Independent artists, authors and performers
Communication Signals	▪ Television broadcasting services ▪ Radio broadcasting services	▪ Radio and television broadcasting industry

Based on that description, we note that an industry may produce different types of works. This is the case, for instance, of advertising agencies, which express their ideas in the form of models or sketches (artistic works) or scripts (literary works) before producing the final good, which may be a brochure (literary work) or a commercial (dramatic work). It is also important to note that

the principal activities described encompass more than the cultural activities that we generally associate with copyright. For example, in addition to cultural goods and services, we find a range of products generated by business services firms or information technology firms, such as architectural or engineering plans and models, computer programs and multimedia activities.

Peripheral Industries

By definition, peripheral industries include the economic industries engaged in the reproduction, distribution and sale of copyrighted goods and services. Most commonly, those industries are involved at the point when the copyrighted works are commercialized and distributed. Some are users of copyrighted products, while others are involved in marketing activities, in conjunction with industries that created the products. For the most part, their commercial roles make it possible for the products to be delivered to the ultimate consumer. A number of copyrighted products are sold on very competitive markets and would have no success without the operational input of other firms or individuals who specialize in promotion, distribution and sales. In order to reflect such circumstances, these activities are included in the peripheral industries group. Digital distribution, introduced by technological innovation, is also included in this category.¹⁸ Table 13 provides a list of activities peripheral to copyright from which the associated industries may be identified.

TABLE 13		
LIST OF PERIPHERAL ACTIVITIES AND INDUSTRIES		
TYPE OF WORK	ACTIVITY	INDUSTRY
Literary	▪ Printing services	▪ Printing and allied support activities
	▪ Binding services	▪ Information services industries (press agencies, libraries, archives)
	▪ Wholesale trade	▪ Book, periodical and newspaper wholesalers-distributors
	▪ Retail trade	▪ Book and periodical stores
	▪ Retransmission services	▪ Telecommunications industry
	▪ Promotional activities	▪ Entertainment agencies and artists
Artistic	▪ Reproduction services	▪ Art dealers
	▪ Exhibition services	▪ Telecommunications industry
	▪ Wholesale trade	▪ Entertainment agencies and artists
	▪ Retail trade	
	▪ Retransmission services	
	▪ Promotional activities	

TABLE 13 (CONT'D)**LIST OF PERIPHERAL ACTIVITIES AND INDUSTRIES**

Musical	▪ See Sound recordings ...	▪ See Sound recordings ...
Dramatic	▪ Services for public distribution and performance ▪ Wholesale trade (distribution) ▪ Retail trade ▪ Retransmission services ▪ Promotional activities	▪ Motion picture and video distribution industry ▪ Motion picture and video exhibition industry ▪ Videocassette wholesalers ▪ Pre-recorded tape, compact disk and record stores ▪ Entertainment agencies and artists ▪ Television broadcasting industry ▪ Cable distribution industry and other television broadcast distribution activities ▪ Telecommunications industry
Sound Recordings	▪ Wholesale trade ▪ Broadcasting services ▪ Retail trade ▪ Retransmission services ▪ Promotional activities	▪ Sound recording wholesalers ▪ Record and tape stores ▪ Entertainment agencies and artists ▪ Television broadcasting industry ▪ Cable distribution industry and other television broadcast distribution activities ▪ Radio broadcasting industry ▪ Telecommunications industry
Performer's Performances	▪ Distribution services ▪ Promotional activities ▪ Retransmission services	▪ Entertainment agencies and artists
Communication Signals	▪ Cable distribution services ▪ Retransmission services ▪ Promotional activities	▪ Cable distribution industry and other television broadcast distribution activities ▪ Telecommunications industry

ECONOMIC PROFILE OF INDUSTRIES ASSOCIATED WITH COPYRIGHT IN CANADA

THE ROLE PLAYED BY COPYRIGHT in the Canadian economy takes on special importance because it involves a number of services industries that are at the very heart of the knowledge-based economy. Copyright is traditionally regarded as a tool most suited to the cultural sector. But as we saw earlier, the Canadian *Copyright Act* offers protection that extends to a number of other sectors of the economy. In fact, were it not for that protection, some firms would be unable to obtain adequate return on the investment in intellectual capital required for creating and distributing their products, or to obtain the full economic value of these products on the market. In the following sections, we examine the importance of the copyright sector in the Canadian economy using data on production, employment and foreign trade.

GDP of the Copyright Sector

The GDP of the copyright sector reached \$65.9 billion in 2000, or nearly 7.4 percent of Canada's GDP. The figure was \$35.2 billion in 1992, which means that production in this sector has risen substantially in recent years. Today, the copyright sector is an important sectoral component of Canada's economy whose production compares to that of the retail trade or wholesale trade industries. Production in the copyright sector is also higher than in other key Canadian industries such as forestry, agriculture and construction.

In addition, the sector shows markedly higher real growth than the rest of the Canadian economy. Between 1992 and 2000, this sector grew at an average real rate of 6.6 percent per year, which is higher than that of the Canadian economy as a whole (3.4 percent). Copyright sector growth also surpassed the growth of a number of other sectoral groups such as financial intermediaries and manufacturing. Over the same period, industries associated with copyright contributed 14.6 percent of Canada's economic growth, making this sector an important source of the country's economic growth. Table 14 shows the economic performance of the copyright sector for the period 1992-2000 alongside that of other sectoral groups.

TABLE 14				
GDP BY SELECTED SECTORAL GROUP				
SELECTED SECTORAL GROUP	GDP (2000) (\$BILLION)	AVERAGE ANNUAL RATE OF REAL GROWTH (1992-2000) (%)	GDP OF SECTOR RELATIVE TO CANADIAN GDP (2000) (%)	CONTRIBUTION TO CANADA'S GROWTH (1992-2000) (%)
Manufacturing Industries	151.7	5.5	17.1	28.0
Financial Intermediaries and Insurance Industries	142.5	3.3	16.1	15.8
Copyright Industries	65.9	6.6	7.4	14.6
Retail Trade Industries	53.8	4.5	6.1	8.1
Wholesale Trade Industries	56.1	6.3	6.3	11.8
Health and Social Services Industries	52.3	-0.2	5.9	-0.3

Principal Industries

The principal industries make up 65 percent of the copyright sector (Table 15). In 2000, the principal industries' share of Canada's GDP was 4.8 percent, or \$42.8 billion. These industries, which encompass firms that create copyrighted works, cut across the various sectors of the Canadian economy and account for a significant portion of knowledge-based industries.

TABLE 15
GDP OF THE COPYRIGHT SECTOR

COPYRIGHT SECTOR	GDP (2000) (\$BILLION)	AVERAGE ANNUAL RATE OF REAL GROWTH (1992-2000) (%)	AS A PERCENTAGE OF GDP OF COPYRIGHT SECTOR (2000) (%)
Principal Industries	42.77	8.0	64.9
Creation	2.69	6.6	4.1
Publishing Industry and Combined Printing and Publishing Industries	4.43	0.7	6.7
Sound Recording Production	0.18	6.6	0.3
Production and Distribution of Motion Pictures and Audiovisual Materials	1.95	9.7	3.0
Telecommunication Broadcasting Industry	3.00	2.4	4.6
Artistic Production	1.37	6.6	2.1
Business Services			
Computer Services and Related Services	14.94	18.4	22.7
Architecture and Engineering Services and Other Scientific and Technical Services	11.73	5.8	17.8
Advertising Services	2.48	4.3	3.8
Peripheral Industries	23.17	4.9	35.1
Reproduction Activities	5.17	(0.1)	7.8
Retail Sales Activities	3.94	6.2	6.0
Wholesale Sales Activities	0.72	6.6	1.1
Telecommunication/Dissemination Activities	13.34	6.0	20.2
Total	65.94	6.6	100.0

This group of industries includes two key sub-sectors: cultural industries and business services. Value added by those sub-sectors in 2000 amounted to \$14.6 billion and \$29.1 billion, respectively. Business services¹⁹ surpassed the cultural industries,²⁰ with higher average annual real growth over the period 1992-2000: 10.5 percent as compared to 3.7 percent for the cultural industries. The significant growth of business services is largely explained by the rapid growth of computer services, which registered an average annual growth rate of 18.4 percent over the period studied. In the cultural industries, the motion picture and video production and distribution industry had one of the best performances, with an average real growth rate of 9.7 percent per year.

Peripheral Industries

The peripheral industries, which are made up of firms engaged in the reproduction, distribution, dissemination and sale of copyright goods and services, account for the remainder of commercial production in the copyright sector. Their production amounts to \$23.2 billion, 35.1 percent of the value added of the sector (Table 15). This group had an average rate of real growth of 4.9 percent per year, which is higher than the rate of the Canadian economy. A significant proportion of that production was generated by industries associated with communication (cable distribution and telecommunication services), which account for 57.6 percent of the peripheral industries' value added. The peripheral activities associated with the wholesale and retail trades are underestimated, because of the difficulty of obtaining detailed statistical data for these activities.²¹ In 2000, the value added in the wholesale and retail trade involving copyright products was estimated at \$4.7 billion, or 7.1 percent of the GDP in the copyright sector. Reproduction activities totalled \$5.2 billion, or 7.8 percent of the GDP in the copyright sector.

Employment in the Copyright Sector

The Canadian work force employed in the copyright sector is composed of industrial employees and self-employed workers. In 1999, the sector employed 5.7 percent of the industrial work force, about 663,000 jobs,²² and 10.6 percent of the self-employed work force, or 260,200 jobs. During the period 1992-99, total employment generated by the copyright sector grew at an average rate of 5.3 percent per year, three times more rapidly than employment in the Canadian economy (1.4 percent). The sector's contribution to job creation in Canada was significant, in that it provided 15.2 percent of the new industrial jobs and 24.7 percent of self-employment during the period in question. Table 16 sets out the figures relating to the work force in the copyright sector.

TABLE 16			
EMPLOYMENT IN THE COPYRIGHT SECTOR, 1999			
	INDUSTRIAL JOBS	SELF- EMPLOYMENT	TOTAL WORK FORCE
Level of Employment	663,172	260,200	923,372
As a Percentage of Total Employment in Canada	5.7	10.6	6.5
Average Annual Rate of Growth (1992-99)	4.3	8.5	4.5
Contribution to Employment Growth in Canada (1992-99)	15.2	24.8	20.9

Industrial Employment

Industrial jobs in the copyright sector are primarily concentrated in business services, which represent 43.8 percent of the sector's industrial employment. Employment in business services grew at an average rate of 10.0 percent per year, while in the other copyright sector industries — cultural industries and peripheral industries — the average annual rate of growth was 1.1 percent. The performance of business services also surpassed that of the Canadian economy as a whole, where industrial employment grew at a rate of 1.6 percent per year. Of all of the industries associated with copyright, computer services, architectural, engineering and related services, and radio and television broadcasting accounted for the largest share. These three groups of industries represented 20.7 percent, 23.1 percent and 15.4 percent, respectively, for a total of 59.2 percent of industrial employment in the copyright sector.

TABLE 17**INDUSTRIAL JOBS IN THE COPYRIGHT SECTOR**

	INDUSTRIAL JOBS (1999)	AVERAGE ANNUAL RATE OF GROWTH (1992-2000)	AS A PERCENT. OF TOTAL INDUSTRIAL JOBS IN CANADA (1999)	CONTRIBUTION TO GROWTH OF CANADIAN INDUSTRIAL EMPLOYMENT (1992-2000)
Literary Works				
Book Publishing Industry	31,381	1.62	0.27	0.27
Newspaper, Magazine and Periodical Industry	31,276	(2.45)	0.27	(0.41)
Computer and Related Services	137,587	13.93	1.18	10.25
Communication Signals				
Television and Radio Broadcasting Services	102,387	(2.13)	0.88	(1.17)
Artistic and Dramatic Works				
Advertising Services	44,926	6.37	0.38	1.53
Architecture and Engineering Services and Other Scientific and Technical Services	152,900	7.24	1.31	5.92
Motion Picture and Video Production and Distribution	23,844	6.95	0.20	0.89
Theatres and Other Shows	13,910	3.68	0.12	0.27
Photographers	5,947	6.52	0.05	0.21
Peripheral Activities				
Motion Picture Projection	10,685	3.21	0.09	0.18
Telecommunication Services	20,672	0.27	0.17	0.06
Commercial Printing Industry	70,282	2.38	0.60	0.90
Plate-making, Typesetting and Bindery Industry	17,375	2.98	0.15	0.28
Copyright Sector	663,172	4.28	5.68	15.19

TABLE 18
SELF-EMPLOYMENT IN THE COPYRIGHT SECTOR

	SELF-EMPLOYED (1999)	AVERAGE ANNUAL RATE OF GROWTH (1992-99)
All Industries	2,462,900	3.63
Architectural, Engineering and Design Services	72,200	6.01
Computer System Design Services	65,600	21.38
Advertising and Related Services	19,700	4.37
Other Professional Services	24,100	7.42
Information, Culture and Recreation		
Publishing	5,400	(5.12)
Motion Picture and Sound Recording Industries	12,500	16.09
Radio, Television and Telecommunications	3,200	0.45
Information Services and Data Processing Services	3,200	1.42
Performing Arts, Spectator Sports and Related Activities	54,300	6.61
Copyright Sector, Total	260,200	8.49

Self-employment

In 1999, the Canadian copyright sector accounted for 10.6 percent of self-employed workers, compared to 7.6 percent in 1992. These workers were primarily in two sub-sectors: information, culture and recreation industries, and business services. A total of 260,200 persons, or 28 percent of the total work force associated with the copyright sector, were in this group. Of that total, 30.2 percent worked in the information, culture and recreation industries. Business services accounted for 181,600 workers, or 69.8 percent of that total. The average annual rates of growth in these sub-sectors were 6.0 percent and 9.8 percent, respectively, over the period 1992-99. By way of comparison, we note that the annual rate of growth of self-employment in all Canadian industries was 3.6 percent over that period.

Labour Productivity in the Copyright Sector

The copyright sector's contribution to Canada's labour productivity growth was valued at 3.67 percent for the 1989-98 period. Despite the limited impact on Canada's productivity growth as a whole, some copyright related industries were highly productive, thus efficient, during that time. Among the most productive were the telecommunication broadcasting, telecommunication carriers and wholesale trade industries, which posted annual growth rates of labour productivity of 2.28 percent, 2.86 percent and 2.53 percent, respectively, double the national rate. Lower or negative compounded growth rates of labour productivity were observed in the printing and publishing industries and some

TABLE 19**LABOUR PRODUCTIVITY GROWTH IN THE COPYRIGHT SECTOR**

COPYRIGHT SECTOR	LABOUR PRODUCTIVITY GROWTH (1989-98) (%)	CONTRIBUTION OF COPYRIGHT SECTOR TO CANADA'S LABOUR PRODUCTIVITY GROWTH (%)
Commercial Printing Industries	(3.26)	(0.89)
Plate-making, Typesetting and Bindery	(0.80)	(0.03)
Publishing Industries	(1.15)	(0.24)
Combined Printing and Publishing	(1.25)	(0.23)
Sign and Display Industries	(0.63)	(0.02)
Telecommunication Broadcasting	2.29	0.88
Telecommunication Carriers	2.86	3.02
Wholesale Trade	2.53	0.16
Retail Trade	1.58	0.52
Computer and Related Services	0.68	0.90
Advertising Services	(4.22)	(0.92)
Architecture, Engineering and Scientific Services	0.43	0.44
Motion Picture, Audio and Video Production	0.29	0.05
Motion Picture Exhibition	2.05	0.04
Copyright Sector, Total	0.71	3.67

business services. Table 19 shows labour productivity figures in the copyright sector over the 1989-98 period.

Foreign Trade

On the international scene, Canada is a net importer of copyrighted goods and services. In 1999, exports in the copyright sector amounted to \$8.9 billion, while imports reached \$9.7 billion. The trade deficit in the copyright sector came to \$761 million, compared to \$1.2 billion in 1992. This suggests a slight improvement in the copyright sector balance of trade in recent years. The deficit is primarily attributable to trade in goods, where the shortfall was \$2.9 billion, which was partially offset by a \$2.2 billion surplus in business services.

Exports of copyrighted goods and services grew at a faster rate than imports: 16.0 percent compared to 12.1 percent. Nonetheless, production in the copyright sector continues to be directed primarily at the domestic market. The popularity of American culture and the proximity of the Canadian and U.S. markets are some of the reasons that explain the United States' position as Canada's dominant trading partner. We note that the Canadian copyright sector depends heavily on the United States in its international trade, with nearly 53.9 percent of business services and 91.7 percent of copyrighted goods exported going to the U.S. market. As well, the majority of goods (84.1 percent) and services (77.3 percent) imported come from the United States.

TABLE 20
FOREIGN TRADE IN THE COPYRIGHT SECTOR, 1999

	EXPORTS (\$BILLION)	IMPORTS (\$BILLION)	BALANCE OF TRADE (\$BILLION)
Trade			
Goods	2.395	5.366	(2.970)
Services	6.552	4.343	2.209
Total	8.948	9.709	(0.761)
As a Percentage of the Copyright Sector's GDP (1999)	15.0	16.4	
Average Annual Rate of Growth, 1992-99			
Goods	20.7	12.6	n.a.
Services	14.6	11.4	n.a.
Total	16.0	12.1	n.a.

INTEGRATION OF THE COPYRIGHT SECTOR TO THE KNOWLEDGE-BASED ECONOMY

THE MODERN ECONOMY IS CHARACTERIZED by the growing significance of new technologies as inputs, a high demand for skilled labour, and rapid development in the intensely knowledge-based services (OECD, 1996). These factors have a direct influence on the capacity of national economies to increase their productivity and competitiveness, the determining factors of economic growth. In Canada, the similar structural changes are observed in the economy. Canadian industries are increasingly knowledge- and new technology-intensive, and the manufacturing and services sectors are more innovative than before. That trend, apparent in the increased use of both technologies and skilled labour, is a determining factor in preserving Canada's competitive advantage and improving its productivity (Gera, Gu and Lee, 1998). These characteristics associated with innovative sectors of the Canadian economy are also present in the copyright sector. They are easily seen in the more technological sub-sectors of copyright, such as computer services and communications, but they are also found in the more traditional industries such as the cultural industries.

Preponderance of Services in the Copyright Sector

The copyright sector consists of a number of knowledge-intensive services industries, such as business services and the cultural industries. In 2000, copyright-related services industries accounted for 85.5 percent of the sector's value added, or \$56.3 billion. This group of industries also grew significantly during the period 1992-2000, at an annual rate of 9.7 percent, surpassing the average annual rate of growth of services industries in Canada, which was 3.6 percent.

TABLE 21
INDICATORS OF KNOWLEDGE IN THE COPYRIGHT SECTOR, 2000

INDICATORS OF KNOWLEDGE	COPYRIGHT SECTOR	CANADIAN ECONOMY AS A WHOLE
Proportion of Services Industries (%)	86.0	67.3
R&D Expenditures (\$Billion)	1.7	9.9
Capital Expenditures as a Percentage of the Copyright Sector's GDP	17.7	23.1
R&D Expenditures as a Percentage of the GDP of R&D-performing Industries in the Copyright Sector	8.2	1.1
M&E Expenditures as a Percentage of Capital Expenditures	72.1	43.7
Knowledge Workers	415,100	1,989,400
Creators	404,200	1,047,300

In fact, copyright affects a significant portion of the production in sectors of the Canadian economy that have experienced strong growth. In 2000, nearly a third (29.3 percent) of the production of information technology industries was directly protected by copyright. That includes the production of the computer services and cable distribution industries, which have a key role in the copyright sector. Similarly, nearly 53 percent of the production of business services was directly protected by copyright. These include computer services, advertising services, architecture and engineering, and other related services.

Importance of New Technologies in the Copyright Sector

There are two aspects to the importance of new technologies in the copyright sector: the participation of copyright industries in creating new technologies, and the use of these technologies by the copyright sector. The creation of new technologies is, however, concentrated in a few copyright industries. In 2000, R&D activities accounted for nearly 8.2 percent of GDP of copyright sector industries that perform R&D (\$1.7 billion). However, we note that such expenditures are primarily concentrated in three industries: computer services, engineering and scientific services, and communications. Despite the unequal distribution of R&D expenditures in the sector, they were higher as a proportion of sector value added (2.5 percent) than in the economy (1.1 percent).

Fixed asset expenditures in the copyright sector [construction and purchase of machinery and equipment (M&E)] totalled \$10.5 billion in 1999, or 17.7 percent of the sector's GDP. For comparative purposes, capital expenditures in all industries amounted to 23.1 percent of Canada's GDP. M&E expenditures as a proportion of total capital expenditures were 72.1 percent for the copyright sector, compared to 43.7 percent for the economy as a whole.

This indicator, which can be used to estimate the level of adoption, use and integration of new technologies in a sector, suggests their widespread use in the copyright sector.

Demand for Skilled Workers in the Copyright Sector

The copyright sector is one of the largest employers of skilled labour in Canada. In 1999, it employed 21 percent of Canada's knowledge-based labour,²³ or twice as many workers as in 1992. Both cultural industries and business services benefited from this skilled work force. Creators of copyrighted products are well represented in it. In 1999, 404,200 creators were working in the Canadian copyright sector: architects, engineers, technicians, publicists, computer scientists, graphic artists, writers, translators and professionals in arts and culture. Other Canadian industries, such as education, manufacturing and other business services, provided work to 643,100 other creators of works. For these professionals, the copyright sector was one of the most important employers in Canada, with an average annual growth rate of 11.5 percent.

The copyright sector is relatively well integrated to the knowledge-based economy; it is involved in creating new technologies and in distributing them on the market. However, creation of new technologies is still concentrated in business services. What distinguishes the copyright sector from the rest of the economy is the predominant role played in it by knowledge-intensive services and the skill level of its work force. To summarize, the copyright sector is an active participant in the new knowledge-based economy.

TRADE-MARKS

IN CANADA, TRADE-MARK PROTECTION is conferred by the *Trade-marks Act*. The Act requires registration with CIPO. It provides legal protection for various types of marks, including trade-marks, certification marks,²⁴ distinguishing guises,²⁵ geographic indications²⁶ and official marks.²⁷

Like other types of IP, trade-marks are by nature intangible. Their purpose is to protect the distinctive elements and reputation of a product on the market. Firms must invest in establishing and maintaining their reputation and the image of their products on the market. Marketing expenditures are regarded as an investment by the firm in establishing a product's image. But generally, it is the total resources that a firm devotes to establishing and maintaining good relations with its customers or suppliers, or to establishing a reputation for reliability in after-sale service, that represents the investment in a trade-mark. If there were no right of ownership, competitors would easily be able to appropriate that reputation. Accordingly, trade-marks establish the ownership rights

that firms may use to ensure that they will receive a fair return on their investment.

Trade-marks benefit two groups of economic agents: consumers and trade-mark owners. To consumers, a trade-mark conveys information regarding the source and quality of a product, so that they can avoid putting costly resources into looking for information. While they derive no pecuniary benefit from trade-marks, the latter have a considerable influence on individuals' consumption behaviour and provide them with economic benefits (Landes and Posner, 1987).

To the firm, a trade-mark may mean that it is able to differentiate its goods and services from others on the market, and to protect the investment it has made in developing new products or improving existing products. If no protection were available, the investment made in promotional activities and in R&D would be jeopardized by other, less innovative firms stealing the limelight. Those firms would be able to take advantage of a competing product's good name by marketing their products under the recognized mark of the innovating firm. In that case, the innovative firm would be unable to earn any return on its investment or to preserve its commercial reputation on the market (Posner and Lander, 1987). Differentiating between products by using a trade-mark allows the firm that owns the trade-mark to charge what is often a higher price than that charged by manufacturers of similar products. Accordingly, the firm is able to recover the costs of activities associated with this kind of strategy, such as market analyzes, quality standard development and advertising (Allegrezza and Guard-Rauchs, 1999).

Trade-marks allow for product differentiation, something that may be essential in a very competitive market to ensure that market share is preserved. Final consumption sectors often have such characteristics, and it may be expected that these industries will make intensive use of this particular IP right. This is what we examine in the following sections.

DEFINITION OF THE TRADE-MARK SECTOR

TRADE-MARK-INTENSIVE INDUSTRIES are defined as industries that make the relatively greatest use of this type of IP in their commercial activities. In theory, identifying these industries would require that existing Canadian trade-marks be classified by industry. In practice, this approach — analyzing the inventory of active registered trade-marks in Canada — is difficult, given that there is no direct concordance between the industrial classifications suggested by the Trade-marks Office and the ones used by Statistics Canada. As well, Canada is not a signatory to the Madrid Protocol, and so CIPO does not adhere strictly to the international industrial classification suggested by that agreement.²⁸

For the purposes of our study, the approach selected for identifying trade-mark-intensive industries was to develop an index of relative trade-mark intensity. That index was constructed using information obtained about the number of trade-mark registrations with CIPO and about advertising and marketing expenditures. This enabled us to classify Canadian industries according to their propensity to use trade-marks as a protective measure. The group of Canadian industries that are most sensitive to the protection afforded by the *Trade-marks Act* could then be identified. The study presents an index of relative trade-mark intensity, and proposes a definition of the trade-mark-intensive sector as a whole. It also creates an economic profile of this sector and assesses the extent to which it is integrated to the knowledge-based economy.

INDEX OF RELATIVE TRADE-MARK INTENSITY

THE NUMBER OF TRADE-MARKS THAT A FIRM owns may be influenced by its diversification strategy, its size and its IP strategy. The index of relative trade-mark intensity may be defined simply as the number of trade-marks the firm owns, corrected for firm size. However, we were unable to obtain data on the total number of trade-marks owned by firms. Data were available on registrations for only one year. An index based on one year is not reliable, because it is heavily influenced by the cyclical movements of industries. To remedy this problem, we used a two-dimensional indicator: the industries' relative propensity to register trade-marks and the relative propensity to make advertising and marketing expenditures. Advertising and marketing expenditures are made by firms to establish and preserve their reputation on the market. They reflect the past and present strategic choices made by firms. For the purposes of this study, we make the hypothesis that those expenditures are sufficiently closely linked to the total number of trade-marks owned by a firm to be a good approximation of the latter figure. The index that we use is thus made of two indicators: trade-mark registrations for one year, and advertising expenditures which, to some extent, corrects for the cyclical movements in the first variable.

Number of Trade-mark Registrations

The first indicator in the relative trade-mark intensity index is the number of trade-mark registrations per dollar of GDP. It reflects the importance of trade-mark registrations to an industry, that is, the relative propensity to register trade-marks. It was constructed using the information in CIPO's trade-marks data base. That indicator considers new trade-marks registered by Canadian companies for three reference years: 1979, 1989 and 1999. To calculate the index, each trade-mark was associated with an industry using the 1980 Standard Industrial Classification (SIC). This matching process, carried out using the Statistics Canada business register, made it possible to code more

than half of the new trade-marks registered in 1979, 1989 and 1999. Nearly 66 percent of the trade-marks were assigned an appropriate SIC code for 1999, against 44 percent for 1989, and 54 percent for 1979. Once again, incorrect or missing addresses, changes in firms' names, and closings and mergers were some of the reasons why some trade-marks could not be coded.

The number of registrations per industry thus obtained was divided by the value added (GDP) of the industry to reflect its size. Industries were then ranked in descending order and separated into three equal groups, identified in Table 22, to represent levels of intensity: low (3), moderate (2) and high (1).

TABLE 22				
RELATIVE PROPENSITY TO REGISTER TRADE-MARKS, 1979, 1989 AND 1999 (NUMBER OF TRADE-MARK REGISTRATIONS PER \$BILLION GDP)				
	1999	1989	1979	GROUP
Leather and Allied Products	55.35	15.36	2.79	1
Other Manufacturing Industries	38.16	37.80	5.12	1
Financial Intermediaries	36.23	29.01		1
Tobacco Products	32.53	12.08	4.72	1
Clothing	26.91	38.68	4.10	1
Refined Petroleum and Coal Products	25.90	59.31	19.35	1
Food	24.56	25.88	8.50	1
Beverage	22.93	17.04	4.89	1
Chemical Products	18.49	26.23	10.69	1
Associations	17.67			1
Textile Products	16.28	28.72	7.76	1
Insurance	15.73	8.95	2.93	1
Wholesale Trade	15.20	19.09	7.96	1
Furniture and Fixtures	14.88	10.97	2.56	1
Business Services	14.79	9.83	2.19	1
Amusement and Recreation Services	14.06	7.59	1.44	1
Printing, Publishing and Allied Industries	13.37	10.65	1.28	1
Farm Services	13.12	15.54		1
Insurance and Real Estate Agencies	10.45	6.66		2
Plastic Products	10.03	12.86	7.84	2
Financial Intermediaries and Insurance	9.73	6.05		2
Storage and Warehousing	9.16	4.23	1.51	2
Non-metal Mineral Products	8.84	4.89	1.12	2
Retail Trade	7.96	8.83	2.07	2
Electrical and Electronic Products	7.89	11.75	2.65	2
Personal and Household Services	7.87	3.71	0.19	2
Food Services	7.76	5.73		2
Primary Textiles	7.57	8.96	0.89	2
Machinery	7.45	5.58	1.57	2
Other Services Industries	6.03			2
Wood	5.99	3.70	2.37	2

TABLE 22 (CONT'D)**RELATIVE PROPENSITY TO REGISTER TRADE-MARKS, 1979, 1989 AND 1999
(NUMBER OF TRADE-MARK REGISTRATIONS PER \$BILLION GDP)**

	1999	1989	1979	GROUP
Metal Products	5.70	4.48	2.03	2
Paper and Allied Products	4.88	5.64	0.52	2
Sand and Gravel Pits	4.10	0.00	3.08	2
Communications	3.91	2.31	0.51	2
Accommodation	3.06	3.94		2
Mining Services	2.85	4.12	0.45	3
Rubber Products	2.77	8.57	0.00	3
Agricultural Industries	2.67	2.41		3
Primary Metal Industries	2.34	1.46	0.65	3
Construction	2.15	0.95	0.06	3
Health and Social Services	1.86	1.03	0.10	3
Transportation	1.58	1.29	0.15	3
Transportation Equipment	1.36	1.32	0.27	3
Educational Services	1.28	0.58	0.03	3
Mines	1.24	0.69	0.18	3
Crude Oil and Natural Gas	0.82	0.59	0.07	3
Other Public Services Industries	0.51	1.04	0.00	3
Forestry and Forestry Services	0.43	0.20	0.00	3
Real Estate Services	0.41	0.91		3
Provincial and Territorial Governments	0.23	0.30	0.29	3
Local Government Services	0.22	0.19	0.00	3
Fishing and Trapping	0.00	0.89	0.00	3

All Canadian industries in the two-digit SIC for 1980, with the exception of three industries,²⁹ registered trade-marks in one of the three reference years. That result, which is consistent with the economic literature on trade-marks, suggests that this type of IP is commonly used by all sectors of the economy and represents practically all products found on the market (Maskus, 2000).

The industrial classification for 1999 is relatively similar to those for 1979 and 1989. In fact, 14 of the 17 industries in group (1) were in the same group in 1989, and nine were in that group for the three reference years. It is worth noting that, in general, the average intensity of trade-mark has risen sharply over the last 20 years, that is, between 1979 and 1999.

Industries that exhibit high propensities to register trade-marks include clothing, food and beverage, and tobacco products. Financial services, insurance, business services, wholesale trade, recreation and amusement, as well as chemical products, and refined petroleum and coal products were also in that group. For the most part, those industries are the ones serving the final goods and services market, which confirms the key role played by trade-marks in the choices made by consumers.

Advertising and Marketing Expenditures

The second indicator in the relative trade-mark intensity index is advertising and marketing expenditures per dollar of GDP. That indicator is used to make up for the lack of data on existing trade-marks.

We have assumed that the value of existing trade-marks may be preserved by making advertising and marketing expenditures. Accordingly, the higher the number of existing trade-marks for a firm, the higher its advertising and marketing expenditures will be. Those expenditures should be strongly correlated with the total number of existing trade-marks and will provide a good approximation of that number. Indeed, our sample shows a rank correlation of 0.74 between trade-mark registrations and marketing expenses. This is consistent with the fact that marketing and advertising expenditures are crucial factors in selling a new product and establishing a commercial reputation in order to acquire market share (Nakamura, 1999).

Expenditures on advertising and marketing by Canadian industries were extracted from Statistics Canada's 1996 input-output data. Table 23 shows the importance of advertising and marketing expenditures relative to value-added in Canadian industries corresponding to the two-digit 1980 SIC. As was done for the first indicator, dealing with relative propensity to register trade-marks, industries have been ranked in descending order and divided into three groups, representing high (1), moderate (2) and low (3) importance.

TABLE 23		
RELATIVE IMPORTANCE OF PROMOTIONAL ACTIVITIES, 1996		
INDUSTRY	ADVERTISING AND MARKETING EXPENDITURES IN RELATION TO VALUE ADDED (ADVERTISING EXPENDITURES PER \$MILLION VALUE ADDED)	GROUP
Beverage	154.13	1
Tobacco Products	100.98	1
Food	92.71	1
Chemical Products	67.81	1
Amusement and Entertainment Services	61.77	1
Retail Trade	55.59	1
Refined Petroleum and Coal Products	44.43	1
Leather and Allied Products	38.84	1
Rubber Products	35.17	1
Furniture and Fixtures	33.85	1
Associations and Other Services	32.68	1
Retail Trade	31.27	1
Textile Products	31.00	1

TABLE 23 (CONT'D)**RELATIVE IMPORTANCE OF PROMOTIONAL ACTIVITIES, 1996**

INDUSTRY	ADVERTISING AND MARKETING EXPENDITURES IN RELATION TO VALUE ADDED (ADVERTISING EXPENDITURES PER \$MILLION VALUE ADDED)		GROUP
Financial Intermediaries	30.57		1
Other Manufacturing Industries	28.30		1
Electrical and Electronic Products	23.85		1
Transportation Equipment	23.55		1
Personal and Household Services	22.83		2
Accommodation and Food Services	21.72		2
Other Organizations	21.45		2
Clothing	20.80		2
Communications	17.66		2
Paper and Allied Products	17.39		2
Business Services	16.79		2
Machinery	13.52		2
Primary Textiles	13.38		2
Printing, Publishing and Allied Industries	13.34		2
Plastic Products	13.28		2
Non-metallic Mineral Products	11.79		2
Transportation	10.17		2
Metal Products	8.85		2
Provincial and Territorial Governments	8.57		2
Federal Government	7.38		2
Construction	6.44		2
Storage and Warehousing	6.10		3
Insurance	6.03		3
Wood	5.75		3
Mining Services	4.90		3
Sand and Gravel Pits	4.73		3
Primary Metals	4.39		3
Other Public Services Industries	4.33		3
Educational Services	4.28		3
Mines	3.66		3
Pipeline Transportation	3.36		3
Health and Social Services	3.23		3
Forestry and Forest Products	1.63		3
Agricultural and Related Services Industries	1.30		3
Fishing and Trapping	0.55		3
Crude Oil and Natural Gas	0.38		3
Federal Government Services	0.08		3
Real Estate Services	0.00		3

Industries in which promotional activities were relatively more important are essentially the same as the ones identified by the first indicator. This suggests that the industries that register the most trade-marks also tend to allocate a greater proportion of their value added to promotional activities. In fact, 12 of the 17 industries that have a high propensity to register trade-marks also have a relatively high share of investment in advertising and marketing. The rank correlation coefficient between the two variables is 0.73, indicating a high level of interdependence between them.

Industries where promotional activities were most intensive are clothing, food and beverage, tobacco products, financial services, business services, wholesale trade, recreation and amusement, chemical products, and refined petroleum and coal products. Among industries not selected as having a relatively high propensity to register trade-marks, there is retail trade, rubber products, transportation, and electrical and electronic products. Those industries are essentially oriented toward final consumption markets. They operate in a very competitive environment, where trade-marks play a crucial role in firms' business strategies.

Construction of a Relative Trade-mark Intensity Index

The index of relative trade-mark intensity, which takes into account both trade-mark registrations and advertising expenditures, is the mean (equal weighting) of the groups in the two sub-indexes (indicators). Using this new index, we define a trade-mark-intensive industry as one in which both the number of registrations and advertising and marketing expenditures are high in relation to industry size. To calculate this index, we had to aggregate some industries in order to standardize the industrial classifications used for each of the two sub-indexes. This reduced the number of industries from 53 to 49.

The intensity index varies from 1 to 3. As for the two sub-indexes, industries were ranked in descending order and divided into three groups. Group 1 consists of industries that were scored 1 or 1.5 in relative intensity, and represents high relative trade-mark intensity industries. Group 2, which consists of industries scored 2 or 2.5, represents moderate relative intensity industries. Group 3, which consists of the remainder of the industries, represents low relative intensity industries. Table 24 shows the index of relative trade-mark intensity for Canadian industries.

Using this index, we can identify eighteen Canadian industries that are trade-mark-intensive. Together, they make up the trade-mark sector. They include wholesale and retail trade, financial intermediaries, business services and a number of manufacturing industries. The next section gives the overall economic profile of these industries and assesses the extent to which they are integrated to the knowledge-based economy.

TABLE 24**INDEX OF RELATIVE TRADE-MARK INTENSITY, BY GROUP**

	TRADE-MARK REGISTRATIONS (1999)	PROMOTIONAL EXPENDITURES (1996)	MEAN OF TWO INDICATORS	INDEX OF RELATIVE TRADE-MARK INTENSITY
Leather and Allied Products	1	1	1	1
Other Manufacturing Industries	1	1	1	1
Tobacco Products	1	1	1	1
Refined Petroleum and Coal Prod.	1	1	1	1
Food	1	1	1	1
Beverage	1	1	1	1
Chemical Industries	1	1	1	1
Textile Products	1	1	1	1
Wholesale Trade	1	1	1	1
Financial Intermediaries	1	1	1	1
Furniture and Fixtures	1	1	1	1
Amusement and Recreation Services	1	1	1	1
Clothing	1	2	1.5	1
Retail Trade	2	1	1.5	1
Electrical and Electronic Products	2	1	1.5	1
Business Services	1	2	1.5	1
Printing, Publishing and Allied Industries	1	2	1.5	1
Associations and Other Services	2	1	1.5	1
Insurance	1	3	2	2
Plastic Products	2	2	2	2
Non-metal Mineral Products	2	2	2	2
Personal and Household Services	2	2	2	2
Primary Textiles	2	2	2	2
Machinery	2	2	2	2
Accommodation and Food Services	2	2	2	2
Fabricated Metal Products	2	2	2	2
Paper and Allied Products	2	2	2	2
Communication	2	2	2	2
Rubber Products	3	1	2	2
Transportation Equipment	3	1	2	2
Building, Developing and General Contracting Industries	3	2	2.5	2
Transportation	3	2	2.5	2
Provincial and Territorial Governments	3	2	2.5	2
Agriculture and Related Services	2	3	2.5	2
Mining Services	2	3	2.5	2

TABLE 24 (CONT'D)**INDEX OF RELATIVE TRADE-MARK INTENSITY, BY GROUP**

	TRADE-MARK REGISTRATIONS (1999)	PROMOTIONAL EXPENDITURES (1996)	MEAN OF TWO INDICATORS	INDEX OF RELATIVE TRADE-MARK INTENSITY
Wood	2	3	2.5	2
Sand and Gravel Pits	2	3	2.5	2
Storage and Warehousing	2	3	2.5	2
Primary Metal Products	3	3	3	3
Health and Social Services	3	3	3	3
Educational Services	3	3	3	3
Mines	3	3	3	3
Oil and Natural Gas	3	3	3	3
Other Public Services	3	3	3	3
Forestry and Forest Products	3	3	3	3
Real Estate Services	3	3	3	3
Fishing and Trapping	3	3	3	3
Insur. Agenc. and Real Est. Agenc.	2		1	n.a.
Local Governments	3		1.5	n.a.

ECONOMIC PROFILE OF THE CANADIAN TRADE-MARK SECTOR**GDP of the Trade-mark Sector**

THE TRADE-MARK SECTOR IS IMPORTANT to the Canadian economy. In 2000, its gross domestic production amounted to \$313.5 billion, or 35.35 percent of total value added in Canada. That sector, which is composed of manufacturing and services industries, also grew at a higher rate than the economy as a whole. Between 1992 and 2000, the average annual rate of real growth of the sector was 5.24 percent, compared to 3.4 percent for the economy as a whole. The size of the trade-mark sector, combined with strong growth, makes it one of the most important sources of economic growth in Canada. Between 1992 and 2000, this sector contributed 54.8 percent of the country's economic growth. Table 25 shows production figures for each industry in the trade-mark sector.

Employment

The trade-mark sector employs 38.75 percent of the industrial work force in Canada, or nearly 4.7 million individuals. Those employees work primarily in wholesale and retail trade, which together represent nearly half of the industrial jobs in the trade-mark sector. Between 1992 and 2000, the average annual rate of growth was 2.74 percent, slightly higher than the rate for the economy as a whole (1.85 percent). Employment in some industries grew more rapidly, for instance in business services (7.52 percent) and furniture and fixtures (4.78 percent). During the period, more than 57 percent of new industrial jobs

created in Canada came from the trade-mark sector. Table 26 sets out the distribution of employment by industry in the trade-mark sector.

TABLE 25				
GDP OF THE TRADE-MARK SECTOR				
	GDP (\$BILLION) (2000)	AS A PERCENTAGE OF CANADIAN GDP (2000)	AVERAGE ANNUAL RATE OF GROWTH (1992-2000)	CONTRIBUTION TO OVERALL ECONOMIC GROWTH (1992-2000)
Food	15.548	1.8	1.3	0.7
Beverage	3.942	0.4	1.3	0.2
Tobacco Products	1.173	0.1	0.7	0.0
Leather and Allied Products	0.250	0.0	(6.9)	(0.1)
Textile Products	1.474	0.2	3.4	0.2
Clothing	3.380	0.4	2.0	0.2
Electrical and Electronic Products	20.141	2.3	12.2	8.2
Furniture and Fixtures	4.358	0.5	11.3	1.7
Printing, Publishing and All. Ind	8.011	0.9	(0.4)	(0.1)
Wholesale Trade	56.723	6.4	6.3	12.0
Retail Trade	57.240	6.5	4.7	9.0
Business Services	55.990	6.3	7.5	14.2
Amusement and Recreation	8.960	1.0	3.6	1.1
Associations and Other Services	17.867	2.0	1.8	1.1
Refined Petroleum and Coal Products	1.235	0.1	1.5	0.1
Chemical Products	12.469	1.4	3.7	1.6
Other Manufacturing Industries	4.514	0.5	3.9	0.6
Insurance Agen. and Real Est. Agen.	6.260	0.7	2.0	0.4
Financial Intermediaries	40.212	4.5	6.1	8.2
Trade-mark Sector	313.488	35.4	5.2	54.8

TABLE 26				
INDUSTRIAL JOBS* IN THE TRADE-MARK SECTOR				
	INDUSTRIAL JOBS (2000)	AS A PERCENT. OF TOTAL EMPLOYMENT IN CANADA (2000)	AVERAGE ANNUAL RATE OF GROWTH (1992-2000)	CONTRIBUTION TO EMPLOYMENT GROWTH IN CANADA
Total, Canada	12,100,643	100.0	1.9	100.0
Food	211,134	1.7	1.7	1.6
Beverage	28,377	0.2	1.8	0.2
Tobacco Products	4,411	0.0	(1.1)	0.0
Leather and Allied Products	11,796	0.1	(3.2)	(0.2)
Textile Products	33,383	0.3	3.8	0.6
Clothing	93,152	0.8	2.6	1.1
Printing, Publish. and All. Ind.	157,125	1.3	1.5	1.1

TABLE 26 (CONT'D)

INDUSTRIAL JOBS* IN THE TRADE-MARK SECTOR

	INDUSTRIAL JOBS (2000)	AS A PERCENT. OF TOTAL EMPLOYMENT IN CANADA (2000)	AVERAGE ANNUAL RATE OF GROWTH (1992-2000)	CONTRIBUTION TO EMPLOYMENT GROWTH IN CANADA
Refined Petrol. and Coal Prod.	15,407	0.1	(1.5)	(0.1)
Chemical Products	95,680	0.8	1.3	0.6
Furniture and Fixtures	67,287	0.6	4.8	1.4
Electrical and Elect. Prod.	139,656	1.2	2.0	1.2
Wholesale Trade	810,503	6.7	3.8	13.7
Retail Trade	1,463,255	12.1	1.2	7.7
Other Manufacturing Industries	87,804	0.7	1.4	0.5
Business Services	957,409	7.9	7.5	32.1
Financial Intermediaries	261,633	2.2	(1.2)	(1.4)
Other Services	250,442	2.1	2.8	3.1
Trade-mark Sector	4,688,454	38.8	2.7	57.3
Note: * Statistics regarding industrial employment in the associations, insurance and real estate, and amusement and recreation industries are not represented as the data were not available.				

In addition to industrial workers, it is estimated that there were more than 939,100 self-employed persons in the trade-mark sector³⁰ in 1999. They worked primarily in wholesale and retail trade, and amusement and recreation. That group represented more than 38 percent of self-employed labour in Canada. The number of self-employed workers in the trade-mark sector grew at an average annual rate of 4.0 percent, which was higher than the average rate for the economy as a whole, which was 3.2 percent. Overall, industrial employment and self-employment in the sector totalled nearly 5.6 million people, or 38.6 percent of the Canadian work force.

Labour Productivity in the Trade-mark Sector

The trade-mark sector contributed 48.1 percent of Canada's labour productivity growth during the 1989-98 period. This high performance was stimulated by significant efficiency gains in several trade-mark related industries such as refined petroleum and coal products, furniture and fixtures, electrical and electronic products, and finance and insurance, which posted annual labour productivity growth rates above 4 percent. Wholesale and retail trade also posted high productivity gains and contributed significantly (20.6 percent) to Canada's labour productivity growth. Negative labour productivity compounded growth rates were observed in business services, printing and publishing, and leather and allied products. Table 27 shows labour productivity figures for the trade-mark sector over the 1989-98 period.

TABLE 27**LABOUR PRODUCTIVITY GROWTH IN THE TRADE-MARK SECTOR**

	LABOUR PRODUCTIVITY GROWTH (1989-98) (%)	CONTRIBUTION OF THE TRADE-MARK SECTOR TO CANADA'S LABOUR PRODUCTIVITY GROWTH (%)
TRADE-MARK SECTOR		
Leather and Allied Products	(2.04)	(0.05)
Other Manufacturing Industries	0.21	0.08
Tobacco Products	0.40	0.04
Clothing	0.65	0.19
Refined Petroleum and Coal Products	5.71	0.62
Foods	1.95	2.61
Beverage	2.67	0.93
Chemical and Chemical Products	2.67	2.93
Textile Products	0.23	0.03
Finance and Insurance	4.43	15.70
Wholesale Trade	2.53	12.64
Real Estate and Insurance Agent Industries	0.63	0.35
Furniture and Fixtures	5.20	2.00
Business Services	(1.05)	(5.18)
Amusement and Recreational Services	(0.98)	(0.77)
Printing, Publishing and Allied Industries	(1.85)	1.31
Membership Organizations	1.54	0.84
Retail Trade	1.58	7.97
Electrical and Electronic Products	5.55	9.85
Other Services Industries	(1.31)	1.34
Total, Trade-mark Sector	1.74	48.14

Foreign Trade

Exports by the trade-mark sector amounted to \$116.5 billion in 2000. Imports totalled \$157.1 billion, making this sector a net importer of trade-mark-related goods and services. The sector had a trade deficit of \$40.1 billion in 2000. In spite of the negative balance of trade, exports rose at an average rate of 14.4 percent for the period 1992-2000, a higher average rate of growth than imports, which was 11.8 percent for the same period.

In 1998, the trade-mark sector exported nearly 37.8 percent of its manufacturing shipments, indicating a lower orientation toward foreign markets than the economy as a whole (54.2 percent). On the other hand, the trade-mark sector is highly dependent on the United States: 86 percent of its exports went to that country, while 58 percent of its imports came from there. Table 28 presents the figures on the Canadian trade-mark sector international trade.

TABLE 28

INTERNATIONAL TRADE IN GOODS AND SERVICES, TRADE-MARK SECTOR

	EXPORTS (2000)	IMPORTS (2000)	BALANCE OF TRADE (2000)	EXPORT INTENSITY IN 1998 (AS A PERCENTAGE OF MANUFACTURING SHIPMENTS)
Goods (in millions)	105,401.70	146,031.23	(40,627.50)	37.80
Food	13,989.40	11,403.78	2,585.65	22.40
Beverage	1,351.60	1,547.69	(196.12)	17.50
Tobacco Products	140.50	82.11	58.35	6.90
Leather and Allied Products	401.70	2,410.60	(2,008.91)	29.30
Textile Products	1,136.50	2,733.97	(1,597.47)	25.80
Clothing	3,039.60	5,329.03	(2,289.40)	34.60
Furniture and Fixtures	6,936.60	2,734.11	4,202.49	80.70
Printing, Publishing and Allied Industries	2,082.90	3,686.26	(1,603.32)	10.20
Electrical and Electronic Prod.	42,092.60	64,650.98	(22,558.11)	75.10
Refined Petroleum and Coal Products	8,460.70	3,029.92	5,430.80	19.10
Chemical Products	17,373.10	27,398.43	(10,025.33)	43.40
Other Manufacturing Industries	8,396.50	21,024.36	(12,627.90)	71.10
Services, 1999 (in millions)				
Business Services	11,120.00	10,609.00	511.00	n.a.
Trade-mark Sector	116,521.70	156,640.23	40,118.53	n.a.
Average Annual Rate of Growth, 1992-99	14.40	11.80	n.a.	n.a.

INTEGRATION TO THE KNOWLEDGE-BASED ECONOMY

THE TRADE-MARK SECTOR IS DIVERSIFIED. It includes a number of industries recognized as knowledge-intensive, such as business services, electronic and electrical products, financial intermediaries, and chemical products. This group of industries represents 41.1 percent of value added in the trade-marks sector, or \$128.8 billion. It grew at an average rate of 7.22 percent, a twice the average rate of growth for the economy.

The sector is also composed of manufacturing and services industries, which are oriented toward final consumption. This group includes food, beverage and tobacco products, clothing, leather products and furniture manufacturing. It also includes services industries, such as wholesale and retail trade, publishing and printing, amusement and recreation, and associations. These more traditional industries make up an important part of the Canadian economy.

In 2000, the GDP of this group was \$186.7 billion, or 20.8 percent of Canada's GDP. However, average growth was lower than for the group of more knowledge-intensive industries: 3.97 percent per year between 1992 and 2000. This rate of growth is still comparable to that of the Canadian economy.

Research and Development

Firms that register trade-marks tend to invest extensively in R&D (Allegrezza and Guard-Rauchs, 1999). It thus seems that the protection afforded by a trade-mark is an important element of the marketing strategy of new products, which may be protected by both trade-mark and patent. Like patents, trade-mark protection enables the firm to keep the returns on its innovation.

Data on R&D in the trade-mark sector seem to confirm the relationship between trade-marks and innovation. In 2000, R&D expenditures totalled \$7.1 billion, or 72 percent of total intramural R&D expenditures in Canada. Those expenditures, which are concentrated in three industries — business services, electrical and electronic products, and chemical products — represent 2.9 percent of the GDP of R&D-performing industries in the trade-mark sector. In those three industries, R&D expenditures reached \$1.65 billion, \$3.48 billion and \$795 million, respectively, for a total of \$5.9 billion or 83 percent of total trade-mark sector R&D expenditures.

TABLE 29		
R&D EXPENDITURES IN THE TRADE-MARK SECTOR		
	R&D EXPENDITURES (INTENTIONS IN \$MILLION) (2000)	AS A PERCENTAGE OF TOTAL R&D EXPENDITURES (2000)
Food	71	0.72
Beverage and Tobacco Products	10	0.10
Textile Products	67	0.68
Furniture and Fixtures	6	0.06
Printing, Publishing and Allied Industries	7	0.07
Electrical and Electronic Products	3,478	35.13
Refined Petroleum and Coal Products	66	0.67
Chemical Products	795	8.03
Other Manufacturing Industries	219	2.21
Wholesale Trade	719	7.26
Retail Trade	40	0.40
Business Services	1,654	16.71
Trade-mark Sector	7,132	72.00
Source: Statistics Canada, 2001.		

CONCLUSION

THE OBJECTIVE OF THIS STUDY was to identify the industries that make the most intensive use of various forms of IP rights. Considering the three main types of IP — patents, copyright and trade-marks — we first described the various measurements of intensity used for each type of IP. We then identified the industries that use each type of IP most intensively, and then we measured the contribution of each to the Canadian economy.

The patent sector was identified using an indicator of relative intensity of patent use, defined as the ratio of the number of patent applications in an industry to its GDP. By classifying industries based on that indicator, we are able to define a patent sector consisting of the following industries:

- Electrical and electronic products
- Refined petroleum and coal products
- Machinery
- Other manufacturing industries
- Plastic products
- Primary textiles and textile products
- Business services
- Furniture and fixtures
- Chemical products
- Transportation equipment.

The patent sector is important to the Canadian economy. It represents more than 17 percent of the Canadian GDP, or over \$130 billion. This sector also experienced strong growth between 1992 and 2000: 7.4 percent annually, compared to 3.4 percent for the economy as a whole. The performance of the patent sector is primarily based on the exceptional growth in electrical and electronic products, transportation equipment, furniture and fixtures, and business services. Some of those industries are closely associated with the knowledge-based economy.

The patent sector is heavily oriented toward exports, with an export intensity of 65 percent, compared to 54 percent for the overall economy. Nonetheless, it has a substantial trade deficit, which seems to be growing. Canada is a net importer of electrical and electronic products, machinery, other manufactured products and chemical products. On the other hand, it is a net exporter of transportation equipment and business services.

In terms of R&D, the patent sector has total expenditures of nearly \$8 billion, or 6 percent of its GDP, a proportion four times higher than that of the Canadian economy.

The copyright sector was defined using a different methodology from that used for the patent sector. Copyright does not need to be registered in order to be effective: it takes effect when the work is fixed. The copyright sector is thus defined on the basis of the definition of the works protected by the *Copyright Act*, i.e. the industries involved in creating, producing, reproducing, making, distributing and selling copyrighted works. By our definition, the copyright sector consists of the following industries:

- Cultural industries
- Business services
- Retail trade (in part)
- Wholesale trade (in part)
- Telecommunications (in part).

This sector is also important to the Canadian economy, with a GDP of nearly \$66 billion in 2000 — more than 7 percent of the Canada's GDP. Between 1992 and 2000, this sector also grew at a higher rate than the economy as a whole, at 6.6 percent. This high rate of growth is primarily attributable to business services, which includes computer services, architecture and engineering, and telecommunications. Those industries are also strongly associated with the knowledge-based economy.

Overall, the copyright sector is not heavily oriented toward foreign markets. Exports account for only 15 percent of the sector's GDP. Overall, it is also a net importer. Business services industries are the exception to that rule, being heavily oriented toward the export market, and enjoying a trade surplus. The sector's R&D performance is also good, at 2.5 percent of GDP, twice the figure observed for the economy as a whole. This performance is essentially attributable to the communication industries.

The definition of the trade-mark sector is analogous to that of the patent sector. Industries that use trade-marks intensively were identified using a relative indicator of trade-mark registrations. These industries are:

- Leather and allied products
- Other manufacturing industries
- Tobacco products
- Refined petroleum and coal products
- Food and beverage
- Chemical products
- Textile products
- Wholesale trade
- Financial intermediaries

- Amusement and recreation services
- Clothing
- Retail trade
- Electrical and electronic products
- Business services
- Printing, publishing and allied industries
- Associations and other services.

Trade-marks are more widely used as a tool for protecting IP than patents or copyright. Virtually all of the industries examined used trade-marks to various degrees. That being said, a majority of trade-mark-intensive industries serve final consumption markets.

The trade-mark sector makes up about 35 percent of the Canadian economy. It also grew at a faster rate than the overall economy — over 5 percent. The sector's strong growth reflects the fast growth experienced in the electrical and electronic products and business services industries.

There seems to be less orientation toward foreign markets than for the economy as a whole. As well, this sector is a net importer, primarily from the United States.

Industries in the trade-mark sector invest about 2 percent of their GDP in R&D, a performance slightly better than that of the economy as a whole. Three industries are primarily responsible for this: electrical and electronic products, business services, and chemical products.

Some industries focus their IP strategies on one type of right, but a significant proportion of industries use a combination of at least two forms of IP. From this study, we can classify the industries that use intensively at least two types of IP into the following groups:

Patents and trade-marks

- Electrical and electronic products
- Refined petroleum and coal products
- Textiles
- Business services
- Furniture
- Chemical products.

Patents and copyright

- Telecommunications and electrical and electronic products
- Business services.

Copyright and trade-marks

- Wholesale trade
- Business services
- Printing, publishing and allied industries.

Industries in the patents and trade-marks group are, for the most part, oriented toward final consumption markets, where product differentiation strategies are important. Establishing a reputation is one way for these firms to differentiate their products and acquire greater market share. For some, competition is based on product differentiation rather than price. Trade-marks are a way of protecting their reputation. But most of these industries also do R&D to create new products. Examples are the electrical and electronic products industries and the chemical products industries, which want to protect the fruits of their research. In the case of a new drug, for example, not only is the chemical formula protected by patents, but the trade name must also be protected, using trade-marks.

Industries in the patents and copyright group also do a considerable amount of R&D and protect their new products with patents. They are heavily dependent on copyright, because either the resulting products are protected by copyright (business services) or they are involved in the reproduction, communication and distribution of copyrighted works.

The copyright and trade-marks group is also characterized by industries where product differentiation is a key market strategy. In that group, most of the goods produced (or distributed, in the case of wholesale trade) by firms are protected by copyright.

Lastly, two industries were identified as belonging to all three sectors: the telecommunications and electrical products, and business services. Those industries develop strategies to make maximum use of the protection afforded by existing IP rights. They were identified as a source of significant growth within the Canadian economy. In a sense, they comprise the heart of the IP industries and the knowledge-based economy in Canada.

ENDNOTES

- 1 See OECD, 1999.
- 2 Investments in knowledge production and dissemination can augment more than just physical factors of production. Investments in education augment labour; skilled workers are more productive than unskilled workers. Also, on the demand side, investments in better health stimulate demand, both through higher wages and through increased life expectancy.

- 3 An application by an inventor will be classified by CIPO according to the International Patent Classification (IPC) in a technical field that covers the content of the application. The purpose of that classification is essentially to identify the type of technology used in the invention, regardless of what particular industrial sector the inventor happens to be in.
- 4 This initial database includes any inventor (individual or firm) whose address was in Canada.
- 5 The reference years were selected arbitrarily. For patents, we wanted to get data for 1979, 1989 and 1999 (as we did for trade-marks), but the Patent Office was unable to give us data for 1979. For applications, in view of the substantial changes to the application process brought into effect by amendments to the *Patent Act* in 1989, we selected 1990 as the reference year.
- 6 This coding exercise resulted in the loss of all data relating to applications made by individual inventors and patents granted to individuals. Accordingly, a population refers to either all applications filed by Canadian firms during a reference year or all patents issued to Canadian firms for a reference year.
- 7 In 1999, CIPO received 4,867 applications filed by Canadians (individuals and firms). Of that number, 58 percent have not been assigned a SIC code as applications filed by individuals cannot be attributed to an industry and because of the additional observations lost due to the coding exercise.
- 8 The choice of an index of patent intensity, rather than a propensity (i.e. patents over R&D spending) was dictated by the need to correct the number of patent applications by a size variable that would not be affected by the differences in R&D intensity of any particular industry.
- 9 These consisted of the following industries: electrical and electronic products, refined petroleum and coal products, machinery, plastic products, chemical products, transportation equipment and other manufacturing industries.
- 10 Trajtenberg (2000) uses patent data broken down by technological categories that are not directly comparable to the standard industrial classification (SIC) used in this study.
- 11 That index was calculated using 1995 data for most of the indicators used.
- 12 We also calculated these two averages for patent applications in 1990, and for patents granted in 1989 and 1999. In all three cases, we found that the average number of applications, or average number of patents granted, was higher in the patent sector than in the whole sample.
- 13 As explained in the section entitled Methodology and Data, the names of firms included in our database were matched with the appropriate SIC codes using Statistics Canada's business register. The matching was done first using an automatic matching from Statistics Canada. We then manually completed a portion of the missing SIC codes using the names of firms that appear in the trade-marks database. Given the size of the task, we had to pay particular attention to firms that had filed at least three applications in 1999.
- 14 Export intensity represents the percentage of manufacturing shipments to foreign markets.
- 15 According to Mackaay and Gendreau (2001), a moral right means that "The author of a work has, subject to section 28.2, the right to the integrity of the work

and, in connection with an act mentioned in section 3, the right, where reasonable in the circumstances, to be associated with the work as its author by name or pseudonym and the right to remain anonymous. Moral rights may not be assigned but may be waived in whole or in part. An assignment of copyright in a work does not constitute a waiver of any moral rights.”

- 16 Since 1998, the Canadian rules regarding private copying makes it legal to copy sound recordings of musical works onto audio recording media for the private use of the person making the copy (“copy for private use”, or simply “private copy”). The amendment to the *Copyright Act* also provided for a levy to be charged on blank audio recording media, the purpose of which is to remunerate authors, performers and makers who hold a copyright in the sound recordings used to make the private copy. See <http://www.cb-cda.gc.ca> (accessed April 22, 2005).
- 17 A collective society is a body that administers the copyright belonging to a large number of copyright owners. It may grant permission to use their works, and specify related terms and conditions. The collective management of copyright is fairly widespread in Canada, particularly for the public performance of music, reprography and mechanical reproduction. Some collective societies are affiliated with foreign societies, whose members they represent in Canada.
- 18 In Canada, a recent decision of the Copyright Board (Tariff 22) relieves suppliers of Internet services of all liability in relation to the right of communication where the suppliers merely supply the conduits for dissemination, and not the content. Their legal liability in relation to the right of reproduction is still uncertain. Given the scope of the distribution of goods and services protected by copyright on the Internet, and the participation of the telecommunication industry in disseminating works, we have included half of that industry’s commercial activities in the peripheral industries group in the definition.
- 19 Business services include computer and related services, architecture and engineering firms, other scientific and technical services, and advertising services.
- 20 The definition of the cultural sector used is the one developed by the Cultural Statistics Program Division of Statistics Canada. It includes activities involving creation, literary publishing, making sound recordings, producing and distributing motion pictures and videos, and radio and television broadcasting. Although Statistics Canada includes advertising services activities in the cultural sector, we decided to include them in the business services group.
- 21 Statistics on the wholesale and retail trade industries are presented in aggregate form in the existing classification. As well, there are several types of businesses, particularly in retail trade that sell copyrighted works but are not regarded as businesses specializing in the sale of copyrighted goods and services. For example, ‘big box’ stores like Costco that sell everything, including copyrighted works.
- 22 This includes salaried and non-salaried employees hired by the industries. The data do not include workers employed in the wholesale and retail sale of copyrighted products.
- 23 The definition of a knowledge-based work force is taken from a study by Lavoie and Roy (1998), where knowledge workers are defined as those who produce knowledge — workers who generate ideas and provide professional advice.

- 24 A certification mark is a mark used for the purpose of distinguishing or so as to distinguish wares or services that are of a defined standard from those that are not, with respect to character, quality or the working conditions under which the wares have been produced.
- 25 A distinguishing guise means a shaping of wares or their containers, or a mode of wrapping or packaging wares the appearance of which is used by a person for the purpose of distinguishing or so as to distinguish wares or services made by that person from other goods or services.
- 26 A geographic indication means, in respect of a wine or spirit, an indication that identifies the wine or spirit as originating in a particular place, where a quality, reputation or other characteristic of the wine or spirit is essentially attributable to its geographical origin.
- 27 Official marks are marks adopted and used by any public authority in Canada (individual or organization) as an official mark for wares or services. An application for a trade-mark similar to an official mark will therefore be rejected.
- 28 That system gives a trade-mark owner the option of having its mark protected in a number of countries by simply filing one application with a single trade-mark office, in one language, with one set of fees in one currency (Swiss francs). See www.wipo.org/Madrid (accessed April 22, 2005).
- 29 Because of data limitations, we had to restrict the analysis of industry codes to two figures in the 1980 SIC. The pipeline transport and federal government services industries as well as the international organizations and other extra-territorial organizations industries registered no trade-marks in 1999, 1989 or 1979.
- 30 Statistics on self-employment show only employment generated by wholesale and retail trade industries, professional, scientific and technical services, and amusement, recreation, gambling and lottery industries. Because of the transition to the North American Industry Classification System (NAICS), a number of SIC codes cannot be directly associated with a single NAICS code. For that reason, the employment indicators are incomplete. However, overall, they are representative of the trade-marks sector.

ACKNOWLEDGMENTS

THIS STUDY BENEFITED FROM COMMENTS made by participants at the Conference on *Intellectual Property and Innovation in the Knowledge-Based Economy*, held in Toronto on May 23-24, 2001. The authors would like to thank Jonathan Putnam for useful comments on an earlier version of this study.

BIBLIOGRAPHY

- Allegrezza, S., and A. Guard-Rauchs. 1999. "The Determinants of Trademark Deposit: An Econometric Investigation (A Case Study of BENELUX)." *Économie Appliquée* 52 2: 52-68.
- Gera, Surendra, Wulong Gu and Frank C. Lee. 1998. *Information Technology and Labour Productivity Growth: An Empirical Analysis for Canada and the United States*. Micro-Economic Policy Analysis Branch, Working Paper No. 20. Ottawa: Industry Canada.
- Landes, W.M., and R.A. Posner. 1987. "Trademark Law: An Economic Perspective." *Journal of Law and Economics* 30.
- Lavoie, M., and R. Roy. 1998. *Employment in the Knowledge-Based Economy: A Growth Accounting Exercise for Canada*. Research Paper No. R-98-8E. Human Resources Development Canada (June).
- Mackaay, Ejan, and Ysolde Gendreau. 2001. *Canadian Legislation on Intellectual Property*. Thompson Educational Publishing.
- Maskus, Keith E. 2000. *Intellectual Property Rights in the Global Economy*. Washington (D.C.): Institute for International Studies.
- Nadeau, Serge. 2000. "Innovation and Economic Performance in Canadian Industries." Micro-Economic Policy Analysis Branch. Mimeo. Ottawa: Industry Canada, (May).
- Nakamura, Leonard. 1999. "Intangibles: What Put the New in the New Economy?" *Business Review* (July/August): 3-16.
- OECD. 1996. *The Knowledge-based Economy*. Paris: Organisation for Economic Co-operation and Development.
- . 1999. *Science, Technology and Industry Scoreboard, Benchmarking Knowledge-based Economies*. Paris: Organisation for Economic Co-operation and Development.
- Statistics Canada. 2001. *Industrial Research and Development, 2000 Intentions*. Ottawa: Statistics Canada.
- Trajtenberg, Manuel. 2000. *Is Canada Missing the 'Technology Boat?' Evidence from Patent Data*. Micro-Economic Policy Analysis Branch, Discussion Paper No. 9. Ottawa: Industry Canada.

OTHER REFERENCES

- Besen, S.M., and L.J. Raskind. 1991. "An Introduction to the Law and Economics of Intellectual Property." *Journal of Economic Perspective* 5, 1 (Winter): 3-27.
- Commanda, M.-J., C. Williams, M. Durand and J. Huffman. 2000. *Technical Notes on the Economic Impact of Culture*. Cultural Industries Statistics Program (September).
- Economides, N.S. 1988. "The Economics of Trademarks." *The Trademark Reporter* 78, pp. 523-539.
- Haley, H.E. 1995. "Canadian Cultural Policy and the NAFTA: Problem Facing the U.S. Copyright Industries." *George Washington Journal of International Law and Economics*.

- Kretschmer, M., G.M. Klimis and R. Wallis. 1999. "The Changing Location of Intellectual Property Rights in Music: A Study of Music Publisher, Collecting Societies and Media Conglomerates." *Prometheus* 17, 2.
- Reese, A. 2000. "Copyright and Internet Music Transmissions: Existing Law, Major Controversies, Possible Solutions." Paper presented at the 28th Annual Research Conference on Information, Communications and Internet Policy (September).
- Samuelson, P. 2000. "The Digital Dilemma, A Perspective on Intellectual Property in the Information Age." Paper presented at the 28th Annual Research Conference on Information, Communications and Internet Policy (September).
- Siwek, S.E., and H. Furchtgott-Roth. 1995. *Copyright Industries in the U.S. Economy: 1977-1993*. (January).



Mohammed Rafiquzzaman
Industry Canada



Shubha Ghosh
State University of New York at Buffalo

3

The Importance of Patents, Trade-marks and Copyright for Innovation and Economic Performance: Developing a Research Agenda for Canadian Policy

INTRODUCTION: CANADA'S PLACE IN THE INTELLECTUAL PROPERTY SYSTEM

THE SUCCESS OF AN ECONOMIC SYSTEM rests on the right economic actors receiving the right economic incentives for production and distribution. Intellectual property rights (IPRs), consisting of patents, trade-marks and copyright, provide the needed incentives for the production and distribution of information products. Unlike agricultural and manufactured products information products, whether in the form of entertainment, legal services, financial services, software, or know-how, have the characteristics of public goods. They are non-rival and non-excludable in consumption. As a result, it is possible for the producer of information products not to receive the full economic returns on its investment. Once an information product is produced and distributed, absent legal restrictions, copies can be made that provide competition to the original producer. Intellectual property laws, by the creation of patent, trade-mark, and copyright rights, allow the original creator to prevent the imitation and distribution of the information product, as well as the appropriation of the investment in the creation and dissemination of the product. By giving the creator the right to prevent copying and distribution without permission, intellectual property laws permit the creation of markets and stimulate growth and innovation in an economy based largely on information products.

The role of intellectual property laws is also important in the manufacturing and agricultural sectors of the economy. Information about the means of producing agricultural and manufacturing goods, whether in the form of know-how or technical inventions or processes, is also a public good, and intellectual property legislation is important in structuring the market for suppliers of important factors of production in those sectors. Although intellectual property laws' reach is quite broad in information and service based economies, it is also relevant for more traditional sectors. Understanding the power and importance of intellectual property law is central for many sectors of the economy, and legislation can serve as an important plank in promoting economic growth and innovation across sectors.

While there is a growing body of empirical and theoretical work based on the study of the importance of innovation and technology to growth, very few authors have empirically studied the effects of institutions that motivate innovation and technological change, such as intellectual property laws. Studying the effects of IPRs requires a quantitative measure of the strength of IPRs in a country, that is, a numerical rating system by which national intellectual property regimes may be assessed and compared. This system, in turn, may provide a basis for assessing the contribution of intellectual property protection to the process of economic development (Sherwood, 1997).

One such study is that of Rapp and Rozek (1990), which compared statistically the stage of economic development with the strength of patent protection for 87 countries. The study rated the degree of patent protection in each country. The rating was confined to patent laws with no consideration of other forms of intellectual property protection. An index was constructed based on each country's adherence to the minimum standards for patent laws proposed in 1984 by the Intellectual Property Task Force of the U.S. Chamber of Commerce. These standards include guidelines for coverage of inventions, examination procedures, term of protection, transferability of rights, compulsory licensing, and effective enforcement against infringement (Smith, 1999). The index is a composite (sum) of dummy variables that take the value one if the criteria applies and zero otherwise. It ranks the level of patent protection for each country on a scale of zero to five. The index takes a value of zero when there are no national patent laws, a value of one when a country has inadequate protection and no laws prohibiting piracy, a value of two when a country has seriously flawed laws, a value of three when a country has flawed laws with some enforcement, a value of four when a country has generally good laws, and a value of five when national protection and enforcement laws are fully consistent with the minimum standards proposed by the U.S. Chamber of Commerce.

Seyoum (1996) sought to determine the impact of IPRs on direct foreign investment and thereby developed an index of IPRs. Seyoum used a mix of 27 developing and developed countries and for each country estimated the

level of protection for patents, trade-marks, trade secrets and copyright and assigned a number to rate the level for each. The information on the level of intellectual property protection was obtained from a survey questionnaire that was administered to intellectual property experts/practitioners in these sample countries. It was also primarily based on guidelines for minimum standards for the protection and enforcement of intellectual property developed by the U.S. Chamber of Commerce's Intellectual Property Task Force in 1987. Questions were asked on the duration of patents, trade-marks, transfer of rights, use of compulsory licences, exclusion of sectors from protection, level of enforcement, etc. Questions were based on a scale of zero to three, with zero representing the lowest level and three representing the highest level of protection and enforcement. Given the questions asked for each form of IPR, the maximum score for the level of patent protection was 21, the maximum level of trade-mark protection was 21, the maximum level of trade secret protection was 9, and the maximum level of copyright protection was 21. Sherwood (1997) developed an index that was similar to Seyoum's. He developed a numerical rating system by which national intellectual property regimes may be assessed and compared. He took a sample of 18 developing countries and estimated the level of protection of IPRs for each. His rating system adopts a scale of 100. In order to evaluate defects and weaknesses in a country's intellectual property regime, points were subtracted from a perfect theoretical score of 100 points. Sherwood assessed the intellectual property regimes under eight major headings: (i) Enforceability (25 points), (ii) Administration (10 points), (iii) Copyright (12 points), (iv) Patents (17 points), (v) Trade-marks (9 points), (vi) Trade Secrets (15 points), (vii) Life Forms (6 points), and (viii) Treaties (6 points). The score of points in each category depended on some established criteria. A country's level of intellectual property protection is the sum of the scores in each category. For details see Sherwood (1997).

Table 1 shows the average level of intellectual property across three G-7 countries for the period 1975-90. Similar data for other G-7 countries were not available in Seyoum (1996). A comparison of the overall level of intellectual property protection indicates that Canada ranks the lowest among all three countries in protecting patent rights and copyright except trade-marks.

TABLE 1				
AVERAGE LEVEL OF INTELLECTUAL PROPERTY PROTECTION				
COUNTRY	PATENTS	TRADE-MARKS	TRADE SECRET	COPYRIGHT
Canada	17	19	7	16
Germany	18	19	9	18
United States	19	19	7	17
Source: Seyoum, 1996.				

Although the average level of protection for trade-marks and trade secrets does not differ between Canada and the United States, patents and copyright are more strongly protected in the United States.

More recently, Ginarte and Park (1997) considered a sample of 110 countries and estimated the index of patent rights for each of these countries, at 5-year intervals, from 1960 to 1990, using a coding scheme applied to national patent laws. The index takes on values between zero (no protection) and five (maximum protection), higher numbers reflecting stronger levels of protection. In constructing the index, five categories of the national patent laws were examined: (1) extent of coverage (patentability), (2) membership in international patent agreements, (3) protection against loss rights (like compulsory licensing), (4) enforcement mechanisms, and (5) duration. Each category (per country, per time period) takes on a value between zero and one. For example, a 0.33 score for enforcement indicates that a country has only a third of the desired enforcement features. The sum of these five values gives the overall value of the patent rights index. The index therefore ranges in value from zero to five. Table 2 summarizes the index values of G-7 countries by year.

For quite some time, patent laws and policies varied widely across countries. With the recent formation of the World Trade Organization (WTO), and the ratification of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs) by G-7 countries, a process of convergence in national patent systems has begun. The standard deviations in Table 2 show that the overall differences in levels of protection have narrowed since 1980. Even if national patent regimes have been converging, the strength of intellectual property protection, measured in terms of the strength in patent protection, remains the lowest in Canada compared to other G-7 nations. This suggests that, overall, the Canadian patent system is less strong in protecting intellectual property than those of other industrial countries.

TABLE 2								
INDEX OF PATENT STRENGTH								
COUNTRY	1960	1965	1970	1975	1980	1985	1990	1995
Canada	2.76	2.76	2.76	2.76	2.76	2.76	2.76	3.05
France	2.76	3.10	3.24	3.24	3.90	3.90	3.90	4.05
Germany	2.33	2.66	3.09	3.09	3.86	3.71	3.71	4.05
Italy	2.99	3.32	3.32	3.46	3.71	4.05	4.05	4.05
Japan	2.85	3.18	3.32	3.61	3.94	3.94	3.94	4.33
United Kingdom	2.70	3.04	3.04	3.04	5.57	3.57	3.57	3.57
United States	3.86	3.86	3.86	4.19	4.52	4.52	4.52	4.52
Standard Deviation	0.47	0.40	0.33	0.47	0.85	0.54	0.54	0.49
Source: Ginarte and Park, 1997.								

Quantifying the level of intellectual property protection in the above manner is rather crude and somewhat arbitrary. A complete picture of a country's IPR protection would include measures of copyright protection, trade secret laws, patents, and other forms of IPR protection. The most comprehensive index available includes only a measure of patent protection. However, patent protection indices serve two purposes. First, they reflect the primary concerns of those who would invest in inventions and innovations. Second, they also serve to compare (quantify) aspects of an intellectual property regime that appear to be most relevant to the enhancement of a nation's technological development and hence economic progress.

In summary, patent laws and practices vary across countries; but, in recent years, there has been a tendency for patent regimes to converge. The existing measures of the strength of intellectual property regimes indicate that the overall strength of the Canadian patent system is the lowest among G-7 countries. Canada also lags in the strength of protecting other forms of intellectual property — copyright and trade-marks — as compared to the United States and United Kingdom. All of these suggest that much remains to be done in Canada to make the execution of its intellectual property laws consistent with their statutory provisions.

Moreover, whatever rating system is applied, Canada has received a lower rating than its industrial counterparts. The relatively low rating of the Canadian patent system may not be conducive to the adoption and development of new technology and new products, which in turn has adverse effects on economic growth, productivity enhancement and increased standard of living. However, a low rating for Canada should not be misinterpreted. It does not signify that Canada has no intellectual property regime, but rather that potential investors will be discouraged by what they find.

What are the implications of Canada's low ranking for the country's economic performance? The topic of intellectual property law is an old and established one. Its role as a policy instrument is only recently being fathomed. Doern and Sharaput (2000), for example, illustrate the importance of intellectual property legislation for Canada in developing innovating institutions and promoting economic interests. The academic literature provides many theoretical and empirical insights into how patent, trade-mark, and copyright laws can be used as policy instruments. The literature also points to many unanswered questions that can serve as the basis for future research. What we know and where we need to go are questions addressed in this study.

The study is divided into three parts. The first focuses on patent law, the second on trade-mark law and the third on copyright law. In each section, a theoretical overview of the body of law is presented. The theoretical focus is on the role each body of law plays in securing economic incentives for innovation and development. The theoretical discussion is followed by an overview of

Canadian law on the subject as a way to illustrate how the theoretical goals of patents, trade-marks and copyright are respectively implemented. Each section concludes with a discussion of the empirical literature with application to the Canadian context. The discussion of the Canadian context allows for a summary of future research directions. Our goal is to provide readers with a handbook of intellectual property law that emphasizes theory, legal practice and policy design, and can be read by practitioners, academics and policy-makers.

PATENT LAW AND INNOVATION IN CANADA

A PATENT IS A GRANT FROM THE GOVERNMENT to the inventor of a novel, non-obvious and useful invention or discovery that gives the inventor the exclusive right to make, use, sell, and import the invention for a limited time. The features of patent regimes can be divided into two categories: those relating to patent *applications* and those relating to patent *enforcement*. Some statutory factors affect the process of obtaining a patent and others the process of enforcing patent rights. In the patent application process, the important task is to determine the *priority* and *patentability* of an invention. The determination of priority relates to who is the first to qualify for a patent. Within most countries in the world, it is the first to file who gets the priority. In the United States and the Philippines, it is the first to invent. Not all patents applied for are eventually granted by a patent office. In most modern systems, a patent is only granted for an invention that is: (i) new, meaning the invention must be original; (ii) non-trivial, meaning that it would not appear obvious to a skilled practitioner of the relevant technology; and (iii) useful, meaning that it is industrially applicable and has commercial value. During the application process, it is necessary to incur fees, undergo examination and determine when public disclosure is to occur. If a patent is granted, the inventor is allowed a certain period of protection. In the post-grant stage, there may be third-party opposition to the grant, or restrictions such as compulsory licensing to third parties. For details, see Park (1997) and Cockburn and Chwelos (1999).

In the *enforcement process*, the courts enforce patent rights through the application of statutory provisions such as a preliminary injunction, contributory infringement, burden of proof reversal, discovery, and doctrine of equivalents. For details, see Park and Ginarte (1997). Both features determine the overall level of patent rights protection in a patent system (a strong versus weak regime). The overall level of protection or strength of a patent regime in turn determines whether the patent regime is fostering creation and the diffusion of technological innovation.

Intellectual property protection in Canada has a long history, and a patent has historically been viewed as the strongest possible form of intellectual property protection (Henderson, Knopf, Rudolph, Watson, Kokonis and McRae, 1994).

Canada was created as a federation in 1867 and its first *Patent Act* dates from 1869. Canadian patent laws were established, and subsequently amended, in light of Canada's economic and political systems, social and economic needs and ethical values. Although most of the provisions of the initial *Patent Act* and subsequent amendments were derived from U.S. patent law, there are features of the Canadian patent system which differ from that of the United States. Hayhurst (1986) provides a good overview of these differences, as do Doern and Sharaput (2000). On October 1, 1989, Canada's *Patent Act* underwent significant amendment to convert the patent system from a *first-to-invent* to a *first-to-file* system. The United States still maintains a *first-to-invent* system.

THE ECONOMICS OF PATENT LAW

IN MARKET ECONOMIES, IPRs are designed to overcome *market failures* — especially low appropriability, high uncertainty, and capital market imperfections — that cause underinvestment in inventive activity (research and development). Thus, the underlying rationale for intellectual property protection is that it improves resource allocation by enabling people who create ideas, products, processes or expressions of ideas to capture more of their creative activity. But protecting innovators too stringently may limit the dissemination of new ideas and, therefore, opportunities for economic growth. Thus, in accommodating their economic development goals, countries should maintain an appropriate balance between incentives to innovate and the need for adequate diffusion of technical knowledge into their economy.

Based on the very presence of a technological gap among nations, it is not difficult to postulate that a society must be innovative and good at producing, distributing and using (technical) knowledge in order for its economy to grow, develop and perform satisfactorily. Changes in technology often take place as a consequence of inventions. Technological change spurs growth, increases productivity, generates jobs and enriches experiences.

Joseph Schumpeter's writings describe three phases in the process of technological change: invention, innovation, and diffusion or imitation. The first two phases refer to technology development. Invention is best defined as an idea, a sketch or a model for a new improved device, product, process or system. An innovation, in the economic sense, is accomplished only with the first commercial transaction involving the new product, process, system or device. Innovation then entails refinement of the basic idea, testing prototypes, debugging, development, engineering, initial production and perhaps initial marketing as well. The third phase is the diffusion or imitation, which occurs after the invention and innovation stages and refers to the process by which the innovation spreads across the market. Successful utilization of an innovation requires that its diffusion take place both nationally and internationally.

It may then be concluded that a full assessment of an economy's performance must take into account all three phases — invention, innovation, and diffusion or imitation. Consequently, four different economic theories of patent law have developed. Each theory is based on different assumptions about the link between patent rights and innovation. The four variations are called the invention-inducement theory, the disclosure theory, the development and commercialization theory, and the prospect development theory. These variations share the assumption that absent strong patent protection, the innovation process will somehow be impeded.

Invention-inducement Theory

This version accords with the view held by most scholars and laypersons of the economic bases for intellectual property law. The protection granted by intellectual property law is necessary to stimulate innovation. Absent the potentially huge rewards that monopolistic control over one's invention could create, no one would have the incentive to invent except for non-pecuniary motives. Intellectual property law operates like a prize or reward granted to the person who first invents. In the absence of such reward or prize, invention may still occur but on a lesser scale. Talent that would move to other sectors will be lured to inventorship.

Disclosure Theory

The disclosure theory has been described as the reverse of the invention-inducement theory. While the invention-inducement theory states that protection is needed to produce invention, the disclosure theory states that protection is needed to make inventors disclose their inventions. Inventions occur for several reasons, including pecuniary reward, according to the disclosure theory. But protection is needed to keep inventors from adopting inefficient techniques to protect their inventions from public discovery and potential theft. The intellectual property system secures rights to the invention in exchange for public disclosure. What is really being promoted is not invention, but discovery by the public of the inventor's work.

The disclosure theory recognizes that the value of an invention lies ultimately in public use rather than private reward. If inventions are used, development and progress are more likely to result than if they are fully privatized and never made public. The assumption is that inventions would not as readily be disclosed without the private monopoly. Although this variation of the traditional justification does not fully adopt the romantic author model, it certainly adopts a selfish author model. Furthermore, this view ignores the costs of creating a private monopoly on the public use of intellectual property.

Development and Commercialization Theory

The disclosure theory rests on the premise that the true value of an invention comes after it is invented. Similarly, the development and commercialization theory bases intellectual property protection on the need to reduce the costs to inventors of marketing and commercializing their inventions. Under this theory, intellectual property law turns inventions into assets that can be sold, licensed, developed, used as collateral for financing, and otherwise turned into a commodity to be distributed through the marketplace. One important application of this theory has focused on investment in research and development (R&D) by governments and state universities. The *Bayh-Dole Act* adopted in the United States in 1980 allowed government funded research laboratories to obtain patents on their inventions and license them. The Act has been justified on arguments rooted in the development and commercialization theory. Since the research was already funded by the government and disclosure was assured because of government funding, neither the investment-inducement nor the disclosure theory were an appropriate basis for the legislation.

Prospect Development Theory

Professor Edmund Kitch is the author of the prospect development theory, which is a hybrid of the other three theories, and consequently suffers from their inability to help understanding the problems of indigenous knowledge and business method patents. In his view, strong IPRs are needed in order to give the original inventor the incentives not only to invent, disclose and market the invention, but also to develop improvements to the invention. The foundation for this theory is that knowledge is a public good that can suffer from a commons problem — overuse by private individuals because of poorly defined property rights. By vesting property rights in the entire commons to one person, the commons can be maintained and used more efficiently. Professor Kitch applies this logic to the commons of ideas: strong ownership rights vested in the inventor are needed to efficiently and fully exploit the value of the invention.

With respect to Professor Kitch's rationale of vesting property rights over the commons in one inventor, the main criticism is that he ignores the value of having some ideas in the public domain that all can use. Although he recognizes this point, his position could readily be used to privatize more of the intellectual commons than is necessary, leading to what Professor Heller has called the anti-commons problem. If property is over-privatized, inefficiencies can result from the creation of excess transaction costs and loss of the benefits of scale economies. In the context of information, there are benefits from sharing ideas and knowledge for the development of ideas and the improvement of technology. Professor Kitch's position does not allow us to resolve this issue.

These four theories have been extensively tested and examined in the academic literature. Professor Adam Jaffe has provided a very thorough and recent survey of the connection between patent law and innovation. He frames the research question in terms of the major reforms to the U.S. *Patent Act* in the 1980s and 1990s, specifically the creation of a specialized appeals court, expansion of the patentable subject matter, legislation enabling research universities to patent and market inventions, and patent term extension. He concludes that these changes in patent policy, justified for their positive effects on innovation, have had little or no effect in stimulating innovation when considered empirically.

Professor Jaffe's conclusions rest on a survey of the scholarly literature. He focuses on three areas: (1) studies of the impact of increased patent scope on innovation; (2) studies of the effects of increased patent protection on less developed countries (LDCs); and (3) studies of patent litigation. The first group of studies provides the strongest support for our argument about the weakness of the patent-innovation link. The literature is divided in its conclusions about patent protection and innovation. The research question is framed around the effect of increased patent scope on the value of the patent and development in a particular industry. The major conclusions are that patents of greater scope may be worth more or may be worth less. The variation in findings may reflect differential costs that arise from having to litigate broader patents and the larger transaction costs that arise from having to invent around or license broader patents. Case studies of the Japanese patent system, which was amended in 1988 to permit multiple claims for a particular patent, and of the U.S. patent system found that the grant of patents inhibited innovation in key industries such as aeronautics and telecommunications. The study of the U.S. experience indicated that the source of the inhibition was the uncertainty among competitors about the future benefits of R&D which increased the costs of transacting licenses on patented inventions.

The biggest difficulty in assessing the link between patent law and innovation is the question of what industry development would have been like without the protections extended by the patent system. There is, of course, no way to answer this counterfactual. Some support is found in studies of the effect of patent protection in LDCs, the second part of Professor Jaffe's survey of the empirical literature. Although these studies are few in number and very general, the central finding is that LDCs would benefit from strong patent protection as a tool to attract investment from Western firms. Such conclusions are hardly counter-intuitive. According to these studies, patent law serves as a means of industry subsidy in LDCs. The more difficult, and unanswered, question is whether the patent subsidy is any more effective than other business subsidies, such as tax breaks or regulatory relief. Certainly, the patent system has costs. The third area of Professor Jaffe's survey, patent litigation, suggests that the grant of a patent leads to a high probability of litigation, especially in some key sectors

such as biotechnology. Furthermore, the threat of litigation has additional detrimental incentives on innovation and product development. Therefore, it is difficult to say that strong patent protection is beneficial for innovation in LDCs.

Professor Jaffe provides three explanations for the weak patent-innovation link. The first is that changes in patent law are accompanied by other changes in the legal and economic environment which make it difficult to isolate the effect of patent policy on innovation. Secondly, patent protection is only one variable affecting the decision to invent. While patent protection secures rewards to innovation, it does not address the other risks and costs associated with the invention process. Many of these risks and costs are difficult to assess and control. Finally, the patent-innovation link rests upon specific economic models, which are sensitive to assumptions about economic parameters.

Professor Jaffe's third point is illustrated by several papers in the economics literature about the effects of patent law on innovation. Several insights can be extracted from this vast literature. First, the link between patent protection and innovation will depend upon the type of competition faced by users in the final market where the patent will be used. Even though a patent results in a monopoly over an invention, the race to obtain the patent dissipates the rents that the patent monopolist earns. If the number of rivals in the race to obtain the patent is fixed, perfect patent protection will increase the rate of technical advance. If, however, patent protection is not perfect and imitation is allowed, then the rate of technical advance is lower. However, this last result changes as the number of rivals changes. If it becomes more competitive to win a patent, then imitation may either increase or decrease the pace of innovation. The reason for this is that increasing the number of rivals when imitation is possible lowers the probability of any given firm winning the patent race, but raises the value of imitating when someone else wins the race. Therefore, the connection between innovation and the strength of patent protection depends upon the number of rivals and how they compete to win the patent.

The value of licensing a patent also has ambiguous effects on innovation and the diffusion of technology. Licensing is found to have two effects. First, it provides a way for innovations to be used ex post by individuals other than the inventor, that is, after the invention is made. Second, licensing raises the value of waiting for someone else to make the invention ex ante. The net effect of patent licensing on innovation and technical advance is ambiguous.

Finally, patents can be used strategically to preempt the entry of new firms in the marketplace. If a patent race occurs between an incumbent firm in an established market and a potential entrant, the incumbent may overinvest in the race in order to deter the newcomer from entering the market. This use of patents illustrates the asymmetric aspect of patent races. The winner of a patent race gains an advantage, and the loser forsakes all the R&D cost incurred to try to win the race. For an incumbent firm, victory in the patent race may mean

not only gaining the value of the patent, but obtaining a stronger foothold in the marketplace. This use of patenting has served to explain the persistence of monopoly or concentrated industries.

In conclusion, recent surveys of the effect of patent law on innovation do not provide overwhelming empirical support for patent protection leading to technical advance. Of course, this does not mean that patent protection is unnecessary for innovation. The conclusion is that technical progress and innovation depend upon many factors, of which patent protection may be only a small part. More importantly, the economics literature underscores the fact that patents often play an important strategic role through patent races, licensing, and deterring entry. Again, the latter research does not lessen the effects that patent law may have on innovation, but it does draw attention to broader roles for patents other than a means of securing rewards to investment.

THE CANADIAN PATENT SYSTEM

THE FUNDAMENTAL GOALS of the Canadian patent system are to promote the creation and diffusion of technology by providing the inventor with a limited monopoly (both in time and scope) over a technological solution in exchange for a full disclosure of the invention. Disclosure of inventions in patent applications is the sole source of patent information, and provides a global tool to assess the state-of-the-art in a given technology field.

A Canadian patent is entirely the product of federal law as embodied in the *Patent Act*. The statute defines a patentable invention and the requirements of patentability, and describes the rights inherent in the patent grant. Since its inception, the *Patent Act* was amended several times during the last century. Extensive amendments were made recently. On October 1, 1989, Canada abandoned its first-to-invent patent system in favour of a first-to-file system. Table A-1 in the Appendix provides a side-by-side comparison of the most important amendments made by the *Patent Amendment Act, 1987*, R.S.C. 1985, c.33 (3rd Supp). Among the numerous other amendments to the *Patent Act*, provisions relating to the novelty requirement have been modified. The duration of the patent grant for applications filed before October 1989 is 17 years from the date of issue. For applications filed after October 1989, the term of the grant is 20 years from the date of filing in Canada. New applications will be laid open for public inspection no later than 18 months from the earlier of the Canadian filing date or the priority date. A patentee and licensees will be able to recover reasonable compensation for damages sustained by reason of any infringement between the date of publication of the patent application (its date of being laid open) and the date of the patent grant. Claims that have been a necessary part of a patent specification have also been modified. The present statute requires that the specification shall "end with a claim or

claims stating distinctly and in explicit terms the things or combinations that the applicant regards as new and on which he claims an exhaustive property or privilege.” (R.S.C. 1985, as amended subsequently; par. 27(4)). Given these changes, it is now well recognized that the 1989 patent reforms expanded the scope of patent protection in Canada (Binkley, 1999).

The primary purpose of the Canadian *Patent Act* is to promote innovation. This is evidenced by its elaborate incentive scheme. It confers exclusive rights which enable the patentee to realize monopoly profits from the sale of his invention by charging prices greater than the marginal cost. The monopoly given with the grant of a patent is evidenced in the *Patent Act* as “the exclusive right, privilege and liberty of making, constructing and using the invention and selling it to others to be used, subject to adjudication in respect thereof before any court of competent jurisdiction.” (*Patent Act*, R.S.C. 1985, as amended; s. 42) With this monopoly, the patentee is able to recover R&D costs. Without this monopoly, competitive imitation would erode monopoly profits, preventing the inventor from recovering such costs (McFetridge, 1995).

While the Act is not as explicit in promoting the diffusion of technology as other nations’ patent laws, the limited and non-renewable patent term and the requirement that the invention be fully disclosed in the patent application constitute an excellent source of technological information and thus contribute to the diffusion of technology. For example, the Japanese patent system is more progressive toward promoting diffusion than invention. The objective of the Japanese system is to encourage inventions by promoting their protection and utilization and thereby to contribute to the development of industry (Article 1, Patent Law). In contrast, by virtue of the disclosure requirements of the *Patent Act*, the knowledge acquired by the inventor during the innovation process is disseminated upon patenting. It then appears that such disclosure permits other inventors to learn from and improve on the patentee’s efforts, leading to an accelerated pace of technological development.

A natural question is: whether the reforms made to the legislation in 1989 have fulfilled the fundamental goals of the Canadian patent system — to promote the creation and diffusion of technological innovations, and thus enhance economic performance in Canada.

Some researchers believe that the 1989 patent reform in Canada did not bring about the promotion of innovation — a fundamental goal of the patent system. According to Binkley (1999, p. 231): “The ease with which we grant patents in Canada combined with the protection offered to patentees by the courts impairs new product development in Canada.”

Such an assertion is based on the proposition that Canada grants patent rights to patentees more broadly than in many other jurisdictions, and that Canadian courts enforce patent rights with vigour and that, as a result, technological development is impaired. See Binkley (1999) for details.

There is some evidence on the link between patent law and licensing in Canada. Licensing is an important form of technology transfer that has been virtually ignored in the econometric literature on IPRs. Foreign direct investment (FDI) is one indirect channel of technology trade. However, licensing to unaffiliated parties is a direct mechanism for technology transfer.

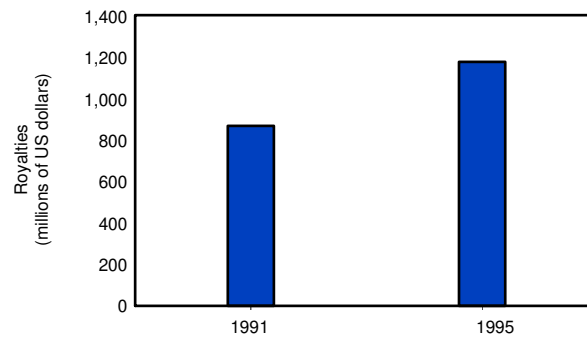
Intellectual property rights play a major role in technology licensing as they facilitate the appropriation of rents from the licensed technology. While patent protection is probably the most important instrument for safeguarding the technology, patent laws vary substantially across countries. The differences in patent laws in host countries influence the licensing behaviour of potential licensors — a distortion in the technology transfer that was first recognized by Horstmann and Markusen (1987). They concluded that strong IPRs would probably favour licensing over FDI by enforcing licensing and royalty contracts. In the absence of strong patents, problems of transmission of information with licensing, such as non-excludability of property over new knowledge and informational asymmetry, may favour FDI over licensing.

Stronger IPRs also affect the sharing of rents between the licensor and licensee. Rent sharing is a commonly observed feature in licensing contracts. Innovators earn a significant portion of the returns from their innovation through licensing. Empirical evidence indicates that licensors earn, on average, 40 percent of the rents from an innovation (Caves, Crookell and Killing, 1983). Stronger IPRs make it harder for the licensee to imitate the licensor's product, and thus reduce the possibility of losing the potential rent from the innovation. On this issue, Gallini and Wright (1990) demonstrate that when imitation is possible, there is asymmetry of information and the licensor sacrifices some rents though its share rises with imitation costs. Accordingly, the share of the rent accruing to the licensor rises with patent strength, increasing the returns to licensing (Maskus and McDaniel, 1999). Thus, the essential point is that the question of whether licensing would rise or fall, or whether the rent from licensed innovations would rise or fall with stronger IPRs is an empirical one.

Quantitatively, licensing is significant. As an instrument of appropriating returns from innovation, it has made a significant contribution to the Canadian economy. For example, in 1991, Canadian receipts of royalties and license fees were US\$928.69 million. In 1995, royalties and licensing fees had increased to US\$1,259.11 million, a 35.6 percent rise in four years (Figure 1). Although Canada experienced a reasonably large increase, it was still one of the lowest among the G-7 countries. Between 1991 and 1995, the largest increase occurred in Japan (117.2 percent), followed by the United Kingdom (80.8 percent), Germany (69.5 percent), the United States (48.8 percent), Canada (35.6 percent) and France (24.6 percent). Italy experienced a decline in royalty payments (14.4 percent) over the same period (Figure 2).

FIGURE 1

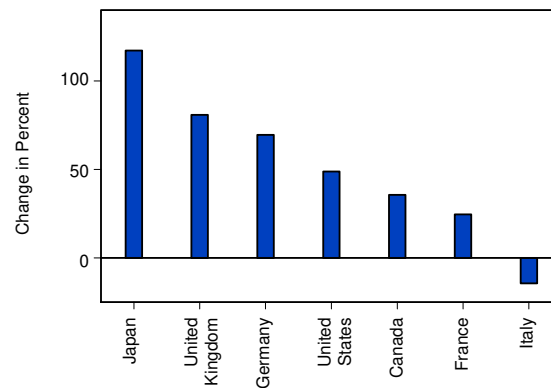
RECEIPT OF ROYALTIES BY CANADIAN INVENTORS, 1991 AND 1995



Source: OECD.

FIGURE 2

CHANGES IN RECEIPT OF ROYALTIES BETWEEN 1991 AND 1995
ACROSS G-7 COUNTRIES



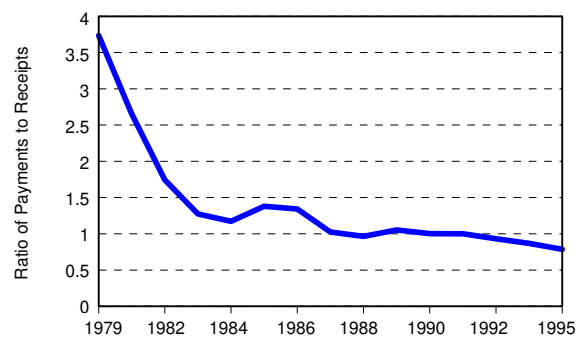
Source: OECD.

The importance of licensing Canadian technology abroad is also reflected in the decline in the technology balance of payments. Traditionally, Canada had a low ratio of domestic-to-foreign applications, indicating that it was a significant absorber of foreign technologies. This trend has recently changed. As shown in Figure 3, the ratio of payments to receipts of royalties and license fees in Canada's technology balance of payments was about 4.0 in 1979. However, the ratio declined to near-balance by 1991, revealing Canada's rising relative position as a technology supplier. Canada became a net exporter of technology in 1995. This reinforces the need for protecting intellectual property overseas so that economic rents from licensed technologies may be appropriated. While licensing is an important form of technology transfer, there is little systematic evidence on whether it is influenced by the strength of local patent regimes.

A recent empirical study that relates the volume of U.S. international licensing to an index of patent strength indicates that, other things being equal, countries with stronger IPRs attract larger volumes of licensed technology and the impact is stronger for arms-length transactions (Yang and Maskus, 1998). Earlier studies are also relevant in this context. A survey of U.S. multinational enterprises conducted by Mansfield (1994) showed that they are less likely to transfer advanced technologies to unaffiliated firms in countries with weak patent rights. In another study, Contractor (1980) examined a sample of 102 technology licences and found that total returns on licensing are higher for patented technologies. Using cross-country data for 1982, Ferrantino (1993)

FIGURE 3

TECHNOLOGY BALANCE OF PAYMENTS FOR CANADA,
1979-95



Source: OECD.

found that membership in the Paris Convention stimulated flows of U.S. receipts of unaffiliated royalties and license fees from the host country.

Thus, the issue is whether the variations in the strength of foreign patent laws affect the flow of Canadian technology trade through licensing and whether stronger patent laws in the recipient countries facilitate the appropriation of returns on licensing of patented technologies.

In contrast with the benefits of licensing, the inadequate functioning of the Canadian patent system in fostering innovative activity and commercialization of new products has also been emphasized by Trefler (1999), who asserts that “[Change] has led to a disturbing distortion of the patent system. Distressingly, firms are finding expensive, litigious ways of circumventing public disclosure of their inventions, thereby redirecting funds away from real R&D, retarding open science, and making innovation more expensive.”

By contrast, Saunders (1999) points out that “I cannot conclude that Canadian patents that ought not to be granted are being granted, yet are being inappropriately upheld by the courts. To the contrary, my experience is that Canadian patents, while not perfect, are generally good, and are reasonably well judged by the courts.”

The debate concentrates on the effects of changes in specific components of the *Patent Act* on the creation and diffusion of innovation. A similar debate is ongoing in the United States. In an effort to harmonize the U.S. patent system with those of the rest of the world, the U.S. Congress has been considering the *Examination Procedure Improvements Act* (Title II of both H.R. 400 in the House and S. 507 in the Senate) that will require, among other things, that each patent application be published as soon as possible after 18 months from the earliest filing date. The proposed legislation has generated a heated public debate. Supporters of the Act, including large and innovating corporations such as Eastman Kodak, GE, IBM, Lucent Technologies, Motorola, Texas Instruments and Xerox, argue that the legislation will increase certainty about legal rights over inventions, help avoid wasteful duplication of R&D expenditures, reduce the number of useless patent filings and create new opportunities for disseminating patent-related information. They also maintain that “...such legislation is critical for the continued vitality of U.S. industry and jobs.” On the other hand, a group of 26 U.S. Nobel Laureates in economics, physics, chemistry and medicine, led by Franco Modigliani, argued in an open letter to the U.S. Senate that “[S. 507] will prove damaging to American small inventors and thereby discourage the flow of new inventions that have contributed so much to America’s superior performance in the advancement of science and technology. It will do so by curtailing the protection they obtain through patents relative to the large multinational corporations.”

Neither side in these debates has been sufficiently guided by empirical work. Given these conflicting views, it seems that a formal empirical analysis of

the impact of various aspects and statutory provisions of the Canadian *Patent Act* in fostering innovations, and thus enhancing economic performance, is badly needed. The point has been well emphasized even by lawyers. As Binkley (1999, p. 231) says, "If I were a skilled social scientist, I would design research that would support or reject my thesis."

Given that the legal and procedural reforms to the Canadian patent system in the late 1980s broadened the scope of patent rights in Canada, the important issues are: Does an expansion of the scope of patent rights really induce more innovative effort? Does it induce additional innovative input? Does it induce innovative output? More generally, what is the impact of the Canadian patent reforms of 1989 on innovation? The empirical exploration of these issues has important implications for both the patent policy debate and the assessment of economic performance. A decade has passed since most of the changes were made to the Canadian patent system and there should be adequate data to test whether there has been a structural change in R&D activity.

EMPIRICAL FINDINGS ON THE LINK BETWEEN PATENTS AND INNOVATION

THE CONNECTION BETWEEN PATENT LAW and economic performance can be divided into three steps: the effect of patent law on the decision to patent, the effect of patenting activity on innovation, and the effect of innovation on growth and other measures of performance such as productivity and the balance of trade.

Effect of Patent Law on Patenting Activity

There is a large body of theoretical literature on various aspects of patent laws including the *optimal length and breadth of patents* (Nordhaus, 1969; Scherer, 1972; Rafiquzzaman, 1987, 1988; Gilbert and Shapiro, 1990; Klemperer, 1990; Gallini, 1992; Chang, 1995; Green and Scotchmer, 1995; Matutes, Regibeau and Rockett, 1996; Eswaran and Gallini, 1996); priority rules such as *first to file* versus *first to invent* (Scotchmer and Green, 1990); *novelty requirements* (Scotchmer and Green, 1990; Scotchmer, 1996; Eswaran and Gallini, 1996); and *public disclosure requirements* of the patent system (Aoki and Spiegel, 1998; Scotchmer and Green, 1990).

The policy-controlled variables that can be chosen in the theory of optimal patent design include patent life and breadth, and novelty requirements. The theory of optimal patent length examines how the competing objectives of providing an adequate incentive for R&D and minimizing monopoly distortions determine an optimal patent length (Nordhaus, 1969; Scherer, 1972; Rafiquzzaman, 1987, 1988; De Brock, 1985; La Manna, 1992; de Latt, 1996). Gilbert and Shapiro (1990) and Klemperer (1990) extend this analysis to determine both the optimal length and breadth of a patent, thereby demonstrating

the importance of patent breadth, or scope, as a policy instrument. Patent breadth represents the degree to which a product or process must differ from a patented one to avoid infringing the patent.

There is no uniform definition of patent breadth. The breadth of a patent determines when the developer of a new invention must compensate the developer of a prior one. It depends on the nature of the invention and tends to be idiosyncratic. In filing for a patent, an inventor lists one or more *claims* that represent the contribution of the inventor over and above the prior art. The Patent Office examines, and possibly modifies, these claims before awarding the patent. Infringement is determined at trial by comparing the allegedly infringing product or process to the claims of the patent (for details, see Hunt, 1999). Scotchmer and Green (1990) define scope in terms of novelty. They considered two standards of novelty (strong and weak) and compared strong novelty requirements (only big inventions can be patented) with weak novelty requirements (small inventions can also be patented) under two priority rules: the first-to-invent rule and the first-to-file rule. They show that the latter provides firms with stronger incentives to patent, but it also induces firms to overinvest in R&D relative to the socially efficient level. In contrast, the first-to-invent rule can sometimes induce firms to underinvest. They further show how the disclosure requirement of patent law may discourage firms from patenting intermediate discoveries, if by doing so they lose an advantage over their competitors in ongoing research. Gallini (1992) defines the scope in terms of the cost of imitation and shows that increasing the life of a patent may induce rivals to invent around the patent and thereby discourage investments in innovation. In this case, the optimal policy is to grant patents that are just broad enough to deter imitation and adjust their length to provide innovators with enough profits to induce them to invest in R&D. Scotchmer (1999) used the cumulative innovation concept to make the point that stronger patent protection does not necessarily increase innovation. Future innovators may be given less incentive to innovate because the level of patent protection afforded to existing innovations makes further innovations more difficult. What future innovators gain from having stronger protection once innovations are made, they may lose by being more likely to infringe existing patents.

More recently, Aoki and Spiegel (1998) defined the scope of a patent in terms of public disclosure requirements, in that patent applications must be published 18 months from the date of filing, even if no patent has been or will ever be granted. They analyzed the consequences of public disclosure of patent applications. They concluded that public disclosure leads to fewer patent applications and fewer innovations; but, for a given number of innovations, it increases the likelihood that new technologies will reach the product market, and thereby increases consumer welfare.

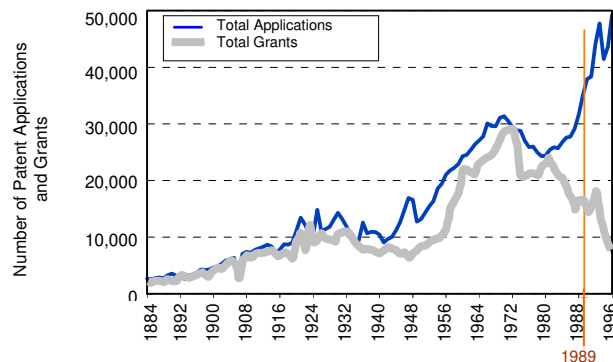
Merges (1988, 1992) examined the impact of non-obviousness requirements on the incentive to innovate. He argues that one role of patents and strict non-obviousness requirements is to encourage firms to engage in *risky* R&D projects, where there is less certainty of commercial success. In the absence of patents, if less risky projects are undertaken there is little social gain to extending protection to more obvious inventions. However, there is the social cost of additional monopolies. O'Donoghue (1998) argues that with transaction costs or costly monopoly distortions, a patent regime based on strict non-obviousness requirements is superior to a regime that requires innovators to license from prior inventors. In the context of a technological leader-imitator model, Cadot and Lippman (1995) show that the leader's incentive to innovate depends on the time required for the imitator to reverse-engineer the latest invention. They show that the leader's incentive to invest in R&D is maximized by the delay between his invention and successful imitation. Finally, Hunt (1999) also examined the impact of non-obviousness requirements on the incentives to innovate. While some authors claim that a less stringent non-obviousness requirement encourages private R&D by increasing the probability that the resulting discoveries will be protected from imitation, Hunt argues that relaxing the standard of non-obviousness creates a trade-off — raising the probability of obtaining a patent, but decreasing its value. He further shows that weaker non-obviousness requirements can lead to less R&D activity, and that this is more likely to occur in industries that innovate rapidly.

Kortum and Lerner (1998) proposed three possible explanations for the change in the propensity to patent: the pro-patent policy hypothesis, the regulatory capture hypothesis, and the fertile technology hypothesis. They found that the U.S. data did not support the first or second hypotheses, thus leaving the third as the most likely candidate. In particular, they argued that R&D management change was the most likely cause. Therefore, the impact of the policy change is called into question.

Rafiquzzaman and Whewell (1998) tested the relative impact of these hypotheses to explain the causes of the recent surge in patenting activity in Canada. Figure 4 presents the trend of patent applications and grants in Canada since 1884. It shows that the growth rate of the number of patent applications has been dramatically increased after the 1989 reform of the *Patent Act*. Their findings suggest that, although both the fertile technology hypothesis and the pro-patent policy hypothesis are at work, the former can better explain the recent increase in patenting activity in Canada. These findings then show that changes in patent policy do not significantly alter overall patenting behaviour. This further suggests that patent policy need not affect the firm's decisions regarding the patenting of innovation output.

FIGURE 4

CANADIAN PATENTING ACTIVITY, 1884-1996



Note: Total Applications indicates the total number of patent applications (domestic and foreign inventors). Total Grants indicates the total number of patents granted (domestic and foreign inventors).

Source: World Intellectual Property Organization (WIPO).

Using patent design alone as a way of stimulating innovation may not be effective. This conclusion is supported by at least two pieces of evidence from Japan and Italy. The Japanese patent system went through a major reform, enacted in January 1988. One of the major changes was that Japan went from a single claim system to a multiple-claim system, thus making a significant expansion in the scope of patent rights in Japan.

Sakakibara and Branstetter (1999) examined the effect on R&D allocation and patenting in Japan after the 1988 reform of the *Patent Act*. They checked whether an expansion of patent scope induced more innovative effort by firms. Their evidence shows that while the 1988 patent reforms significantly expanded the scope of patent rights in Japan, their impact on additional R&D effort and innovative output (patenting activity) was only modest. Specifically, the study found little evidence that the expansion of patent scope induced additional R&D effort by Japanese firms. However, looking at the patenting activity of Japanese firms in the United States, the study showed that the patent reforms in Japan resulted in increased innovative output.

Scherer and Weisburst (1995) examined the change in R&D activity of pharmaceutical firms after Italy passed a law allowing pharmaceutical product patents in 1982. They found that Italian firms which were largely imitators before the law was changed did not become innovators afterwards. The level of R&D expenditures and new products among Italian firms did not increase significantly.

However, patenting activity by pharmaceutical firms did increase. This is not surprising simply because firms in the pharmaceutical industry tend to utilize patents rather than trade secrets to protect their innovations.

In summary, given the limited empirical evidence cited above, it seems that patent-strengthening policy shifts, through changes in various aspects of patent laws, do not have significant effects on fostering R&D and innovative output. This evidence, however, is very limited in scope in that it is country-specific and industry-specific. Therefore, a natural question is: Did the 1989 patent reform in Canada induce more innovative effort and innovative output by firms in Canada? The only study available for Canada suggests that the pro-patent policy shifts in Canada had little significance in increasing innovative output (Rafiquzzaman and Whewell, 1998). Therefore, it is important to know whether changes in various aspects of patent laws have induced more innovative effort in Canada. In particular, has the 1989 patent reform brought about the intended goal of fostering creation and diffusion of innovation? To this end, it is important to analyze empirically, for example: (i) What is the impact of the first-to-file system vis-à-vis the first-to-invent system in the creation of innovation, with respect to both products and processes? Has the first-to-file system enhanced technological diffusion? (ii) What has been the impact of public disclosure requirements on innovation? (iii) Have the 1989 reforms that resulted in an expansion of patent scope in Canada induced more innovative efforts by Canadian firms? Given that a decade has passed since the 1989 reforms, it is important to test whether the reforms have brought about a structural change in R&D and innovation activities among Canadian firms.

The Link Between Patenting and Innovation

Gould and Gruben (1996) argued that if firms innovate only to capture or hold market share, they may not increase their rate of innovation with stronger IPRs when their market share is already guaranteed. The theoretical work of Rivera-Batiz and Romer (1991) confirms such conclusions in a closed economy context. The authors demonstrate that in a closed economy, protecting intellectual property may not increase innovation because the prevailing competitive framework is inadequate to facilitate innovation. In these economies, copying foreign technologies is more profitable than innovation. There is empirical evidence which suggests that stronger IPR protection may not provide a stimulus to innovation in countries that are highly protected from international trade. For example, in a survey of more than 3000 Brazilian firms, Braga and Willmore (1991) found that firms' propensity to develop their own technology or to purchase it abroad were both negatively related to the degree of trade protection enjoyed in the industry. The theoretical work of Rivera-Batiz and Romer (1991) confirms such conclusions.

Other evidence suggests that strong intellectual property protection stimulates innovation. Survey evidence suggests that, at least in the United States, protection stimulates innovation (Mansfield, 1986) and the social rate of return appears to be considerably higher than the rate of return to the innovator (Mansfield, Rapoport, Romeo, Wagner and Beardsley, 1977). In a Brazilian survey, 80 percent of 377 firms said they would invest more in internal research and would improve training for their employees if better legal protection were available (Sherwood, 1990). Mansfield (1994) finds that U.S. firms, particularly in the chemical and pharmaceutical industries, limit FDI in countries with weak IPR protection.

In contrast, open economy regimes may exhibit a stronger linkage between intellectual property protection and innovation. In an open economy, local firms are more likely to face competition from foreign producers that use the latest technology both in their production process and in their products. Local firms may wish to meet this challenge by purchasing technology from abroad, but find that inadequate protection of intellectual property at home severely limits their efforts. The owners of the foreign intellectual property may not be willing to sell their products or license innovations (technology) to firms in a nation that does not have adequate protection to prevent potential competition generated by piracy. There is empirical evidence supporting to this argument. In a survey of 100 major U.S. firms in six manufacturing industries, Mansfield (1994) found that a weak IPR system in a country deterred FDI and joint ventures, especially in R&D facilities.

While the impacts of the shifts in the patent policy through changes in specific statutory provisions of the patent law provide mixed results on incentives for innovation, the question remains as to what is the impact of the overall (aggregate) strength of the patent system on innovation. From a theoretical point of view, the impact is uncertain; it depends on circumstances. In closed economies, protection of intellectual property may not increase innovation because the competitive framework that prevails in these economies is inadequate to facilitate innovation. In contrast, open economy regimes may exhibit a stronger linkage between intellectual property protection and innovation.

The Link between Innovation and Economic Growth and Other Economic Measures

The diffusion of technological innovations, i.e. the process by which the use of new technology spreads, is widely recognized as being an engine of economic growth. Economic growth is a function of technological progress, which depends in turn upon the flow of new technologies and the rate at which these technologies are diffused throughout the economy. Thus a high level of technological

innovations will lead to a large increase in productivity and thus a great acceleration in economic growth.

Innovation stimulates growth by causing the introduction of new goods and services to the market. In addition, innovation results in improved methods of production of current goods and services that leads to economic growth as well. Differences in policies across nations which encourage the creation and diffusion of innovation may therefore be an important determinant for explaining differences in cross-country growth rates. Thus study of the factors explaining the differences in economic growth differences is important, as they affect the standard of living.

Economic theory suggests that in market economies, the power of expected profits is the driving force behind the motivation to innovate (Gould and Gruben, 1996). Individuals engage in innovative activities expecting that institutional arrangements will not deprive them of the value they create. Unless the returns to innovative activity accrue adequately to the producers, the incentive to continue to innovate will diminish or disappear altogether. Thus well-defined IPRs, in the form of patents, trade-marks, copyright, and trade secrets, foster innovative behaviour, such as investments in R&D, and thereby accelerate economic growth. In addition, patent protection may invite foreign investment, foreign trade, and a flow of new technology which contribute to the economic growth process of a country. Thus there is a relationship between economic growth and efficient intellectual property protection.

Economists have long studied the relationship between technological progress and economic growth. The traditional theory of economic growth, originating with Solow (1956), assumes that a country's production is carried out by employing only labour and capital and the production function exhibits constant returns to scale. This neoclassical theory predicts that economic growth and productivity is driven by exogenous (that is, unexplained) technical progress, and that productivity levels and growth rates across nations should converge over time. The neoclassical model of economic growth would predict that poor countries should grow faster than rich countries, i.e. convergence in per capita income should occur. Empirical evidence indicates that such convergence did not occur and poor countries, in general, have not grown more rapidly than rich ones (Barro, 1991). The traditional theory does not apply as diminishing returns to capital in relatively rich countries have been avoided due to advances in technology.

In contrast to the traditional theory, the new theories of economic growth have tried to endogenize the role of innovation in the growth process. These new theories argue that the rate of innovation is the result of the profit-maximizing choices of economic agents, and that it is therefore possible for there to be permanent differences in productivity levels and growth rates.

Because the rate of innovation is an outcome of the profit maximizing choices of economic agents, and IPRs provide a market incentive which in turn stimulates innovative activities on the part of private firms, IPRs and economic growth are best studied within the context of endogenous growth theory. Within endogenous growth theory, there exists a field of research — pioneered by Romer (1990), Aghion and Howitt (1992), Grossman and Helpman (1991), among others — that considers innovation as the engine of growth. Endogenous growth models are based on the idea that innovation is carried out to make profits on the introduction of new and differentiated products by increasing the degree of product variety or quality. Every new product subsequently adds to the stock of human knowledge. Thus the rate of growth of the economy will vary directly with the rate of introduction of new products. In addition, economic growth will be faster the larger the stock of human capital or the better the environment to accumulate human knowledge. By creating an environment that is conducive to the accumulation of human knowledge, IPRs will tend to increase innovation and economic growth.

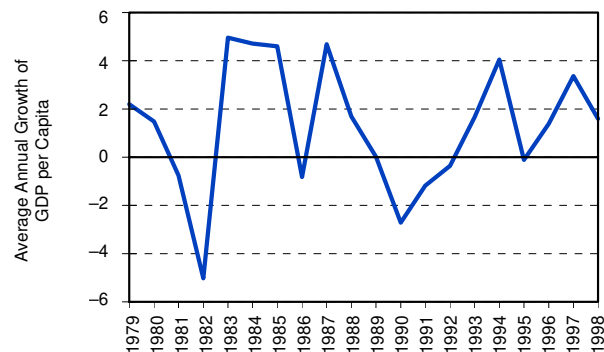
While the endogenous growth theory predicts that stronger protection of intellectual property will stimulate growth through stimulating innovation, there is very little empirical evidence to support this prediction. Economists have recently started to empirically determine the role of IPRs in economic growth (Park and Ginarte, 1997; Torstensson, 1994; Thompson and Rushing, 1996; Gould and Gruben, 1996). Their research seeks to establish an empirical link between IPRs and economic growth in order to assess the explanatory power of differences in intellectual property protection on cross country differences in economic growth. These studies measure the level of IPR protection across nations by the level of patent protection. Park and Ginarte (1997) considered a cross section of 60 countries in the world and found that IPRs affect economic growth by stimulating the accumulation of factor inputs like R&D capital and physical capital. Thus patent rights indirectly affect growth via stimulating R&D investment. Using cross-country data on overall levels of patent protection, trade regimes, and country-specific characteristics, Gould and Gruben (1996) found that intellectual property protection (as measured by the degree of patent protection and levelled by the Rapp-Rozek index) is positively related to economic growth. They further found that the effects are stronger in relatively open economies than in closed economies. In addition, controlling for other important determinants of growth, they found that those countries with the highest level of patent protection tended to grow fastest. The elasticity of intellectual property protection was 0.425, suggesting that a one percent increase in the strength of patent protection increases economic growth by 0.43 percent. In another study, Thomson and Rushing (1996) considered a sample of some 112 countries and used the Rapp-Rozek index of the strength of patent protection in order to establish the link between the level of patent

protection and the rate of economic growth. Their study also found that stronger patent protection enhances economic growth rates and the association is highly pronounced once a country has achieved a particular level of development.

In summary, existing empirical evidence suggests that IPRs indirectly affect growth via stimulating R&D investment. This suggests that after controlling for other factors of growth and investment, countries with weaker patent protecting have on average lower rates of R&D activity and growth performances. It seems this is indeed the case in Canada. On the one hand, the overall level of patent protection in Canada has been lower than other industrial countries as indicated by the lower value of the patent protection index. At the same time, economic growth has been showing a declining trend (Figure 5). The rate of growth in real gross domestic product (GDP) per capita was less in the 1988-97 period than in the 1978-88 period (Figure 6). In addition, our preliminary estimates indicate that over the period 1980-95, the level of patent protection in Canada was negatively correlated with GDP growth rates, suggesting that IPR protection may be a plausible factor in explaining the slow growth rate in Canada.

FIGURE 5

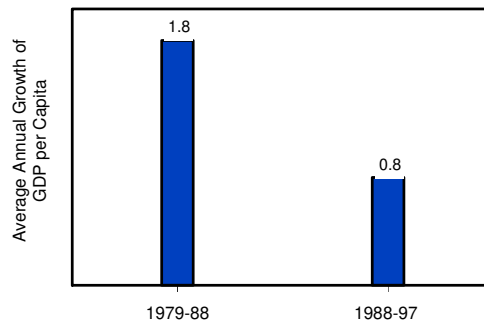
GROWTH OF REAL GROSS DOMESTIC PRODUCT, 1979-98



Source: Statistics Canada.

FIGURE 6

GROWTH OF GROSS DOMESTIC PRODUCT PER CAPITA,
1979-88 AND 1988-97



Source: Statistics Canada.

Finally, there is a growing body of literature that examines the nature and the direction of trade flows which may arise from stronger international protection of intellectual property. Several authors have looked at the theoretical link between trade and IPRs (Brown, 1991; Flam and Helpman, 1987; Schwartz, 1991; Taylor, 1993, 1994; Maskus and Penubarti, 1991, 1995, 1997; Maskus and Eby-Konan, 1994; Smith, 1999). These authors consider the decisions of firms to export to countries where changes are made to patent laws and find that trade volumes could rise or fall with the adoption of stronger patent regimes. They demonstrate that after a marginal change in patent legislation in a country, the optimal response of a firm could be either to increase or decrease its exports to that country because of a trade-off between enhanced *market power* for the firm resulting from stronger patents and larger *market size* (expansion) due to the reduced ability of local firms to imitate technologies embodied in imported goods. This fundamental indeterminacy may result from three other factors. First, besides patent laws, the trade reactions of foreign firms depend upon the structure of import protection. It is possible, for example, that a profit-maximizing exporting firm could either increase or decrease the volume of trade with a country that strengthens its patent laws, depending on the height of the tariff it faces (Maskus and Penubarti, 1995). Second, decisions by firms that own a new product or process about whether to export to a market are codetermined with decisions to service markets through licensing or FDI (Horstmann and Markusen, 1987). Third, firms will tend to trade more with

economies that have strong patent laws when they find that exporting to these economies raises their global profits and induces additional R&D efforts (Deardroff, 1992; Helpman, 1993).

Since the market power and market expansion effects are countervailing, the direction of the relationship is indeterminate. The theoretical literature in this area provides at best some guidance. It suggests that countries with strong patent rights tend to have high per capita income and that there is a link between the stage of development and policies toward patent rights (Deardroff, 1990; Ginarte and Park, 1997; Gruben, 1992; Nogues, 1990; Rapp and Rozek, 1990; Sherwood, 1990). As countries develop, their incentives for protecting intellectual property increase. On this issue, Maskus and Penubarti (1995, p. 230) note that "It seems probable, however, that the market expansion effect may tend to be more dominant in larger countries with highly competitive local imitative firms. On the other hand, the market power effect may tend to be stronger in smaller countries with limited capacity for imitation."

The direction of the effects of national patents rights on bilateral exports was further defined by Smith (1999), from both a theoretical and an empirical standpoints. Smith argues that the direction of the patent right effects on trade depends on the strength of the importing country's threat of imitation. The threat of imitation is a function of the importing country's IPR regime and its ability to imitate foreign technology embodied in imported goods. She postulates that an importing country with weak patent rights and strong imitating abilities poses a strong threat of imitation to the exporting firm. In these countries, one expects an increase in exports through the market expansion effect.

Thus, in principle, different levels of IPRs could expand or reduce trade and the direction of the impact depends on the relative strength of the market expansion and market power effects of patent rights. Therefore, the impact of IPRs on exports is an empirical issue.

Maskus and Penubarti (1995) provided the first systematic empirical evidence on whether differential patent laws influence international trade. They found a strong positive relationship — a market expansion effect — between the manufacturing exports of OECD (Organisation for Economic Co-operation and Development) countries and the strength of patent rights, and the relationship is strong in both large and small developing countries. This positive relationship is observed for nearly all manufacturing industries. This effect is particularly strong in developing economies with significant imitative capabilities, suggesting that, in these economies, stronger IPRs increase trade flows through the expansion of market size. However, the effect is weaker in small developing countries with low incomes, suggesting that trade enhances the use of market power. Ferrantino (1993) also provided empirical evidence on the link between IPRs and trade using U.S. data, although he drew weaker conclusions. More recently, Smith (1999) updated this work and showed a considerably

stronger trade impact. Her empirical evidence indicates that U.S. exports are sensitive to patent rights in importing countries, and the direction of the relationship depends on the threat of imitation. She finds that strengthening patent rights enhances market power in countries where the threat of imitation is weak which will in turn reduce U.S. exports to those markets. Stronger patent rights, on the other hand, will increase U.S. exports to high-threat markets.

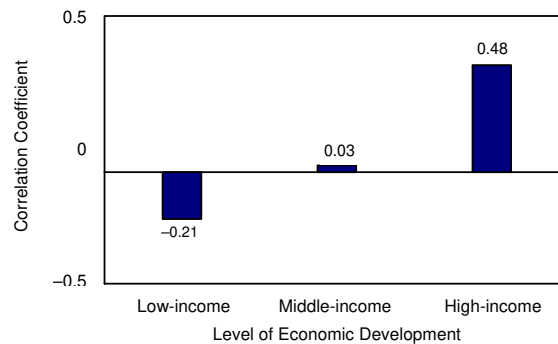
Given the importance of this issue, there is virtually no published empirical research on the extent to which the distribution of Canadian exports is influenced by the international pattern of IPRs except a study by Rafiquzzaman (1999). In that study, Rafiquzzaman provided the first systematic empirical evidence about the effect of national differences in patent rights on Canadian exports. He investigated the sensitivity of Canadian exports to national differences in IPRs using cross-sectional data on manufacturing exports, detailed by province of origin, country of destination and industry at the two-digit level. The data on bilateral trade come from Statistics Canada's TIERS (Trade Information Enquiry and Retrieval System) database. They show exports from Canadian provinces of origin to countries of destination (76 countries in the sample). The data are detailed for the 22 categories of the two-digit SIC (Standard Industrial Classification) level of commodity aggregation. The strength of intellectual property protection is measured by the degree of patent protection.

The study found that the cross-country patent strength and Canadian exports have a high positive correlation, both in magnitude and statistical significance. For example, the correlation coefficient was 0.24 in 1990. This suggests that, overall, Canadians tend to export more to countries where their IPRs are highly safeguarded.

However, the direction of the effect differed according to the destination country's level of economic development. The level of economic development of destination countries was measured according to the World Bank's classification. Importing countries were classified into three groups: high-income, middle-income and low-income countries. High-income developed countries are those that have a per capita income in excess of US\$7,910. Middle- and low-income countries have a per capita income between US\$636 and US\$7,910, and less than US\$636, respectively. These categories are based on the World Bank's classification of income per capita (World Bank, 1993, p. viii). For the high-income group, Canadian bilateral exports and national patent rights are strongly correlated, in terms of both magnitude and statistical significance; for the low-income group, they are significantly and negatively correlated (see Figure 7). In the middle-income group, patent rights and Canadian exports are virtually unrelated as indicated by the weak and statistically insignificant correlation coefficient. Thus, there is substantial indication that stronger patents induce more trade across all high-income countries and less trade across all low-income countries.

FIGURE 7

CORRELATION OF CANADIAN MANUFACTURING EXPORTS AND STRENGTH OF NATIONAL IPRs BY IMPORTING COUNTRIES' LEVEL OF ECONOMIC DEVELOPMENT, 1990



Source: Rafiquzzaman, 1999.

CONCLUSIONS ON PATENT LAW

IN THEORY, PATENT LAW PROMOTES INNOVATION, technological change, and economic growth by securing the right to appropriate the returns from innovation in the hands of the inventor. However, the connection between strong patent protection and various measures of economic performance is weak. Since Canada has recently amended its patent legislation to strengthen its protections, it offers a valuable experiment by which to gauge the economic effects of patent law. The following research questions would be worth pursuing:

- measuring the success of Canadian patent reform in fostering innovation and enhancing economic performance;
- measuring the effect of strengthened patent protection on R&D spending;
- measuring the impact of patent protection on economic growth;
- studying the effect of the institutional features of the Canadian patent system, such as pre-grant disclosure requirements, the first-to-file priority rule, and the multi-claim requirements on technology diffusion and economic productivity;

- determining the effect of the patent system on the inventive activity of small to mid-size entities;
- studying the effect of patent protection on human capital development and on-the-job training;
- understanding the connection between intellectual property protection and domestic and foreign direct investment in Canada;
- understanding the impact of patent protection on licensing and the flow of Canadian technology.

Equally challenging issues are raised by developments in trade-mark and copyright laws, the subjects of the next two sections.

PROMOTION OF BRAND AND FIRM IDENTIFICATION THROUGH TRADE-MARK LAW

A TRADE-MARK IS A WORD, a symbol, a design, or a combination of these, used to distinguish the wares or services of one person or organization from those of others in the marketplace. Trade-mark protection harkens back to the system of medieval guilds where the branding of products was used to indicate origin and distinguish the work of one guild member from that of another. In capitalist economies, trade-mark law serves three principal purposes: the creation of goodwill and firm reputation, the lowering of search costs among consumers and the prevention of consumer confusion, and a mechanism for price discrimination. Put very simply, a trade-mark allows a consumer to distinguish firms from other firms and products from other products, and also permits firms to distinguish among consumers.

As an example of this, consider the use of trade-marks in the market for gasoline. The trade-mark EXXON allows the firm to identify itself as the source of gasoline of a particular quality. Seeing the trade-mark EXXON applied to a particular type of gasoline allows consumers to make choices as to what type of gasoline to buy. Finally, brands allow firms to discriminate among consumers. If consumers sharing a certain demographic characteristic or income range buy EXXON gasoline as opposed to unbranded gasoline, the firm can discriminate in terms of price by charging more for the branded than the unbranded product, and also by providing a different product-service mix for the branded than for the unbranded product. Each of these goals of trade-marks has its economic benefits and costs.

The primary benefit of trade-marks is the creation of firm and product identity. A business that is just starting needs to establish a reputation for itself and for its products and services. Trade-marks serve to establish this reputation.

Note that a trade-mark is different from a trade name, which serves to identify the name of a business. Sometimes a trade name can also serve as a trade-mark, as with BMW or HILTON. There is a reputation associated with a trade name, but that reputation will entail more than the quality of the products and services provided by the firm. A trade-mark establishes the reputation of a business in association with a particular product or service. Consequently, a trade-mark can be viewed as a means of establishing reputation that is narrower than that established by a trade name. For example, two firms may have the same trade name, but it is unusual for two different firms to have the same trade-mark for the same product or service. Therefore, two different firms will not sell in a given market automobiles that are both called CARAVAN or WINDSTAR, and would not be allowed to under applicable trade-mark law. The reason for this distinction between trade names and trade-marks is that trade-marks also serve the function of protecting the consumer from confusion in searching products and services in the marketplace.

As an illustration of this benefit, consider a firm that is starting out in the software business. The firm will have a trade name to establish its identity as a business, but it may have different products ranging from accounting software to word-processing software. Each of these products might have a distinct trade-mark associated with it to help in identifying the source of the software. For example, the firm may adopt ACCOUNTSOFT for its accounting software or GRAPHCON for its word-processing software. Such trade-marks allow the firm to distinguish its software from others when consumers go out in the marketplace. If the product is particularly attractive, consumers will know what to ask for. Competitors will also recognize the product as well, and absent trade-mark law protection they may try to imitate the trade-mark, as opposed to the quality of the product, and divert sales from the start-up firm. Trade-mark law, at its minimum, would serve to prevent this type of imitation of names in order to protect the consumer from confusion and to protect the start-up's investment in its reputation.

Trade-mark law would also serve to protect the creator of trade-marks from other harms such as dilution or false association of the mark. If a non-competitor in the previous example started using the trade-mark GRAPHCON for a particular product that is graphically pornographic or violent (for example, a computer game as opposed to a word-processing program), then the start-up's reputation may also suffer. Even though a consumer may not confuse the game from the word-processing program, the common name may cause a sense of false association or false information about the affiliation of the producer of the computer game and the word-processing software. Therefore, most trade-mark law systems protect not only against the use of a trade-mark by a competitor, but also against uses by a non-competitor that may result in dilution or false association and other reputational harms.

One cost associated with the use of trade-marks is a reallocation of resources from the production of more innovating and desirable products and services toward expenditures on the creation of trade-marks, advertising and the development of a reputation. This cost may be exaggerated since consumers would not buy a new product or service simply because of the brand name if there is no difference in quality. But case studies in the pharmaceutical and automobile industries (as well as common-sense familiarity with the marketplace) demonstrate that a market for brand names is created through the trade-mark system. In other words, firms create trivial variations in product quality but expend resources on image and branding. It is difficult to measure the economic costs of such practices. The benefits are most likely minimal if economic benefits are measured by productivity growth in the production of better quality goods and services. Some of these costs can be addressed through trade-mark law itself by establishing a high threshold for the grant of a trade-mark and proof of infringement, issues we will discuss in more detail below.

A cost related to that of establishing a market in brands is that of price discrimination. By establishing different brands for the same product, a firm can discriminate between upscale and downscale consumers. An example of this phenomenon is provided by the luxury car market. Often there is very little difference in performance between a luxury version and a non-luxury version of an automobile. The LEXUS and TOYOTA brands often mark cars that are similar in quality. But the more upscale brand can attract a higher price. A similar phenomenon occurs with pharmaceuticals. Such price discrimination has benefits. By being able to service two groups of consumers, the firm may sell more output and sell to a broader market than would be possible without price discrimination. For example, in the luxury car market, if the firm could not create two brands and sell one for \$60,000 and the other for \$25,000, it would most likely create one medium-quality brand for \$30,000. The upscale market would still buy, but the downscale market would be priced out. As a result fewer consumers would be served and the firm's profits may be lower. But, of course, price discrimination has its costs especially if it is used to identify low-cost buyers and sell them a substantially lower quality product. This latter type of price discrimination might actually harm consumers from the perspective of equity and lead to a reduction in both the quantity and quality of branded and non-branded goods in the marketplace.

The final cost of trade-marks is the administrative cost associated with enforcing trade-mark rights. Some mechanism must be used to protect trade-marks. At a minimum, a registration system would be necessary to establish priority and resolve other disputes. Another mechanism would be necessary to establish when a firm has acquired rights in a given trade-mark, and of course infringement disputes must also be resolved through some system. Self-help is possible but may be inefficient by comparison with legal enforcement.

Most trade-mark systems employ a combination of administrative and judicial enforcement. An agency is established to grant trade-mark rights and to record them. The agency serves as a gatekeeper to check that a trade-mark is being used to brand a product or service and that the trade-mark is worthy of protection because of consumer identification. The agency would also serve to resolve conflicts before a trade-mark is established, for example, in ensuring that a proposed trade-mark does not conflict with existing or other proposed trade-marks. Finally, the agency may serve to cancel marks if they have been abandoned and fail to continue to offer consumer association with the firm. The judiciary serves as a forum for resolving infringement disputes and to punish through judicial remedies such as damages and injunctions copying of the mark by a competitor or dilution by a non-competitor.

Much of the economic effects of trade-marks discussed above arise in the area of trade dress, which will be addressed separately below. Trade dress protection applies to the design of a product. For example, the decor and atmosphere of a restaurant would be protected by trade dress. Such protection is particularly important for start-up firms who need to distinguish their product and service from competitors when there may be very little distinction in actual products or services across firms. A restaurant is an example of such a business; a retail outlet for books would be another. The economics of trade dress protection, an evolving area of law that is especially controversial, provides an important mirror on the purposes and costs of trade-mark protection more generally.

THE ECONOMICS OF TRADE-MARK LAW

THE ECONOMIC DESIGN OF PATENT and copyright law is to promote innovation in the applied arts and sciences while providing incentives for dissemination of information. Trade-mark law fits into this design in a very complex way. On the one hand, trade-mark law provides incentives for the creation of new words with which to identify new products and services. This expansion of the lexicon is important and examples such as THERMOS and ASPIRIN, both once trade-mark protected, demonstrate how trade-mark law can promote innovations in language. However, it is clear that trade-marks' role in innovating language is subsidiary to the commercial goals of selling products and services. An artist or research scientist can receive copyright or patent protection even if the subject matter is never commercialized. However, a firm cannot receive trade-mark protection unless the trade-mark is actually used in commerce to brand a particular product or service. The economics of trade-mark law, despite its ability to promote the development of language, is grounded in the creation of markets for products and services.

However, the effect of trade-mark law on the dissemination of information and the resulting effect on the promotion of innovation need to be considered. The branding of products makes it difficult for new entrants to enter a market because of the need for them to establish a reputation and distinguish their products and services from those of incumbent firms. Branding also creates loyalties with consumers and makes it difficult for consumers to switch to a new brand. Trade-mark law can be used to supplement the protection granted by patent law or copyright law. While patent and copyright grants are time-limited, trade-mark rights last potentially forever, or at least for as long as a trade-mark serves to associate a source with the product or service. In several industries, firms attempt to protect, through trade-mark law, products and services that could otherwise be patented or copyrighted. Branding in the pharmaceutical industry, discussed more fully below, is one example. But the use of brands extends beyond one industry. Computer software is protected by a combination of patent, copyright, and trade-mark laws. The character of Mickey Mouse, whose copyright is almost expired, is still protected by trade-mark law as an identifier of the Disney Company, and this trade-mark will disappear only when consumers fail to associate the character with the firm. The legal relationship between trade-mark and other intellectual property laws is still an open question. A pending case before the U.S. Supreme Court, involving the owner of an expired patent in traffic signs attempting to seek trade dress protection for the signs, should resolve these tensions. But the economic question of how trade-mark protection should be structured still remains.

The economic basis for trade-mark law rests on the protection of reputational investments made by firms and on the prevention of consumer confusion in their search for products. Consequently, there is little tension between trade-mark law and other intellectual property laws if it is correctly applied and administered. If a product is protected by patent law or copyright law, it can still be protected by trade-mark law, even after the patent or copyright has expired. For example, if a firm has patent protection on computer software, then trade-mark protection can still be acquired for brand identifiers, such as the name of the software, when the patent expires. Trade-mark law protects very different interests from those protected by patent and copyright laws. The difficulty arises when the subject matter of the bodies of law are blurred. Design elements of a product can be protected by patent, copyright and trade-mark laws. If a firm has a patent over design elements and the design elements also serve as a trade-mark (for example the shape of the product), then the difficult question is whether trade-mark protection for the exact same elements of the patented design should continue when the patent expires. The argument against such continuation is that trade-mark law is effectively extending the life of the patent, undercutting the balance within patent law between promotion and dissemination of innovation. The arguments in favour of continuation recognize

the different interests protected by trade-mark and patent laws. Patent law gives the patent owner an exclusive right against the world to prevent use. Trade-mark law gives the trade-mark owner the right over the use of the trade-mark when such use would cause confusion among consumers or dilute the trade-mark owner's reputation. Even though the subject matters of the patent and trade-mark may overlap with respect to design elements, the scope of rights is different and there is arguably no conflict between the two sources of protection.

The economic interaction between trade-mark law and other intellectual property laws rests on assumptions about the economic efficacy of the trade-mark system. My discussion above implicitly assumes that the trade-mark system is an ideal one and is economically rational. The argument also ignores the way in which market actors may use trade-mark law strategically to deter entry and gain market share without necessarily providing benefits such as innovation or the creation of a reputation. What should ideally look like a trade-mark law system designed to promote economic rationality?

Landes and Posner (1987) present the classic discussion of the economics of the trade-mark law system. In a formal model, they demonstrate the role of trade-marks in reducing search costs for consumers and in providing incentives for investment in a reputation and in product and service quality. The authors apply their formal model to various trade-mark doctrines (mostly from the United States, but shared by Canada) to assess their rationality. They conclude that since there is no scarcity in names and symbols, trade-mark law serves a minimal role in the development of language and the creation of new words. Such benefits are only a side effect from trade-marks' role in creating brand identifiers to minimize consumer confusion. Granting trade-mark protection only over distinctive names, ones that are arbitrary or suggestive or having secondary meaning, is a desirable means to prevent consumer confusion and permit competition in the creation of new brands. Granting protection for terms that are purely descriptive (such as SPARKLING CLEAN) would not serve to reduce search costs in identifying quality brands since such terms serve other informational goals, such as describing the product and its uses. Furthermore granting protection over descriptive terms would also increase the barriers to entry in an industry since entrants would be prevented from using terms to describe the quality of a product when it attempts to compete in the relevant product market. However, if the descriptive term has a secondary association in the consumer's mind with the product's source (such as with HOLIDAY INN), then the mark is protected in order to preserve the consumer interest in association, especially when other descriptive terms exist.

The authors also provide a valuable economic analysis of genericide, or the loss of trade-mark protection when a trade-mark becomes the generic designation of a product, as in the case of ASPIRIN. In such cases, even if there

may be some consumer association with the firm producing the product, the use of the trade-mark to designate the product does not serve the consumer's interest in reducing search costs or the producer's interest in preserving reputation. The name or symbol designates a broad class of products or services and hence loses its trade-mark function of establishing brand and reputational identification. The difficulty, however, is in the costs of preventing genericide. Firms spend resources to ensure that a trade-mark is not used generically by policing the marketplace. Such expenditures are used in part to preserve the reputation of the product, to ensure that the trade-mark is not being applied to products of inferior or different quality, but they also serve to ensure that the trade-mark is not being used generically either in a commercial setting or in journalistic reporting. These expenditures are a form of self-help by firms to maintain the reputational quality of the trade-mark.

While Landes and Posner (1987) offer a demand side or consumer based explanation of trade-mark law, Choi, Lee and Oh (1995) consider the supply side benefits of trade-marks. They show in a theoretical model how trade-marks can serve to establish reputational linkages across firms and how multi-product firms could find it desirable to use the same trade-mark for several different products. Such linkages allow firms to offer a greater commitment to quality and provide external information on the quality of the product or service.

Common shapes can also be given trade-mark protection and such protection may extend beyond any patent or copyright that protects the product itself. In the pharmaceutical industry, the authors point out, firms protect the shapes and colors of pills under trade-mark law from generic imitation of the same drug. Such protection, the authors conclude, makes sense given the brand loyalty of consumers who can be assured of quality based on the shape and color of pills associated with trusted firms. In the context of pharmaceuticals, such protection also alleviates confusion among pharmacists filling orders. Landes and Posner (1987) conclude:

[W]here there are large benefits from source identification and high costs of using means other than size, shape, and color to identify, we would expect, and we find, that courts grant trade-mark protection to common sizes, shapes, and colors of prescription drugs, although they would not do this with other products. Non-prescription drugs are an example: the manufacturer can display the brand name predominantly on the container and packaging and does not require size, shape, and color for source identification.

Presumably, the same reasoning would apply to granting trade-mark protection for designs when patents on these designs expire. However, it should be noted that in more sophisticated models, it has been found that the duration of trade-mark and patent protection should be finite. Veall (1992), in the context

of a Cournot model of competition, finds that the duration of patent and trade-mark protection should be finite, the length depending upon innovation costs, production costs, interest rates and taste parameters. This result would suggest that the expiration of a patent may cut off trade dress protection as well.

Finally, Landes and Posner (1987) explain the economic rationale for providing protection against dilution of a trade-mark. They conclude that dilution, or use of a mark by a non-competitor, diminishes the reputational value of the mark by creating consumer confusion as to association of a product with a firm. Furthermore, dilution hurts consumers who may buy branded products to gain prestige. In this case, the authors are sceptical of allowing trade-mark protection, especially if preventing dilution would result in reduced competition and higher prices. Finally, they argue that allowing dilution would diminish incentives for creating prestigious names if imitators could copy them. However, the authors suggest that since there are so many prestigious names, competition in the market for licensing prestigious names would lower licensing fees to zero. As a result, owners of prestigious trade-marks would lose very little in royalties and hence would not be adversely affected by dilution. The strongest argument for preventing dilution, the authors conclude, is the prevention of false associations in the minds of consumers.

Landes and Posner (1987) also analyze trade-mark law from the perspective of a single firm devoting resources to create a reputation and product quality in the market for a product or service. However, trade-marks arise in various market structures and involve competition not only across brands (inter-brand) but also within brands (intra-brand). Perry and Groff (1986) present an important model of intra-brand competition and trade-mark licensing. They find that trade-mark licensing results in lower prices as more branded firms compete. The lower prices, however, result in less profit per brand and consequently the creation of fewer brands. As a result, trade-mark licensing creates a welfare gain through lower prices and a welfare loss through fewer brands and lower quality. Analyzing the welfare effects in a model of monopolistic competition, the authors conclude that when fixed costs are firm-specific, in other words the establishment of a franchise entails very high costs, then trade-mark licensing lowers consumer welfare on net. However, if fixed costs for firms are low, but the fixed costs of creating a brand are high, then trade-mark licensing will benefit consumers on net as the fixed costs of creating a brand can be spread across more firms. Perry and Groff's results suggest that licensing of trade-marks should be facilitated when fixed costs are brand-specific rather than firm-specific. This conclusion would have implications for the compulsory licensing of trade-marks and for the promotion of intra-brand competition.

Trade-marks serve the important economic function of creating incentives for reputation building and product quality among firms, which benefit consumers in their search for products and services. However, trade-marks can

also impose barriers to entry for new firms in a market. Trade-mark law serves to strike such a balance by limiting protection to distinctive marks and denying it to purely descriptive or generic terms. Although trade-mark law may lead to the proliferation of brands and added expenses in creating brand names and preserving brand identity (at the expense of developing new products or services), licensing may serve to limit brand proliferation as Perry and Groff indicate. The economic analysis of trade-mark law is an ongoing debate with important policy implications for competition, many of which can be studied in the contemporary legal debate over trade dress protection.

THE SPECIAL CASE OF TRADE DRESS PROTECTION

THE DESIGN OF A PRODUCT or the setting in which a service is provided can also be protected as a trade-mark. Such trade-mark is called trade dress protection. Very broadly, trade dress refers to the packaging of a product or service. What constitutes packaging includes elements such as the shape of a product (as for a pill or capsule, or the grill of an automobile) or its color (as with clothing or lawn equipment or insulation). In the retail or service sector, the layout of a building can be protected as trade dress. For example, the theme and decor of a restaurant can serve the trade-mark function of identifying the source and reducing consumer search costs.

Trade dress protection is important in many industries, such as pharmaceuticals, restaurants, manufacturing, computer software, and retailing. There are two difficulties raised by trade dress protection. The first, discussed earlier, is the overlap with design protection under patent, copyright and *sui generis* statutes. From an economic perspective, this overlap creates problems with enforcement and with the possible overprotection of products and services in some industries. Trade dress protection is not incompatible with other intellectual property protections since it protects against consumer confusion while other substantive laws protect the investment of the creator of intellectual property. The additional element of consumer confusion limits the expansion of the scope of patent and copyright protection. In practice, courts may have difficulty drawing these lines, the concern being that trade dress protection may provide incumbents in a market an added advantage over an entrant. The use of trade dress protection in the pharmaceutical industry raises such concern, especially if it hurts the ability of generic drug manufacturers to compete.

The second issue raised by trade dress protection is fashioning standards for protection. The difficulty stems from determining when trade dress is distinctive and deserving of protection. Many aspects of trade dress are functional, such as the layout of the salad bar in a restaurant, and hence cannot be protected. Many aspects also skirt the line of functionality, such as color and shape, and should not be protected. The legal standard for trade dress protection

has required secondary meaning. This requirement means that the party seeking trade dress protection must establish a connection in consumers' minds between the trade dress and the source of the product or service. In order to meet this requirement, the party seeking protection will have to spend resources on advertising and the creation of goodwill before trade dress protection will be granted. During the period when goodwill is being established, trade dress can be copied by a competitor. As a result, many small businesses, especially in the restaurant and retailing industries, have argued that trade dress protection should be granted without having to show a secondary meaning. Removing the secondary meaning requirement would permit small, start-up businesses to obtain protection for distinctive design elements before spending resources on advertising and the creation of goodwill. In *Taco Cabana v. Two Pesos*, a 1991 case, the U.S. Supreme Court recognized this problem and ruled that trade dress protection can be granted without secondary meaning if the trade dress is distinctive. However, the Court has retreated on this issue, ruling that secondary meaning is required for protection of colors and patterns. The Supreme Court of Canada has shown less support for trade dress protection, especially in the area of pharmaceuticals.

Trade dress protection raises issues with regard to the expansion of the scope of protection accorded by other intellectual property laws and the requirements for protection (with resulting costs for new businesses). These issues have crucial implications in several key industries and for competition policy more broadly. Opderbeck (2000) presents a compelling economic case for the protection of trade dress. He argues that trade dress can lower consumer search costs and reduce consumer confusion in choosing among products and services, much like the traditional names and symbols that have been the subject of trade-mark law. Denying protection to functional elements would limit, he concludes, the use of trade dress protection as a tool to deter entry and harm competition. The author also concludes that there is little conflict between trade dress protection and patent protection.

One important issue not discussed here but broached in some detail below is trade dress protection for the look and feel of graphical user interfaces in computer programs and for web sites. These issues overlap with those raised by copyright protection for computer software.

THE CANADIAN SYSTEM OF TRADE-MARK LAW

THE CANADIAN TRADE-MARK SYSTEM goes back to the mid- to late 19th century and has continuously provided a national system for the protection of marks and symbols. This system has undergone some fundamental changes to accommodate an expanding market economy that seeks harmonization with the rest of the world. The current system can be assessed against the discussion

of the economics of trade-mark protection to gauge its efficacy. For the most part, the Canadian system has met the goals of trade-mark law as outlined above, but there are particular issues raised as to the scope of protection, especially for trade dress.

As compared to the system of patent registration, the trade-mark system seems to work relatively efficiently. In fiscal years 1994-95 and 1995-96, respectively 27,883 and 26,629 patent applications were received by the Canadian Intellectual Property Office. There were 11,074 and 8,242 patents granted, respectively, out of these applications. For trade-marks, there were 28,567 and 29,528 applications received in the same fiscal years, with 15,961 and 14,817 trade-marks granted, respectively. It is also important to point out that roughly 90 percent of patent applications are from non-Canadian firms; with respect to trade-mark applications, 55 percent are from Canadian firms and 45 percent from non-Canadian firms.

Trade-mark protection is differentially used by large and small businesses. While trade-marks are an important asset for large and multinational firms, they are an even more important asset for small businesses attempting to establish a reputation, identity, and goodwill. The impact of current trade-mark policy on small business is crucial and has important implications for competitiveness, economic expansion, and innovation.

Background History

The first trade-mark statute in Canada was the *Trade-mark and Design Act* of 1863. It created a system of national registration for trade-marks and provided protection against infringement nationally. The goal of the Act was largely to create a national registry and prevent unfair competition and other unfair trade practices. The Act was repealed in 1932 and replaced by the *Unfair Competition Act*, a more general statute that encompassed both trade-mark registration and infringement and unfair trade practices such as false advertising and counterfeiting. But it was cumbersome and not finely tailored to the needs of trade-mark owners. While the *Unfair Competition Act* is still in effect, trade-marks are currently regulated by the *Trade-marks Act* of 1953, which provides a system of protection, national registration, and claims of infringement. The 1953 Act imposed stiff restrictions on trade-mark licensing; these restrictions were relaxed through the 1993 amendments to the *Trade-marks Act*.

The *Trade-marks Act* of 1953 requires a trade-mark application to be reviewed by an agent of the Trade-marks Office before a trade-mark is registered and given national protection. The review process entails several fees, totalling about \$600, as well as legal costs. In order to obtain registration, the applicant must show that the mark has been used in Canada. This feature differs starkly from the European system, which does not require use for registration, and

from the U.S. system, which allows registration based on an *intent-to-use* application. The review process involves, first, a search of the trade-mark database to detect any conflict with previously registered trade-marks. If such a conflict exists, the applicant is advised and can amend his application to avoid the conflict. After the search, the agent examines compliance with the requirements of the *Trade-marks Act*. This process involves back and forth negotiations between the applicant and agent to ensure compliance. The key hurdle at this juncture is to demonstrate to the agent that the trade-mark is distinctive. The administrative review is typically much shorter for trade-marks than for patents, which can take up to three years. If the agent finds that the statutory requirements for trade-mark registration are met, the proposed mark is published and made open to opposition from anyone seeking to challenge the mark. The opposition phase is an administrative proceeding with appeal to federal courts. If the mark survives the opposition phase, it is registered. Any claims of infringement or trade-mark invalidity can be raised through the courts.

The 1953 Act imposed restrictions on trade-mark licensing. To understand these restrictions, it is important to recognize that the primary purpose of trade-marks in Canada is to indicate the source of a product or service. Therefore, under Canadian law it is very important that a mark be distinctive before it is registered. Under the 1953 Act and prior common law, licensing of the mark was viewed as lessening the distinctiveness of the mark, resulting in increased consumer confusion. Although the 1953 Act did not prohibit licensing, it did require that licenses be registered with the Trade-marks Office and that licenses be approved by the Registrar of Trade-marks, who had to be satisfied that the license (which would include assignments and other transfers) would not be contrary to the public interest. The Act did not define public interest, but the requirement was read to be synonymous with preventing consumer confusion. Furthermore, the Registrar had the authority to police the terms of the licence to ensure that the trade-mark owner had adequate control over the licensee to maintain the quality of the trade-mark product or service. As one author described the licensing restrictions, in many modern commercial situations, the administrative efforts and costs associated with complying with this system was quite burdensome. The costs of filing registered user applications for each licensee and franchisee were prohibitive, particularly since merchandise and franchise programs were not static. The burdens imposed by the 1953 Act were corrected by amendments enacted in 1993, which are discussed below.

One uncertainty under the current Canadian *Trade-mark Act* is the treatment of trade dress. It seems that trade dress protection is much weaker than in the United States and European countries. In a recent case, trade dress protection was denied for the shape and color of pills since these aspects of product design did not indicate the source of the product but rather aided in determining dosage and the type of medication to take. While such a ruling

may ensure competition in the pharmaceutical market, and especially the development of a market for generic drugs, the uncertain treatment of trade dress protection would have negative effects for start-up firms in the restaurant and retail sectors. This issue needs to be more closely examined and addressed from an academic and legislative perspective, and through case law.

Recent Developments

The 1993 *Intellectual Property Law Improvement Act* corrected the restrictions imposed on licensing under the 1953 *Trade-marks Act* primarily by abolishing the registered user system. Licences no longer have to be registered or approved by the Registrar of Trade-marks. Instead, distinctiveness rested on the degree of control exercised by the owner in licensing the trade-mark. Control can be direct through the institution of guidelines or private inspections or indirect through the creation of a subsidiary or use of an agent to police the licensee. Furthermore, the reputation of the licensee can be used to prove that the licensor exercised control over the licensee in maintaining the quality of the trade-marked product or service. Under the 1993 Act, related firms and unrelated firms are treated similarly for the purpose of determining control. This treatment is very different from U.S. law, which provides that distribution of a trade-marked product or service by an entity that is under the corporate control of the trade-mark owner is attributed to the trade-mark owner. Corporate control is not sufficient to establish control under the trade-mark law in Canada. One exception is provided for pharmaceutical companies, for which control can be established by common stock ownership. In Canada, the related firms rule is used not only to establish control over the trade-mark, but also to establish vicarious liability for trade-mark infringement.

The 1993 amendments remove the burdens imposed on licensing under the 1953 Act. Instead, licensing is treated as a matter of private contract negotiation and regulations are limited to ensure that the licensor is maintaining control over the product or service so that the trade-mark can serve its role as a source identifier and indicator of quality that reduces consumer search costs and avoids consumer confusion.

Summary

The Canadian trade-mark system is ostensibly guided by the principles that ensure an economic, rational trade-mark law: indication of source, creation of goodwill and reductions in consumer search and confusion. The regulatory burden on licensing has been corrected and replaced by a contractual system. The rules on control can be clarified to expand licences to and uses by related persons to include corporate control. The burden of trade-mark registration seems minimal, though the standards of distinctiveness are quite high and the

role of secondary meaning could be expanded. In addition, the protection of trade dress needs to be strengthened and the standards for protection clarified. The treatment of trade dress and the administrative process could have important implications for competitiveness and the development of small businesses.

IMPORTANT CASE STUDIES ON TRADE-MARK LAW, INNOVATION, AND ECONOMIC GROWTH

FEW ECONOMETRIC STUDIES have linked trade-mark protection and use with economic growth and productivity. A difficulty in such studies is measuring output and controlling for trade-mark effects. Since trade-mark protection is potentially infinite, it has been impossible to measure the effects of trade-mark protection by varying trade-mark duration. Although a potential study could consider the effects of genericide on firm profitability, the problems are (1) disentangling the effect of the generic trade-mark from other protection, especially protection through trade names and trade-marks on related products or services that a firm may sell and (2) defining the relevant measure of output.

Firm profitability is one measure, but it is difficult to separate the influence of trade-marks from other investments in goodwill, such as advertising or customer relations. Unlike patent and copyright which in theory affect technological change and development, trade-marks' effect on productivity is more tenuous. There is no reason to think that a firm may grow more quickly simply because it has trade-marked products. Given the requirement that a trade-mark must be used in commerce before it is registered, one would expect that causation would be in the opposite direction, larger, more successful firms would have more trade-marks. Furthermore, given trade-marks' role in identifying source and protecting consumers, their effect on the economy would not normally be captured by measures of productivity. Instead, we would expect trade-mark protection to influence the quality of goods and their price, and hence would be reflected in cost-of-living indices and measures of consumer satisfaction or welfare (as opposed to productivity measures). The pharmaceutical industry provides one test of this argument since both branded and non-branded products compete in that market. A discussion of the literature examining the pharmaceutical industry is presented below.

Allegrazza and Guard-Rauchs (1999) offers one of the only studies of the factors influencing the registration of trade-marks. Analyzing a survey dataset of BENELUX businesses conducted in 1996, the authors studied the factors determining whether a business had registered a national trade-mark. They found that the likelihood that a firm had a trade-mark registration was positively affected by the firm's R&D expenditures and the size of its workforce. However, the authors also found that when the sample was restricted to registrations made within a year or two of the survey, the size of the workforce did

not have any explanatory power. The authors conclude that the trade-mark system serves many of the same goals as the patent system in promoting innovation and R&D. In addition, trade-marking provides a competitive advantage in monitoring the activities of rivals in the marketplace not offered by patenting. This latter effect explains the authors' finding that, for more recent trade-mark registrations, the size of labour force had little explanatory power.

The empirical literature is divided into two segments below. The first comprises general studies of trade-marks and intellectual property protection in specific industries. The second, studies of the pharmaceutical industry.

Trade-marks and Business Development

Wilkins (1992) offers a seminal study linking trade-mark protection with the rise of the modern corporation and the expansion of free enterprise in the United States during the late 19th and early 20th centuries. The author surveys the development of trade-mark law and shows how it paralleled developments in the modern corporation. Historically, trade-mark law served as a means for firms to establish an identity and to expand into the marketplace and compete effectively. As markets expanded, so did the recognition of the need for legal protection of intangible assets like trade-marks. Quoting one legal authority from the mid-1920s, the author concludes that the courts recognized that "the owner of a trade-mark, who expends large sums of money in making his mark known to the public as a symbol and guarantee of excellence of the quality of his product should receive the same protection from the courts for his investment in advertising his trade-mark that he would undoubtedly be entitled to receive for investment in plants and materials."

The author recognizes the potential anti-competitive uses of trade-marks and notes that courts recognized also this negative effect of trade-mark protection. Government suits brought under the *Sherman Act* in the early 1920s attacked the use of trade-marks as a tool of dividing markets and imposing restraints on trade. These cases recognized that trade-mark owners could use their marks strategically to maintain a dominant position in the marketplace and to raise barriers to entry. Although modern antitrust and competition laws scrutinize trade-marks less closely and temper the anti-competitive uses with a consideration of pro-competitive benefits, the prior case law set a precedent for a sceptical view of trade-marks. However, the author concludes that, as a historical matter, courts on balance tended to look upon trade-marks more favourably in the early part of the 20th century, and antitrust challenges to trade-marks arose in egregious situations.

The author also carefully distinguished trade-mark from patent protection, finding that trade-mark protects goodwill and the use of brands in commerce, while patents protect investment in R&D and technological innovations.

Trade-marks have the effect of promoting the corporation and business entities through the creation of what the author calls “spider effects.” These effects create positive reputational externalities for the firm. As a result, trade-marks allow firms to recoup investments in reputation and goodwill that promote the creation of better quality products and firm growth. These benefits allow the firm to invest more in other assets like patents. As the author concludes: “The trade-mark’s fundamental contribution to the modern corporation was that it generated efficiency gains by creating for the firm the opportunity for large sales over time. It was the trade-mark, as transmitter of information, that made possible the effective utilisation of patents and new technology.”

Finally, the author identifies five efficiency gains from trade-mark protection, the first static, the remaining four dynamic. The static effect of a trade-mark is allowing the firm to take advantage of economies of scale by attracting a set of customers through brand identification and creation of brand loyalty. By allowing firms to differentiate its products, trade-marks create some degree of market power. But this market power does not simply mean higher prices for consumers. Instead, product differentiation allows firms to integrate forward into distribution and take advantage of economies of scale and scope, which allows prices to ultimately be lower for consumers than in situations where unbranded products are sold in perfectly competitive markets. Trade-marks facilitate the exploitation of scale economies, which resulted in lower average costs and lower prices.

Dynamically, trade-marks serve four economic functions, according to the author. The first dynamic benefit is the lowering of capital costs that resulted from the creation of a good reputation. Trade-marks allow a firm to establish a name that permits creditors to more readily monitor the reliability of issuing debt. The second dynamic benefit stems from the reputational benefits in labour markets. Simply put, trade-marks allow firms to establish a name and reputation which then allows for brand identification by consumers and name recognition among potential employees. The third dynamic benefit arises from investments in R&D and technological improvements, facilitated by higher profits and the continuity provided by a trade-mark with strong reputational effects. The author identifies two sources for this benefit: (1) incentives to invest added profits into technological improvements that lower costs and (2) investments in new product lines that benefit consumers by creating competition in markets. Finally, trade-marks have the dynamic benefit of shifting the demand curve and increasing the set of consumers that a firm can service. These shifts result from both the informational effects and the reputational effects of trade-marks. This final effect is corroborated by Pashigian and Bowen (1994) who find that increases in women’s wages during the 20th century increased the demand for branded products.

In short, trade-mark protection serves to lower costs by allowing firms to take advantage of scale economies, establish reputation, and gain advantage in credit markets, labour markets, R&D, and product markets to service consumers. Many of these benefits are documented by Giddens (1973) in a case study of the adoption of the EXXON mark by Standard Oil in the late 1960s. The change in name, according to the firm, reduced consumer confusion and allowed the firm to economize on and coordinate advertising expenditures and promotion on a nationwide product market.

Higgins and Tweedale's 1995 study of the cutlery industry in Sheffield, England, presents an alternative perspective to Wilkins' account of the benefits of trade-mark protection. The authors demonstrate that trade-mark protection worked to the detriment of the cutlery industry as it embroiled firms in suits over infringement. Trade-mark law was used defensively to deter entry and maintain market share at the expense of creating new products or lower costs. In fact, the expansion in scale occurred in the cutlery industry not as a result of trade-mark protection, but of mass production techniques in the late 19th and early 20th centuries, which resulted in lower prices and better servicing of markets, but also lower quality products. Although the authors recognize the importance of trade-marks for firms like Coca-Cola and regions like Champagne (and even in the contemporary cutlery industry), they conclude that trade-marks should not be analyzed in isolation from other assets and developments in business methods.

Finally, trade-mark licensing is an important issue to consider in analyzing the effects of trade-mark protection on competition. Lane (1988) finds that in some industries (such as breakfast cereals) entry would not occur without licensing because of the barriers created by brand identification. However, licensing may lower a trade-mark owner's investment in promotion and creation of brand loyalty. The loss in expenditure on promotion may offset price reductions that result from licensing. Bates (1995) finds that businesses that begin as a franchise are less successful than those that begin as independent entities. Although franchises are more heavily capitalized than independents, franchises are less profitable than independents of the same age and have a lower survival rate (65.3 percent as opposed to 72 percent for non-franchise firms).

Bates' study contradicts some of the theoretical studies which conclude that franchise arrangements are more conducive to business success, such as that of Rubin (1978).

Pharmaceuticals

The competition between branded and generic drugs has been a field of inquiry in the economics literature that sheds light on the economic effects of trade-mark law. Much of this literature also has implications for patent protection.

The pharmaceutical industry is a fruitful (and important) arena for understanding the economic benefits of branding and the interaction between trade-mark law and patent law, both key themes in this survey article.

The effect of intellectual property law on the pharmaceutical industry has taken place through patent law. The removal of compulsory licence requirements and the extension of patent term to 20 years in 1993 were seen as benefiting the pharmaceutical industry by providing stronger protection for patented drugs and limiting the competitive forces provided by compulsory licensing regimes. However, pharmaceutical companies gain a competitive edge not only through patent protection but through advertising and brand loyalty, business goals facilitated by trade-mark law. Unfortunately for the industry, trade-mark law has provided less protection and weakened the competitive advantage given by patent law. In *Eli Lilly v. Novapharm*, a 1997 decision from a federal trial court, Eli Lilly was denied trade dress protection in the shape and color of its tablets because the court found that such elements did not indicate source but facilitated the task for pharmacists and consumers in measuring dosage and identifying the medication. Although this decision weakened trade-mark protection for pharmaceutical firms, it facilitated the entry of generic drug manufacturers, which could ultimately benefit consumers.

Comanor (1986) presents a comprehensive study of the pharmaceutical industry in the United States, with a survey of relevant articles pertaining to intellectual property protection, regulatory burden and competition. The study focuses specifically on monopoly returns in the pharmaceutical industry and the impact of generic competition. The author cites three principal studies that looked at price dynamics upon patent expiration (Schwartzman, 1976; Statman, 1981; Bond and Lean, 1977). Each study independently found that pharmaceutical companies could charge prices above marginal cost for patented drugs even after their patent expired. Price competition was minimal in the pharmaceutical industry for many products, although there was evidence of substantial price competition in the market for antibiotics, a product less controlled by patents. One study found that out of 12 drugs whose patent expired, only four showed substantial price declines after expiration of the patent. According to the study, the period of exclusivity accorded by patent law provided ample time for identification of the drug with a specific brand name and the development of brand loyalty. Another study reached a similar conclusion: Persistent dominance in the face of competition from cheaper, more highly-promoted substitute drugs would suggest that the product differentiation advantage of being first with a *breakthrough* product is very substantial indeed. Comanor (1986) concludes from these studies that "because of effective brand loyalty, the original firm was not forced to meet the lower prices charged by new suppliers." Citing a 1982 study by Schmalensee, he finds similar effects in industries other than pharmaceuticals. These studies of price competition in markets for patented

products and the persistence of brand loyalty would imply that trade-mark protection can inhibit price competition and serve to lengthen the duration of the patent monopoly.

Studies of the impact of the entrance of generic drugs in the pharmaceutical industry indicate a benefit from trade-mark protection for patented drugs. Comanor cites a 1979 study by Grabowski and Vernon which concluded: "The substitution of generic for brand-name products already off-patent and supplied by multiple parents shifts cash flow from research-intensive firms to non-research-intensive firms. This reduces the supply of internal funds available to former firms to undertake R&D investment." Comanor adds that "while consumers gain from generic substitution, the question again is whether monopoly returns should be promoted as a reward and an incentive to innovation."

An answer to Comanor's question is provided by Grabowski and Vernon's 1986 study. That study assessed the impact of *The Drug Price Competition and Patent Term Restoration Act* of 1984, a U.S. law that lowered entry barriers for generic drugs and extended patent protection for new pharmaceutical products. The authors concluded that the entry of generics resulted in substantial price decreases for prescription drugs. The impact of the entry of generic producers on R&D expenditures was difficult to measure, but the expanded patent term provided by the Act could alleviate any adverse effect on R&D expenditures. Grabowski and Vernon made the following prediction about the effects of generic competition on R&D expenditures by pharmaceuticals: firms seeking blockbuster drugs will not be deterred by generic competition in pursuing these wonder drugs, while firms relying heavily on internal funds to finance R&D expenditures may be deterred. The effect on R&D expenditures by firms will have different effects depending upon the diversification of existing drug portfolios, dates of patent expiration, and the number and type of new drugs in the pipeline.

Scherer (1993) addresses what he calls the paradox of limited price competition for off-patent drugs when generic substitutes are possible. He suggests that pharmaceutical companies abandon the price-insensitive market and continue to sell the branded drug to loyal customers and allow the firms manufacturing the generic, non-branded product to service the more price-sensitive customers. As a result, the market is bifurcated through a price discrimination strategy, as described by Frank and Salkever (1985). One phenomenon he noticed in the early 1990s is that firms with off-patent drugs are not producing generic versions. He concludes, based on anecdotal evidence, that firms do not wish to create competition with their own branded products and permit price arbitrage. However, he also notes a trend emerging among pharmaceutical companies distributing both branded and unbranded versions of off-patent drugs, a practice already common in Germany. Scherer predicts that such a practice of price discrimination by firms would result, upon patent expiration,

in stability or increases in the price of the branded drug, reductions in the price of the firm's generic version, and bigger price reductions in the price of generic substitutes.

In the pharmaceutical industry, trade-mark law serves as a means of extending the patent monopoly through the creation of brand loyalty. Whether this is beneficial or not rests on a comparison of the benefits of lower consumer prices with the potential negative effects on R&D expenditure. However, the negative effects may be small or mitigated by other changes in intellectual property law.

CONCLUSIONS ON TRADE-MARK LAW

THE CANADIAN TRADE-MARK SYSTEM promotes in many ways the economic goals of an ideal trade-mark regime. Although there are few systematic, econometric studies about the effects of trade-marks on economic growth and innovation, case studies suggest strongly that trade-mark law does play a role in the development of specific firms and business networks. Trade-marks play an important role in many industries to strengthen patent protection and create monopoly rents that can be used to finance R&D. The following research questions are raised by this survey and are important to pursue:

- the role of trade-marks in allowing firms to take advantage of scale economies;
- the role of trade-marks in allowing firms to extract monopoly rents that can be used for R&D;
- the importance of trade dress protection in the pharmaceutical industry and in the service sector;
- measuring the effects of trade-marks on reducing consumer confusion and lowering search costs;
- trade-mark licensing practices and dissemination of products.

These research questions will be broached again in the concluding section of our study and compared with the issues raised by our survey of patent and copyright laws.

PROMOTING INFORMATION INFRASTRUCTURE THROUGH COPYRIGHT LAW

A COPYRIGHT IS A RIGHT to prevent copying of literary, artistic and musical works. It arises automatically without a period of registration but does not give a complete monopoly in the way that patents do. A copyright does not protect the underlying ideas or concepts themselves but rather protects the way an author or artist expresses an idea or concept. Other rights exist that are related to or *neighbouring on* copyright and typically include the rights of performing artists, producers of phonograms and broadcasting organizations.

Copyright arose in 17th-century England as a response to the power of the stationers' guild, which upon grant from the monarch decided what was published and in what quantity. Copyright created a right in the author of a work to determine when and in what manner his work would be published. It is important to recognize that copyright law has its roots in control over publishing and the printing press since control over technology is at the heart of many modern copyright cases. Digital music, file-sharing and Napster — the sources of several compelling and ongoing copyright disputes — illustrate the intimate connection between copyright and technology. Under all copyright systems, the owner of the copyright is the creator of the book, movie, musical composition or other creation that is the subject matter of copyright. The owner has certain rights granted under copyright law to control the distribution, performance, adaptation and copying of the creation. These rights are subject to certain uses by the public, some of which are expressly permitted under the statute (certain uses by educational or non-profit entities) while others are deemed acceptable under the fair use balancing test (such as video home recording). The difficult questions raised by copyright stem from the creation of new technologies, such as the photocopier or the Internet, that permit copying and the creation of new works. The legal issue is to what extent uses of the new technology are copyright infringement rather than fair or permitted uses of copyrighted works.

While control over technology is a key issue under copyright law, even more compelling are issues raised by authorship. Modern copyright law adopts a positive approach to defining authors' rights. An author's rights over his copyrighted work extend only to what is provided by the relevant copyright statute. Outside the statute, rights can be defined by analogy or through statutory interpretation. However, some jurisdictions recognize a natural right to the author to control all aspects of the creation, even those not specifically granted by legislation. This moral rights approach views the creation as an aspect of the author's personality that deserves as much protection as the author's personhood.

Canada has aspects of both the positive and moral rights perspective in its copyright law.

The distinction between the positive and moral rights approaches becomes clear as one considers the business context within which copyrighted works are created. The roots of copyright law are in book publishing and, for a long time, copyright law covered only books. But as aesthetic and business sensibilities changed, copyright law expanded to include maps, charts, drawings, paintings, music, movies, broadcast, letters, notes, computer software, video game displays, and architectural works. Authorship is often hard to fix with many of these creations; computer software is often a team work, as are architectural works. Often, works are created in a corporate setting. Even though the creator is ostensibly the beneficiary of copyright law, the copyright may be held by someone other than the creator, such as the creator's employer. Under a moral rights system, the creator would still have control over the copyrighted work even though the copyright may be held by someone else. The implication is that any decision by the copyright owner to alienate or transform the work would be subject to the rights of the creator to protect his personality in the work. Because of the complications this would create in business settings, most jurisdictions have moved away from moral rights. However, moral rights can still play a role in the visual arts or in the literary arena, where authors may still protect the integrity of their work. For utilitarian subjects such as computer software or architecture, moral rights have little or no place.

The expansion of copyrightable subject matter beyond books means that copyright law will have an impact on many industries. However, this statement is true for all areas of intellectual property. All industries use trade-marks and patents, as well as copyright. The difficulties raised by copyright have to do with the scope of the copyright holder's rights. A trade-mark owner's rights extend to the mark or symbol trade-marked, the source identifier attached to a particular product. A patent owner's rights extend to uses of an invention, and the scope of the invention is defined by the claims of the patent. Copyright protection extends to all the original elements of a work. Its scope can potentially be quite broad. Furthermore, there is typically no disclosure requirement under copyright. The patent owner must publish his claims so the world can know the scope of his invention. The trade-mark owner's mark or symbol is known to the public since prior use is a requirement for registration. However, the elements of a copyrighted work need not be disclosed in order to obtain protection. In both Canada and the United States, copyright protection attaches when a work is fixed in a tangible medium. Registration and deposit of the work is a requirement for filing a lawsuit. Computer software are copyrighted, but are often kept secret so that the public cannot modify or know the underlying code. Movies and photographs are open for the public to see, but the technique for creating a given visual effect will most likely be kept secret.

The scope of copyright protection and the lack of disclosure requirements for copyright raise important questions for copyright policy and industry practices. For example, when is it okay to reverse-engineer a computer program to determine its underlying code? If the copyright owner's control is plenary, then the answer might be never. The same may be true for a photographer who makes a copy of a photograph to recover a negative. Giving too much control to a copyright owner may have anti-competitive or anti-innovation consequences. However, too little control would limit the copyright owner's incentive to innovate and create copyrighted works. As a result, copyright law charts a treacherous and often uncertain course between rights of access and rights of control. In the United States, fair use and permitted uses provide a compass to map this course, but fair and permitted uses come at the expense of reduced incentives to create. Under Canadian law, narrower protection is given for rights of access through the doctrine of fair dealing.

As the reader may have gathered, the impact of copyright law can be quite large, cutting across many industries and many business practices. By striking a balance between access and control, copyright law serves as a means to regulate the flow of creative works and ultimately the flow of knowledge and information. More than trade-mark and patent law, which largely serve the role of assigning and recording property rights, copyright law regulates actual practice and the information economy. Therefore, copyright's impact on industries ranging from publishing to music to computers to telecommunications can be immense and, therefore, important to understand.

Our survey of the economic impact of copyright law follows the structure of our survey of trade-mark law. First, we review the economics of copyright law, followed by a discussion of its role in the computer and information sectors. The Canadian copyright system is then described, followed by a discussion of important case studies that help to understand the efficacy of Canadian copyright law and issues raised for future research.

THE ECONOMICS OF COPYRIGHT LAW

LIKE PATENTS, COPYRIGHT GIVE THE OWNER an exclusive right to use the item protected by the copyright. The grant of an exclusive right allows the owner to control the development and distribution of the protected item and serves as a reward for creating it. As a result, the economics of copyright law mimic those of patent law. The grant of a monopoly power creates a market distortion that generates rents which reward the owner for creating a new product and a new market. The welfare effects of granting a copyright or a patent rests on a comparison of the costs of the market distortion with the benefits of innovation.

But copyright differs from patents in significant legal and hence economic ways. First, the copyright grant is much longer than the patent grant. Patents currently last for 20 years from the date of filing the application. Copyright lasts the life of the author plus 75 years for natural persons and 95 years for legal persons. The longer duration can be explained by the differences in subject matter between patents and copyright. Patents are granted to novel, useful and non-obvious inventions, items that will be used in manufacturing and could become invented around quickly. The returns from patents are more immediate. Copyright is granted to original expressions fixed in a tangible medium (such as a printed page or a computer hard drive) and protection is granted to the expressive aspects of a work. Since expressions are more personal than utilitarian, creating a market for the work would arguably take longer and be more difficult. Examples abound of artists whose works were not recognized until long after they were created or long after their death. The longer duration of copyright protection reflects these realities.

This rationale for longer copyright protection seems odd when applied to utilitarian items like computer software, that seem more akin to the subject matter of patent law. Arguably, copyright protection for computer software may result from a historical accident. In the 1970s, courts consistently held that computer software were not patentable because they were an embodiment of mathematical algorithms or ideas that could not be patented. As a result, the software industry shifted to protecting computer code through copyright law. In fact, U.S. courts have recently moved to allow patent protection for computer software, with the result that multiple protections, under copyright and patent law, can be granted for the same work. In Canada, however, patent protection is not available for software. As with the trade dress and patent overlap, multiple protection is not necessarily undesirable if the two bodies of law protect different elements. Although copyright and patents overlap more closely than trade dress and patents, copyright technically protects expressive elements but not utilitarian elements, while patents can protect utilitarian elements. As a result, the two sources of law are complementary rather than duplicative.

Another key difference between copyright and patent is the means of obtaining protection. A patent grant involves a fairly rigorous and lengthy administrative process. A copyright is created once an original work is fixed in a tangible medium of expression and no administrative review is required to create a copyright. However, enforcement of a copyright requires registration of the work with a centralized agency. The registration requirement serves two functions. The first is a notice function to publicize to the world the copyright status of a work and the identity of the copyright owner. The second function is an administrative review of the copyrightability of the work. Administrative review is minimal, but there are cases where the Registrar of Copyright has refused registration (and consequently made enforcement of the copyright

impossible) because the work was not original. Although the administrative costs of copyright are sizeable, they are nowhere near as burdensome as for patents. Furthermore, while the grant of a patent requires disclosure of the invention in a way that enables an ordinary person skilled in the art to imitate it, registration of a copyright does not require disclosure. Instead, the copyright owner deposits a copy of the work with the Registrar (or, in the United States, with the Library of Congress). This distinction is important for computer software. If the code were patented it would have to be disclosed. Copyright registration requires only deposit, which means that a disk containing the code (even if it is encrypted and not readable) is all that has to be submitted to the Registrar. The choice between patent and copyright protection in the United States, where such a choice is available for items like software, will hinge upon the desirability of disclosure.

The final distinction between patent and copyright has to do with the scope of the rights that the owner obtains through the grant. Patent protection provides strong protection against all uses of the invention with no fair use or fair dealing limitation. Copyright protection gives the owner the exclusive rights to copy, distribute, adapt and perform the work, with extensive fair use and permitted use limitations under U.S. law and with fair dealing provisions under Canadian law. As pointed out before, patent ownership is shorter (but stronger) than copyright ownership. Patent ownership is also more narrowly defined and limited to the claims, or description, of the patented invention. Copyright ownership is fuzzier and not circumscribed by claims. Instead, copyright ownership extends to the original expressive elements of a work (characters in a novel, structure of a poem or computer program, look and feel of a graphic user-interface or movie), and the boundaries of protected expression are not described by claims but often determined by a court in an infringement action. It would be fair to say (with some exceptions) that patent law offers the owner stronger, shorter and more certain protection than copyright law.

From an economic perspective, copyright and patent law while both promoting innovative activity through a monopoly grant, do so in very different ways. The differences can be explained with respect to subject matter, but it should be noted that in many instances, particularly with computer software, the subject matters of patent and copyright overlap. The explanation for the differences, despite the similarity of goals and some overlap in subject matter, rests in providing innovators a set of rules from which to choose that best suits their needs in controlling their creative works and inventions. Instead of a one-size-fits-all legal system, the intellectual property system provides the alternatives of patent and copyright (and, to a certain extent, trade-mark) from which to choose in designing legal protection. Assessing the economic efficacy of copyright law entails understanding the economic goals of intellectual property law more broadly and copyright law's relation to other intellectual property law.

Besen and Raskind (1991) present an economic analysis of intellectual property law that includes separate discussions of patent, copyright and trade-mark laws. Their assessment of the three areas rest on the conclusion that an ideal intellectual property law system should (1) provide incentives for innovation through a monopoly grant that allows for monopoly pricing and price discrimination, (2) permit innovation at minimal cost by lowering administrative costs and the transactions costs of licensing for the use of protected works, and (3) create a proper balance between innovation and dissemination. The economic analysis of copyright law must take into account each of these elements.

Waterson (1990) concludes that, with its narrow scope, copyright protection is more appropriate than patent protection in cases where product variety and consumer diversity is desired. For example, he suggests, in areas like software where consumers "desire a plethora of specific applications for specific situations," copyright protection is a more appropriate tool than patent protection (p. 869). However, when product variety is not desirable and standardization is the goal, patent protection is more appropriate.

Landes and Posner (1989) have written the seminal article on the economics of copyright protection. Their work addresses several objections to strong copyright protection such as (1) the fact that the creator of an original work has a lead time advantage over the creator of a copy and this lead time serves as an adequate incentive to create, (2) the fact that copies are often of lower quality than the original and hence not as marketable, (3) the fact that creators of original works can control their work through contracts, and (4) the fact that creators of original works are often motivated by non-pecuniary reasons. While the authors recognize these arguments as possible objections to the need for a copyright system, they reject each of them. Instead, they find that copyright law gives the creator the requisite control to monitor and determine how the copyrighted work is used and distributed. The law also serves to lower transactions costs in controlling and disseminating the work, especially with advancements in technology that permit mass distribution. Copyright law provides a way to reduce transactions costs in the use and creation of a work by giving the creator a bundle of rights that can be exploited commercially through control over distribution of the work, and licensing of the rights to use and develop the protected elements of the work.

The authors develop a formal model of copyright protection and describe an ideal copyright system that would maximize social welfare. In their model, copyrighted works are both the output of an innovative process and an input to future innovation. They derive several implications from that model. First, copyright protection should be stronger for works that are more socially valuable. Second, copyright protection need not be set to maximize the number of works created and in fact should be set below the level that would maximize the number of works created. Third, copyright protection should expand as

income and technological advances expand the size of the market and as the cost of copying declines. Fourth, if it is possible to distinguish between literal infringers and those who borrow copyrighted materials to create new works, there should be greater copyright protection against the former than the latter. Finally, the lower the administrative costs and the greater the response to copyright protection, the stronger should copyright protection be.

Their formal model is applied to several copyright doctrines. First, the authors explain the classic idea-expression distinction in copyright law, which states that copyright does not protect ideas but expressions of ideas. The authors reject the semantic question of what constitutes an idea and what constitutes an expression. Instead, they adopt a functional approach and ask whether protection would hinder innovation and the development of markets for creative works. Granting protection to fundamental building blocks, such as literary techniques or historical facts, would give the owner too much control and would potentially hinder the development of new expressions. Since expressions are more individualistic and particularized and can be invented around, there is less or no danger of monopoly control or anti-competitive conduct if expressions are given copyright protection.

The authors also examine copyright protection for derivative works. Derivative works are created from previously copyrighted works or works in the public domain. A copyright owner has the exclusive right to make derivative works from his copyrighted work. For example, if someone wishes to make a movie from a copyrighted novel, the movie maker must obtain permission from the owner of the copyright in the novel. The movie maker would have a copyright in the original elements that were added to the novel in the movie. Absent permission, the copyright owner of the novel could prevent the movie maker from exercising rights over his movie because it would be an infringement of the novel. The question is why should the copyright owner have the right to make derivative works? Landes and Posner provide an answer based on transactions costs. Copyright in the derivative work is necessary to give the proper incentives to create derivative works. Granting the copyright owner the right to make derivative works consolidates ownership and makes it easier for parties to negotiate and transact for the creation and distribution of new works.

Finally, Landes and Posner (1989) address the question of the scope of copyright protection and specifically the issues of fair use and optimal copyright duration. Fair use, according to them, serves to reduce transactions costs in the creation of critical, new works that provide benefits for consumers. With some new technologies, such as videotape recorders, the cost of obtaining permission is so prohibitive for consumers that prohibiting copying for home use under copyright law would reduce consumer benefits and welfare. Fair use provides a stop gap to permit the practice without permission. Furthermore, fair use is desirable when critics or reviewers wish to sample material from a copyrighted

work in order to provide consumers with information about that work. However, parodies of copyrighted work would not be fair use and would most likely be derivative works that the copyright owner could prohibit. As far as duration, Landes and Posner conclude that life of the author plus 50 years (the term at the time of writing under U.S. law) is economically rational since it gives the author control over his lifetime and also benefits his proximate descendants. The authors' general conclusion is that while the duration of the copyright term is optimal, fair use can serve to limit the copyright owner's control in high transactions costs/high consumer benefits situations.

One important question in the area of copyright protection pertains to protection for data and databases. This question parallels questions about copyright protection for unpublished works or works like letters or diaries that are designed for personal use. Landes (1992) develops a mathematical model of copyright protection for unpublished works and concludes that unpublished works should be protected differently under copyright law than published works. He presents three main findings: (1) unpublished works produced for purely private purposes (such as a letter or diary) should have relatively weak protection against reproductive uses (such as for scholarship); (2) fair use should not protect purely reproductive uses of unpublished works, that is, use that merely duplicate or copy the unpublished work without introducing value added; and (3) similar rules should apply for unpublished works prepared for publication as opposed to purely private uses. Landes' analysis has implications for the protection of databases, which involve the compilation of purely private, unpublished information. The copyright treatment of databases is described more fully below.

The analyses of Landes and Posner (1989) focus on the incentives copyright law provides to the creator to create new works and to control their distribution, reproduction and adaptation. However, copyright law technically prescribes rights to the copyright owner, who may in fact not be the creator. Copyright ownership will vest in someone other than the creator under the work-for-hire doctrine, which vests ownership of copyright in the employer rather than in the employee who actually creates the work. Hurt and Schuchman (1966) discuss this dichotomy in the context of the publishing industry and conclude that copyright law may, in many instances, strengthen monopoly power. However, the separation of ownership and creation is consistent with the economic analysis of copyright law. In most situations, the employer would be in a better position to negotiate control over the copyrighted work than the employee, and hence to lower the transactions costs of developing and reproducing the copyrighted work.

Nonetheless in some situations, such as with the visual or literary arts, denying control to the creator may result in reputational externalities not being internalized. Hansmann and Santilli (1997) address the issues of author's control

and reputation. The problem can be stated as simply as follows: if a work receives a bad reception from the public, who is to blame? If the author lacks control, then the author can be blamed for the poor quality and subsequent poor reception of the work. This possibility creates a reputational externality: the author might be held responsible for something he had no control over. Giving the author some control by recognizing his or her rights (also known as moral rights) can correct this externality problem. Recently, many jurisdictions have recognized authors' rights either as *sui generis* statutes or as amendments to copyright legislation. Such statutes and amendments give the authors rights to control the integrity of their works from alteration or adaptation. The Canadian experience with authors' rights is discussed below. The economic analysis would imply that such statutes are beneficial in solving a narrow problem linked to authorial reputation.

Copyright protection serves an economic function of coordinating ownership and reducing transactions costs in the exchange of copyrighted works. However, these benefits come at the expense of the monopoly grant. Granting the owner the right to control the distribution, reproduction and adaptation of a copyrighted work will have implications for the dissemination of that work. Because of these effects on dissemination, some authors have proposed limits on copyright protection. O'Hare (1985) considers the effects of copyright on distribution through different media (such as book publishing or painting or photocopying) and finds that monopolistic or oligopolistic market structures may not be the most appropriate for these different works. He concludes that the appropriate market structure depends upon such things as the market for subsidiary uses, the high fixed costs of copying and the market for copies. According to O'Hare (1982):

[B]asic copyright protection is useful only for a subset of the intellectual property to which it now applies. The critical requirements are that the work be valuable in derivative forms, or that copying be expected at a rate of many copies per pirate and that the fixed costs of copying a particular work be low... [I]t is not worthwhile for authors and publishers to pursue increased copyright protection for many kinds of media ... I am pessimistic, for example, about the likelihood that copyright for computer software publishers will suppress copying except by competing publishers.

O'Hare's pessimistic assessment rests on the recognition that new technologies allow wide distribution and on the undesirability of allowing copyright law to suppress new technological developments. O'Hare seems to believe that attempts to suppress the technology would be futile.

Many of the issues raised by O'Hare can be addressed formally through mathematical models based on economic theory. Novos and Waldman (1984)

presented a model that considered the effects of copyright law both on the production of new works and on their dissemination. They address the argument that increased copyright protection would have two effects: increasing social welfare by stimulating the production of new works, and decreasing social welfare by limiting use and access. The authors attempt to assess which of these two effects is larger. Their model captures both the development of new works and their free reproduction by consumers. Consumers differ as regards the costs of reproduction: those with high costs buy the copyrighted good directly; those with low costs resort to copy. However, consumers are identical in how much they value the copyrighted work. The authors conclude that increasing the amount of copyright protection (as captured in the costs of reproduction) tends to increase social welfare by promoting production, but tends to have little negative effect on social welfare through underutilization. As a result, increased copyright protection has a positive effect on social welfare. The authors do point out that their results may be sensitive to their assumption that consumers do not differ in the value they attach to the copyrighted work.

Takeyama (1997) develops a sophisticated model of copyright protection that takes into account intertemporal substitution. In her model, a firm produces a copyrighted work over two periods. Consumer can copy the work at some cost, and the copies compete with the firm's output in the second period. Her model parallels Ronald Coase's famous model of the durable goods monopolist. In Coase's model, a monopolist selling a durable good faces two constraints on monopoly pricing. The first is the resale constraint: selling a durable good creates competition for the monopolist. The second is the time consistency constraint: commitments to limiting quantity and raising price cannot be credibly made by the monopolist because of future demand for the product. These two constraints, according to Coase, limit the ability of the durable goods monopolist to price above marginal cost. In fact, in the case where the durable good lasts forever, monopoly pricing would be forced down to marginal cost. In Takeyama's model, copying imposes similar constraints on the copyright owner's intertemporal pricing decision. The copyright owner still obtains rents, but they are smaller with copying than without. Consequently, consumers are better off intertemporally when copying is allowed than when it is prohibited. The conclusion supports weaker copyright protection and perhaps a larger scope for fair or permitted uses of copyrighted materials. Takeyama also examines ways in which the copyright owner can increase rents even in the face of copying, such as through versioning the product and giving away cheaper versions to some consumers. This strategy allows the copyright owner to price discriminate and to extract larger rents, avoiding the time consistency constraints and possibly reducing consumer welfare.

The case for relatively weak copyright protection is also made by Koboldt (1995) who develops a model of copyright that takes into consideration both the production of copyrighted works and their dissemination. The author finds that market mechanisms for production and dissemination based on strong copyright protection would lower consumer welfare. Her model is static and describes the market for a copyrighted work that can be supplied both by the copyright owner and copiers. Copyright protection serves as an incentive to create new works, but protection also limits copying. She finds that some intermediate level of copying would balance the goals of production and dissemination. The author concludes:

There may be mechanisms that render copyright protection obsolete or imply a reduction in the intensity of protection. Generally, these alternative institutional arrangements are important because a copyright system can never produce the first-best solution to the problem of information production and dissemination. Thus, there is room for other mechanisms to perform better than a system of copyright protection, backing up a market.

One possible institutional arrangement is copyright collectives, intermediary organizations that facilitate licensing of copyrighted works between owners and users. These collectives have been most active in licensing performance rights for music, such as CAPAC, PROCAN and SGDA in Canada. Hollander (1984) provides a careful analysis of copyright collectives with special focus on the Canadian case. He states the problems posed by these collectives as follows:

It has been argued that collectives increase welfare by allowing their members to appropriate at least some of the benefits intellectual works generate in certain markets, thereby strengthening the link between the social gain from creative works and private gains accruing to creators. On the other hand, the question has arisen whether such advantage might not be counterbalanced by anticompetitive behaviour on the part of a collective which occupies a dominant position in the market."

Within a formal mathematical model, the author finds several positive welfare effects from copyright collectives: (1) an increase in the number of works produced and circulated; (2) an increase in creators' revenues arising from improved bargaining power; and (3) a reduction in bargaining costs. While the author observes the possibility of anticompetitive conduct through denial of entry into the collective for new creators, he finds little evidence of this activity in practice. Instead, collectives guarantee "access without restriction and distribution of revenues to creators on the basis of performance."

However, the case for weak copyright protection is not accepted by all economists. Adelstein and Peretz (1985) argue that fair use should be applied very narrowly. Expanding fair use would lower the incentives to produce creative

work and therefore would harm consumers. Furthermore, fair use prevents the creation of decentralized organizations (such as the copyright intermediaries) which resolve the problems of transactions costs in licensing and distribution of copyrighted materials. More importantly, fair use undercuts incentives for technological development as copyright holder shift their efforts to fighting technological development as opposed to embracing it.

The economic analysis of copyright law provides support for copyright protection, but the devil is in the details. How much protection is optimal is an open question. A central theme of the literature is that copyright protection should not be absolute and should be subject to fair and permitted uses. The economic analysis supports very broadly a system of copyright protection that is weaker than patent protection. This prescription may stem in part from the different industries and technologies affected by copyright, in part from the ease in which copyrighted works can be copied as opposed to patented inventions, and in part from copyright's focus on protecting expression and the need to use copyrighted works as inputs for new expressions. Some economic analyses have suggested, based largely on anecdotal evidence, that copyright protection is not needed for innovation. Frank (1996) provides an example from the world of chess, where a system of chess problems and solutions was developed without copyright protection. Goff, Shughart, Tollison and Pociask (1987) find that copyright law has had some impact on the citation of older articles in the economics literature. Cohen (2000) argues that the economic model of copyright fails to quantify creativity, and that price discrimination as a means of rent extraction is impossible to achieve. Finally, in his examination of the debates over copyright reform in light of advances in communications technology, Berg (1971) criticizes the economic model of copyright and property rights for ignoring political battles over property rights definition. Despite these limitations, the economic analysis of copyright provides some helpful tools in assessing copyright law and its effect on social welfare, innovation and economic growth. However, much of this analysis must be applied to the information sector — the most important economic sector affected by copyright law. We broach issues specific to this sector in the next section.

COPYRIGHT LAW, COMPUTER SOFTWARE AND OTHER INFORMATION SYSTEMS

COPYRIGHT LAW'S INFLUENCE reaches across many industries from publishing to broadcasting to entertainment. Copyright's role in the economy has been described as critical in a knowledge-based, information services-based economy. The policy and legal tensions are created by copyright's roots in book publishing and print technology and its application to information systems and non-linear, digital technologies. These tensions have been addressed by isolating the key

features of the knowledge-based economy and the ways in which copyright must adapt to these challenges. I focus on three key problems: (1) network economies and standard setting, (2) software, and (3) broadcasting and performance rights.

Network Economies and Standard Setting

The foundation underlying the information economy is the network. Market systems could survive with one buyer and one seller. Adding buyers or sellers in traditional markets raises costs but does not necessarily add any benefit. Markets in information economies survive and expand through network effects. More buyers and sellers in information-based markets expand the benefits of the market through network effects. The classic example is the telephone. A market with only one telephone cannot survive, but add more users and the benefits of the market expand geometrically (of course with some additional costs). Because of network effects, the stakes are higher in markets in information economies. Dominant players in such markets earn extra-normal profits and can readily capture a large part of the market for a sustained period. The reason for such dramatic returns is that network effects can result in lock-in. Once a product reaches a critical mass in the marketplace, it may be very difficult for consumers to switch to a new product without giving up the network benefits. The example is provided by the gauge of a railway or the voltage for electric appliances. Another example is provided by the telephone network. Because of this lock-in effect, a dominant firm can have an advantage for a long time and set the standard for the industry. The dynamic of information markets is expansion through network effects, which results in lock-in and the establishment of a dominant standard.

Network effects have been controversial in the field of antitrust, especially because of their implications for monopolization. Margolis and Leibowitz (1999) have questioned the contention that lock-in leads to inefficiency. Their research provides useful empirical background for understanding the dynamics of network effects. The relevance for copyright is in addressing the question whether copyright protection should be granted to copyrightable material that may serve as a basis for a dominant standard in an industry. Two examples from the computer industry are protection for operating systems and for standardized interfaces. Consumers benefit from standardization in an operating system and in interfaces. As Besen and Raskind (1991) state:

The greater the degree of standardization, the larger is the array of complementary inputs (software, repair services, and the like) available to users, and the easier it is to switch from one system to another. These forces also create a tendency for only a small number of standardized features of interfaces to exist at any one time, and make the introduction of new interfaces more costly and difficult.”

Since there are benefits to consumers from standardization, the question is whether copyright protection should be granted in order to encourage innovation in the creation of standards.

Besen and Raskind summarize well the arguments for and against copyright protection in their discussion of screen displays and user interfaces:

Proponents of independent protection of screen displays have argued that substantial expenses are involved in developing interfaces and that without legal protection, too few resources will be devoted to that activity.... In response, it has been argued that many standardized interfaces result from arbitrary choices among a number of equally good and widely-known alternatives or conversely there may be only a single way to accomplish a given objective. In either case, providing intellectual property protection would grant considerable market power to the owner of the right to control the standardized interface.

The authors cite proposals for thin or weak copyright protection for user interfaces (and potentially other standards). They suggest that patent law would better serve the purpose of protecting user interfaces (and possibly other standards) as patent law has a high threshold for protection. A higher threshold would ensure that trivial developments will not be protected. Whether patent law or copyright law should be used, the authors admonish against patent or copyright races in which potential intellectual property owners expend valuable resources that could be used for productive uses in trying to obtain patent or copyright protection. The incentives for patent races, the authors conclude, could be attenuated by providing weaker intellectual protection or through a system of compulsory licensing. Such licenses could be administered by private organizations, providing another role for copyright intermediaries.

Computer Software

The software industry exhibits network effects as discussed in the previous subsection, and much of the discussion about copyright's role in the presence of network effects applies to computer software. But software raises other issues, most notably the relationship between patent law and copyright law. As discussed briefly above, courts were reluctant to grant patent protection to software in the 1970s. As a result, much of the pressure to protect software shifted to copyright and *sui generis* statutes. The support for *sui generis* protection for software waned since copyright, with its roots in control of information, seemed to serve the purpose of protection well. However, copyright law was amended in part to deal with the special issues raised by software, such as transient copies, backups and ROM (read-only memory). While all jurisdictions recognize software as copyrightable subject matter, the patentability of software continues to be an issue, with reversal of earlier positions against patentability. In addition,

protection of databases also raises software-related issues, especially to the extent that licensing can serve to protect intellectual property.

Dam (1995) confronts many of the major challenges raised by software for copyright. He addresses the question of network effects and concludes that their existence would not preclude copyrightability since the denial of copyright protection "is bound to have an effect on the incentives for software R&D." The author also suggests that issues of standardization and network effects can be addressed through contracts in the form of joint ventures and strategic alliances among firms. Competition over standards is also feasible but such competition requires strong intellectual property protection. As Dam concludes: "Competition among standards, with the resulting impetus for rapid improvements in leading products, is arguably much more important for users than any reduction in prices that might result from allowing copying of these leading products." He finds that permissive copying would hurt incentives to innovate and therefore would narrow fair use in the context of computer software. The one exception to copying would apply to decompiling software for reverse-engineering purposes.

Dam also surveys the efficacy of patent protection and *sui generis* protection for software. Patent protection, he admonishes, may be too uncertain and leaves room for patenting of trivial or inconsequential software innovations. *Sui generis* protection is also lacking because of the administrative costs imposed by recreating foundation principles already present in copyright and patent law. The author reaches four conclusions. The first is that copyright and patent law provides "a sound basis for an economically efficient system of protection." The second is that copyright with its relatively weak protection adequately deals with the problem of network effects without creating significant rent-seeking or monopolization concerns. According to Dam's third conclusion, copyright also "provides a sound basis for preserving a balance between innovation today and innovation tomorrow." Finally, uses that are transformative of rather than substitutive for copyrighted works should be deemed fair use under copyright.

Broadcasting

Copyright's role in the information economy extends not only to the computer industry but also to radio and television broadcasting. The backbone of the information economy is communications, and the crucial communication sectors are in broadcasting. Copyright issues in broadcasting industries are very different than in the software industry. Part of the difference stems from the overlap between copyright law and communications regulations; another stems from differences in the underlying technology by which content is created and disseminated. A particularly exciting area not discussed here is copyright issues linked to the Internet, where issues raised by software and those raised by broadcasting merge in important and yet-to-be-determined ways. We leave the

discussion of the Internet for future research and focus instead on computer software and broadcasting separately.

There are three copyright issues facing broadcasting industries that have been the subject of economic analysis: (1) compulsory licensing, (2) home videotaping and (3) performance rights of copyright owners.

In the late 1960s, when cable television was developing as a competitor for advertising-funded broadcasting, U.S. courts held that there was no copyright liability for the importation of distant signals. In response, Congress implemented a system of compulsory licensing for broadcasting under which broadcasters would have to license signals and content to other providers under rates that were administered by a copyright tribunal. The compulsory licensing scheme was viewed as a compromise between strong IPRs for broadcast signals that would allow the owner to prevent any use of its signal, including rebroadcasting, and access rights for other broadcasters. From an economic perspective, compulsory licensing served as a way to lower transactions costs. Users could access the copyrighted material for a fee. While the owners could not deny access, they could still obtain payment for the use of the signal. Such an arrangement arguably has lower transactions costs than one in which users and owners would have to negotiate separately for each signal or content used or enter into a blanket licence.

Besen, Manning and Mitchell (1978) strongly criticized the compulsory licensing arrangement on three grounds. First, not imposing full copyright liability would result in free-riding. Through compulsory licensing, users are not paying the full value of the use and viewers are not paying the full value of the program. Free-riding leads to underproduction of broadcasting content. Second, while lowering negotiation costs, a compulsory licensing system also results in lower rates than those achieved through negotiated licences. Because of the improper pricing of use, some broadcasters may be forced out of business or choose not to enter the industry. Finally, the authors conclude that "since the distribution of royalty fees need bear little relation to the value of a particular program, the composition of programming will also be adversely affected."

Another source of free-riding arises from home recording of broadcast signals through videotaping television programs or cassette-taping radio programs and compact disks. Unless deemed fair use, such copying would constitute copyright infringement. The copyright owner could sue for damages or demand a licensing arrangement. No rigorous effort has been made to measure the costs or benefits of such home copying, but recent legislative initiatives in the United States have provided some econometric measure of the value of home copying. In light of then proposed legislative restrictions on digital audio taping (many of which were enacted in the *Audio Home Recording Act of 1993*), Mannering (1994) estimated the costs to the industry and the benefits to consumers from permissive home copying. Using a sample of 517 respondents to a survey conducted by the Office of Technology Assessment about choices of compact disc ownership,

usage and copying, the author estimated a logit model to explain choices over compact discs as a function of demographic and economic variables. He used the estimated model to predict behaviour if a ban was imposed on copying resulting in a decline of blank tape purchases. The predicted gain in revenues to the recording industry was \$1.98 billion in the year of the ban, with a corresponding loss to the blank tape industry of \$798.7 million, for a net gain of \$1.18 billion. Consumer losses were measured by the value of the blank tapes that were not purchased, estimated to be \$4.2 billion. The author concludes that a ban on copying would result in a net loss to society.

Transactions in broadcasting involve not only the broadcaster and the end user, but also the performer, in many cases a singer, but also actors, who may have a protected copyright interest in the performance. Copyright law provides special permitted uses for public performances of protected songs, videos and other broadcast contents. For example, section 110 of the U.S. *Copyright Act* permits broadcasting of video or music in educational settings, religious settings and functions of veterans' associations so long as the primary purpose is not commercial. Some uses are permitted even in commercial settings, such as the playing of a radio in an eating establishment or the playing of a compact disk to advertise the song in a record store. Without these special permissions, such uses would constitute infringement requiring compensation. The two major copyright intermediaries in the United States, BMI and ASCAP, caused quite a stir a few years ago when they challenged the use by the Girl Scouts of certain copyrighted songs in public performances. Should all performances require compensation paid to the copyright owner, and if not, when should there be an exemption?

Kobayashi and Yu (1995) address this question in a formalized model where broadcast content is described as a public good which is an output produced by the copyright owner and an input used by a producer as part of a public performance to be consumed by the end user. The authors describe the public performance as a modified public good and ask whether the copyright owner should be compensated for the modifications made by the end user. They conclude that the end user should not be charged but the producer should be. As they put it:

It would not be in the interest of the original copyright owner to demand payment from end users of the modified intellectual property as such a fee would reduce the total demand for the copyrighted material. Once again, the economic analysis suggests that it is in the interest of the copyright owner to charge one price to the producer of the modified public good, and not to charge a separate price to the users of the modified public good.

Kobayashi and Yu provide a useful economic approach to determining when performance rights should be protected.

First, they require a showing on the part of the copyright owner that a performance (such as singing *Happy Birthday* at a party) would result in actual damages. If there are damages, then there is a case for infringement. If there are no actual damages, then the focus shifts to the interdependence in demand between the challenged performance and the licensed or substitute performances. If there is interdependence, as measured by cross-price elasticity of demand, then there is also a case for infringement. For example, if a local bar uses a dish satellite to broadcast a game that is blacked out locally, the relevant inquiry for infringement of the performance rights is whether the cross-elasticity of demand for the broadcast in the bar with the price of a ticket to the stadium is negative. If so, then the copyright owner has a claim for against the bar for infringing the performance right.

Second, the authors would make a distinction between modified and unmodified public goods. If a copyrighted work is modified, then the right to control public performances should go to the producer of the modified work and not to the holder of the copyright in the material that is the input to the modified public good. For example, if a radio station broadcasts a song with permission from the owner of the copyright on the song, and the radio broadcast is rebroadcast by a commercial establishment for a fee, then, according to Kobayashi and Yu, the performance right should go to the radio station and not to the copyright holder. The authors argue that this would lower costs since the producer of the modified public good would have the proper incentives and would be in a position to maintain control over the modified work. In cases, where there is performance of an unmodified work, the right would, of course, vest in the copyright holder. Note that this analysis is consistent with the authors' conclusions about payment for modified public goods. The efficient arrangement is for the copyright holder to charge the producer of the modified work for use of the copyrighted material and not charge end users separately. Accordingly, the producer of the modified work would have the exclusive right to prevent public performance of the modified public good by end users.

Towse (1999) complements nicely Kobayashi and Yu's study by examining the royalty structure of performance rights as administered by copyright intermediaries, such as BMI. He presents a rich model of music publication and distribution that considers not only the incentives to innovate but also the issues of risk bearing and entrepreneurship raised by the publication, distribution and marketing of music. She finds that:

Despite high aggregate earnings from copyright in the music industry, the vast majority of musicians earn relatively little from specific copyright and performers' rights. The large sums of royalty income that copyright law enables to be collected go mainly to publishers... and to a small minority of high earning performers and writers.

Although copyright provides an allocation of rights which permits market transactions, the actual market outcomes depend upon bargaining power and the allocation of resources in the industry.

The broadcasting industry raises compelling problems for copyright law with respect to the economic efficacy of compulsory licensing, home copying and performance rights. These issues will become more salient, especially in their interaction with computer software, as the Internet develops and matures.

Summary

In this section, we summarize the main challenges to copyright law presented by the information economy. This section and the previous one on the economics of copyright provide an overview of the economics literature addressing copyright law. It is against this background that we now examine the copyright system in Canada.

THE CANADIAN SYSTEM OF COPYRIGHT LAW

IN THIS SECTION, WE PROVIDE AN OVERVIEW of the system of copyright protection in Canada with special consideration of computer software, databases, moral rights, and emerging international and constitutional issues.

Overview

Canadian copyright law has its roots in British law and it has been described as decidedly British in origins and content. Federal legislation was first enacted in 1875 and the first major *Copyright Act* was adopted in 1924, modeled on the 1911 British law. The next major change was a series of amendments brought in 1936, which created the Copyright Appeal Board. Then, there were no major changes until 1988, with the first phase of the copyright reform process that culminated in 1997, when copyright law was amended in response to 40 years of technological and market changes. The principal changes arose from the advent of digital technology and the information highway through fibre optics and cable. Such changes had profound implications for the creation, reproduction and dissemination of copyrighted works and created an interactive process for information retrieval and creation that turned passive consumers of information into authors and providers of information.

The primary impetus for copyright reform in Canada came from the 1984 White Paper tabled by the Trudeau government, and revived by the Mulroney government in 1985. The White Paper called for a reworking of copyright law to catch up with developments in information and communications technology. The first amendments, passed in 1988, contained the following provisions:

- explicit statutory protection for computer programs;

- a broadened definition of choreographic works and their inclusion as a separate category of copyrightable subject matter;
- expanded and strengthened moral rights for authors;
- the abolition of compulsory licensing provisions for sound recordings;
- statutory foundations for the collective exercise of copyright by licensing bodies with a distinct regulatory regime for their control;
- a restructuring of the Copyright Appeal Board into the Copyright Board of Canada;
- stiffer penalties for infringement;
- creation of a retransmission right as part of a broader telecommunication right (enacted in response to U.S. opposition to rebroadcasting of U.S. signals by Canadian stations).

Several other amendments were adopted in 1993 and 1994 to meet treaty obligations under NAFTA and in response to international pressures. They included: (1) the creation of a commercial rental right for computer programs and sound recordings; (2) guarantees of IPR protection for non-Canadian nationals in Canada, while ensuring that enforcement of IPRs does not become a barrier to trade; (3) a redefinition of publication and prescription of new copyright terms; (4) a narrowing of the gramophone exception that would apply to public performances in terms of radio receiving sets; (5) provision of limited protection to performers against unauthorized broadcasts and sound recordings of their live performances, with exceptions for *fair dealing* (analogous to *fair use* under U.S. law) for (a) private study, research, criticism or review, and (b) temporary audio-taping of a public lecture for newspaper reporting.

The 1997 amendments were the most important and, at the time of enactment, heralded as critical to maintaining a Canadian identity and sovereignty in an era when globalization and the information revolution are erasing national borders. Also influential to the passage of the amendments was the value added to the Canadian economy by *cultural industries*, which were said to inject \$16 billion into the economy annually and play a key role in job creation. The main provisions of the amendments included:

- a levy on blank audio-recording material;
- exemptions for non-profit educational institutions, libraries, archives, museums, and people with perceptual difficulties permitting the reproduction, performance and communication for educational purposes under specified conditions and for limited archival purposes;

- the protection of exclusive book distributors against parallel book imports in Canada except for used books and books for personal use;
- the adoption of statutory damages and injunctive remedies against likely infringement of related works, whether copyrighted or not;
- the creation of three collective regimes for the private enforcement of copyright, responsible for (1) the collection of revenue from the levy on blank audiotapes, (2) the distribution of performance rights, and (3) the management of compulsory licences for the reproduction and public performance of news programs or other programs by an educational institution for educational purposes, and for the retransmission of distant signals;
- the enactment of neighbouring rights granted to recording artists and makers of sound recordings to protect against unauthorized public performances and broadcasts of sound recordings.

The copyright amendments enacted in the late 1980s and 1990s marked an important change in the regulation of cultural industries. Doern and Sharaput (2000) describe it as follows: “Cultural policymakers could no longer as easily protect Canadian culture using subsidies, and thus they turned, propelled again by international pressures, to the intellectual property realm as the next available policy tool.” The shift to legal protection from subsidies pitted several economic interests against each other. At the aggregate level, the tensions were between creators and users of cultural property. There were also industry-specific tensions. These tensions can be summarized as follows:

- creators opposed the exemptions for educational institutions, libraries and archives as being too broad;
- performers and record producers were critical of neighbouring rights that granted exclusive rights over performances and telecommunications, as opposed to the right to equitable remuneration for uses, which were extended to performances of sound recordings (but not of audio-visual media);
- broadcasters objected to the fact that the telecommunication right did not apply to cable and direct-to-home services;
- creators of software, sound recordings and films were concerned that the ban on parallel imports of books did not extend to other works;

- user groups objected to the levy on blank audiotapes, some arguing that imposing this levy at the manufacturing and importation levels would simply lead to a grey market in audiotapes, others arguing that the levy was too broad and should not be imposed on those who make copies for legitimate purposes;
- educational institutions and libraries objected to the narrow scope of the exemptions, especially the lack of an exemption for distance learning and the need to license reprographic rights from copyright collectives.

The development of Canadian copyright law reflects the complex influence of copyright policy on the information economy and the interest groups affected by changes in information policy.

Computer Software

Computer software was recognized explicitly as copyrightable subject matter in the 1988 amendments, where it was categorized as a literary work. The Act and subsequent case law developed the following rules concerning copyright protection of software, as reported by Morrow and Limpert (1996):

- the Act exempts from infringement the making of a single copy of a computer program through adaptation, modification, conversion or translation of the program for the purposes of compatibility, for personal use, provided the reproduction is destroyed after the person ceases to be the copyright owner;
- the Act permits the making of a backup copy of legally purchased software;
- programs embedded in a silicon chip are protected by copyright;
- a programmer can be treated as an independent contractor and will be the owner of the copyright in the program if the programmer does not integrate himself in the business for which the program was written.

An important and continuing debate involves the legality of reverse engineering under copyright law. This issue is discussed in detail in the next section on case studies of copyright law.

Databases

Copyright protection of databases under Canadian law is limited to protecting the selection and arrangement of the data and not the data itself. A database is protected as a *compilation*. Howell (1998) isolates the following key legal issues surrounding the protection of databases:

- sweat of the brow, or industriousness, is not sufficient for copyright protection. The copyright owner must demonstrate creativity or some qualitative factor in order to receive protection;
- by contrast with the United States, where the sweat of the brow doctrine was rejected in order to comply with the Constitution, there is no similar limitation under Canadian law;
- rejection of the sweat of the brow doctrine in Canada can be traced to British roots and to several opinions of the House of Lords, but the rejection is not unambiguous;
- fair dealing with respect to databases has not been addressed by the Canadian courts, but the statutory basis for fair dealing is narrower than that for fair use in the United States.

Database protection is an evolving area that raises the most important questions for copyright protection and regulation in the information economy.

Moral Rights

As discussed above, moral rights protect the rights of the creator in maintaining the integrity of the copyrighted work. They protect the reputational externalities that arise in the market for information, especially when the creator and owner of the copyright are different persons. Moral rights comprise four separate categories of rights: rights of paternity, of integrity, of disclosure and of withdrawal. Paternity rights protect the attribution of the work; integrity rights protect adaptations and changes to the work; disclosure rights protect the publication of the work; and withdrawal rights protect the distribution of the work. Canada adopted moral rights provisions as part of the 1988 amendment process under sections 14.1-14.2 of the *Copyright Act*, which provide for rights of paternity and integrity, but not disclosure and withdrawal rights.

Moral rights have been criticized for granting the author too much control over his work at the expense of commerce and users' rights. The Canadian system addresses these concerns by not recognizing disclosure and withdrawal rights. Rushton (1998) offers a rigorous assessment of moral rights and bases his case for a limited recognition of moral rights on the need to protect the creator's

incentive to create and control his work. He adopts a personality theory of authorship, but is concerned about the effect of a broad protection of moral rights on users. The author concludes: "There are monetary aspects to artists being able to protect their reputation... [b]ut there are non-monetary welfare aspects as well... [A]s new technologies force the monetary aspects of copyright to evolve, so too will moral rights."

Rushton (1997) concludes that the provisions of the 1997 amendments were driven by concerns for protecting moral rights rather than the economic rights of copyright owners. He states:

The law-and-economics method seeks a regime which maximizes social wealth. Where studies in this mode were carried out in Canada, they were generally sceptical of provisions which appear in [the amendments]: neighbouring rights, the levy on tapes, and prohibition on parallel importation. The reason is that, in general, strengthening creators' rights in copyright increases social welfare only if it will translate into more works being created (and even then the increased protection is not necessarily justified). But no analysis has yet demonstrated that any provisions [in the amendments] will lead to the creation of more works.

The author is also sceptical of the effect of the amendments on bolstering Canadian cultural industries, even at a net monetary loss to society. He strongly recommends that the economic effects of copyright law be taken into consideration as part of the next round of copyright amendments in Canada, those dealing with regulation of the Internet.

Emerging International and Constitutional Issues

International law and constitutional law both impose important constraints on Canadian copyright law and need to be considered in depth.

Handa (1997) surveys the developments in Canadian copyright law influenced by international developments. He finds that "Canadian intellectual property policy is being increasingly dictated by external pressures from trading partners." Such pressures are consistent with Canada's interest "to ensure that informational products receive universal protection" especially as Canada develops strong export markets for such products. He argues that international pressures may cause Canada to lose some degree of control over its copyright law, but also advises that control can be maintained through effective trade negotiations to achieve concessions in the development of copyright law. Finally, the author concludes that as harmonization of law proceeds, the tension between copyright law and competition policy will be brought to the forefront.

Fewer (1997) discusses the constraints placed on copyright law by the Canadian Charter of Rights, particularly the protections given to freedom of expression. The author sees some conflict between the two bodies of law,

especially with respect to control over the creation of transformative uses and fair uses (or fair dealing in the use of) copyrighted works. He predicts that freedom of expression will play a more active role in copyright law enforcement, but this role does not inevitably lead to reduced protection for copyrighted works. Copyright law and freedom of expression are not in conflict:

The *Copyright Act*, properly construed, should be an engine of freedom of expression; the integrity of the incentive structure built into the Act is crucial to maximizing the flow of information and dissemination of knowledge... Interpreting more rigorously the fair dealing defence, widening the public interest defence, and generally interpreting the *Copyright Act* in a fashion that accommodates both the proprietary interests of copyright owners... and the expressive interests of users of copyright materials... will go far in constitutionalizing copyright.

The constitutional dimensions of copyright will become more apparent as the next stage of the copyright amendment process dealing with regulation of the Internet unfolds. The author points out that a section of the final report on copyright issues and the Internet claimed that “the act of browsing in digital environments constituted a reproduction for the purposes of the *Copyright Act*.” Since freedom of expression would include rights of access and reading under the Canadian Charter, he predicts that copyright amendments pertaining to the Internet “should attract considerable constitutional scrutiny.”

Summary

This section gave an overview of the complexity of Canadian copyright law, highlighting the important developments in the law and the ongoing controversies. The debates in Canada over copyright law mirror the debates in the economics literature on access to and control over information through copyright law. However, Canadian copyright law is far from the ideal prescribed by economic analysis. Instead, the copyright system is a mix of economic and moral rights principles resulting from a compromise between creators and users, subject to international and constitutional pressures. The impact of legal developments on economic performance is examined in the next section.

STUDIES ON COPYRIGHT LAW, INNOVATION AND ECONOMIC GROWTH

THERE ARE FEW COMPREHENSIVE economic studies of the Canadian copyright system. However, there are individual studies that address specific provisions or industries. Here, we look at the most important of these studies and draw inferences about the economic efficacy of Canadian copyright law.

Evaluation of Copyright Amendments

The amendment process, whether of copyright law or some other legislation, serves as a natural experiment to test the effects of copyright rules on economic behaviour. Smith (1988) offers such an assessment and reaches the following conclusions, based on the impact of changes on social welfare:

- the recognition of reciprocity as required for compliance with international treaty obligations fails to deal adequately with Canada's position as a net importer of information goods;
- it is not in Canada's interest to reduce the extent of copyright protection because of possible retaliation, and given the small size of copyright payments, the potential costs of retaliation in other areas exceed the potential gains of a reciprocal approach to copyright protection;
- the performance right granted to performers will either decrease or leave unaffected the total number of performances produced because the proposed revenue distribution scheme (administered by a private copyright intermediary) separates the reward from the intended result, reducing the incentive for creating performances;
- a direct subsidy program for performances would be more effective in increasing performers' revenues than the proposed royalty scheme;
- recognizing a performance right for sound recordings would have limited economic benefits and substantial costs as it would result in an outflow of royalties to the United States, where master tapes are held. Canadian content requirements would only slightly reduce this outflow;
- the expansion of copyright collectives is not justified and may raise the administrative costs of enforcing copyright.

The author concludes that the purpose of copyright revisions is not to increase the output of copyrighted works and increase the well-being of all Canadians, but to "provide subsidies to Canadian creators outside the established funding programs that now exist."

Software and Reverse Engineering

This topic is perhaps the single most important for the software industry and copyright policy. Its importance goes beyond software, with broader implications for the Internet and digital technologies.

Handa (1995) addresses both the economic and legal treatment of reverse engineering of software. She argues that because some aspects of computer software are non-rival and non-excludable, like most information goods, absolute privatization of rights in software is not the appropriate approach. Furthermore, because of network effects and the issues raised by standardization and compatibility, reverse engineering of software is desirable in order to develop products that would be compatible with a dominant standard. After surveying other common law jurisdictions that have provided limited protection for reverse engineering from copyright law, the author urges Canada to adopt specific legislation to protect reverse engineering or to recognize reverse-engineered products as protected under the fair dealing principle. As discussed above, the 1997 amendments to the *Copyright Act* reflect the first approach, with specific statutory provisions permitting copy for the purposes of reverse engineering.

Broadcasting

Copyright amendments recognizing performance rights and imposing licensing requirements on Canadian broadcasters have been the subject of research with mixed conclusions about the benefits of such reforms.

Faber (1998) contends that the amendments would adversely affect the fledgling private radio industry in Canada. His focus is on the neighbouring rights provisions intended to strengthen the performance rights of performers and creators of sound recordings. Such rights “may actually hamper cultural development by imposing increased copyright fees on Canadian radio, a medium that has played a crucial role in promoting Canadian culture.” The author concludes that “in addition to imposing economic hardship on struggling radio stations, the neighbouring rights provisions will fail to help the artists they were intended to benefit... Only the most successful Canadian artists will earn extra income from the performers’ rights provisions.” He estimates that as a result of the amendments, each member of a performing rights association would earn less than \$10,000 annually.

Globerman and Rothman (1982) provided an early study on the effects of granting copyright protection to performers. They concluded, more than 15 years before the enactment of related amendments that there was “no compelling evidence of significant social benefits from implementation of a performer’s right. Indeed, its institution would likely reduce the quantity of original performances in Canada, and accentuate income differences between

full and part-time performers.” Their conclusion rests on the effect of the royalty provisions on the demand for Canadian performances. Creating a copyright would decrease the demand for Canadian performances since there would be an increase in fees on the re-use market. Without an increased supply of performers, the returns to performances as measured by the price paid would fall, as would the number of Canadian performances. This negative effect on quantity could be offset by an increase in supply resulting from the creation of a copyright. As the number of individual performers increases, because of the creation of a copyright, wages would fall, resulting in a lower cost for performances and an increase in their supply. The actual effects would depend upon the elasticity of supply. Since the supply of performances is estimated to be relatively inelastic, the authors predict that the number of performances will decrease because of the creation of the copyright. Furthermore, they contend that “considerations of fairness and equity in the distribution of income offer no compelling arguments for imposing a performers’ copyright.”

Copyright and Competition Policy

The effect of copyright protection on market competition is increasingly gaining the attention of policy-makers. However, there has been little systematic study of copyright regimes and competition policy. We briefly discuss two studies here.

Wiegand (1996) considers the compulsory licensing regime for cable under the U.S. *Copyright Act* of 1976 and finds that it creates barriers to entry in the market for superstations and alternative broadcast delivery systems. According to the author, the compulsory licensing scheme has resulted in higher royalty fees than would be established through market forces. Copyright law should assign the rights over distant broadcast signals to either the program supplier or the receivers of the signal. This would permit effective competition in the market for superstations and alternative broadcast delivery systems that “would both place competing technologies on an equal footing and increase competition among superstations.”

Walther (1975) treats the relationship between copyright law and competition policy more broadly and proposes that as copyright law becomes globalized in a context of free trade, the interest in competition policy will increase.

CONCLUSIONS ON COPYRIGHT LAW

LIKE PATENT LAW, COPYRIGHT LAW is designed to provide rewards for innovation by giving the copyright owner the exclusive right to exploit the copyrighted work. However, as it protects expression rather than invention, copyright law strikes a different balance between private rights of exclusion and public rights of access. Furthermore, since copyright law focuses on expression, it serves as an important regulatory tool in the information economy, one that

affects many interests in distinct and diverging industries. The survey of copyright law invites consideration of the following research topics:

- copyright protection and R&D expenditures;
- information sharing and copyright norms;
- reverse engineering practices and copyright's role in second generation innovation;
- performance rights and the distribution of royalties;
- the benefits and costs of moral rights protection.

Copyright's role and the answers to these research questions will become more crucial as copyright reform moves on to the next stage in Canada with the regulation of the Internet.

SUMMARY AND CONCLUSION

THE FUNDAMENTAL IMPORTANCE of the intellectual property institution for economic performance, through its impact on innovation and technological change, has long been recognized by Schumpeter (1934), Arrow (1962) and others. There is a large body of theoretical literature focusing on the effects of intellectual property regimes on economic performance. Although this literature has yielded many important insights, the resulting impact is generally ambiguous and depends on circumstances. Therefore, the impact of an intellectual property regime on economic performance is an empirical issue. However, the empirical literature on the issue is notoriously limited. As a result, our understanding of the impact of the intellectual property institution on most measures of economic performance is still far from satisfactory.

The intellectual property institution in Canada has a long history and patents have historically been viewed as the strongest possible form of intellectual property protection. Canada was created as a federation in 1867 and its first *Patent Act* dates from 1869. Since its inception, the *Patent Act* was amended several times over the last century. Extensive amendments were also made recently. On October 1, 1989, Canada abandoned its first-to-invent patent system in favour of a first-to-file system. Among the numerous amendments to the *Patent Act*, provisions relating to the novelty and non-obviousness requirements, the duration of a patent, and the requirement to publicly disclose patents have been modified. These changes are in place, but very little is known about whether the special features of the Canadian patent system and the changes made to the legislation in 1989 had any impact on Canada's economic performance. The assessment of the intellectual property reforms of the 1980s

is an empirical question, given that more than a decade has passed since most of the changes were introduced, and there should now be adequate data to test whether a structural change in innovative activity has occurred.

The main thrust of this study is to assess whether the protection of IPRs enhances economic performance by fostering both the creation and diffusion of technological innovations. The study had three principal objectives : (i) to review the literature, both theoretical and empirical, dealing with the economic implications of IPRs; (ii) to understand how and whether intellectual property regimes affect technological innovations, and thus productivity, growth, international trade, FDI, licensing, human capital development and the innovative capability of small and medium-size enterprises; and (iii) to assess the implications of the Canadian patent regime, particularly the 1989 reform of the *Patent Act*, for promoting the creation and diffusion of innovations and thus for Canada's economic performance. Studies of these implications would have immediate policy relevance.

The issue of IPRs has received growing attention in the arena of international trade and investment policy. This is clearly seen in the inclusion of negotiations on TRIPs within the context of bilateral or multilateral trade policy. The implicit policy assumption behind these negotiations is that differences in IPRs across nations affect international trade and investment flows.

Intellectual property in the form of patents, trade-marks and copyright is a firm-specific asset whose exploitation by the firm is enhanced through its global marketing strategy. There are three ways by which intellectual property may be traded. It may take the form of exporting goods embodying a creative component, of FDI, or of licensing the asset to an overseas competitor. National differences in IPRs affect each of these channels of intellectual property trade. An important question is whether trade in Canadian intellectual property is sensitive to the strength of IPRs in the receiving countries.

This study has surveyed what we know and what we need to know about IPRs and their influence on economic performance. We hope that the research collected and summarized will serve as a roadmap for future work toward understanding the key role of intellectual property as a tool of economic policy.

APPENDIX

TABLE A-1

COMPARISON OF THE MOST IMPORTANT AMENDMENTS MADE BY THE
PATENT AMENDMENT ACT, 1987, R.S.C. 1985, c.33 (3RD SUPP.)

OLD ACT	NEW ACT
1 First to invent.	First to file.
2 Must file within 2 years from the first printed publication or Canadian sale or use.	One-year grace period after publication/ making known by applicant or, in all other cases, absolute novelty.
3 No government publication of patent application until the patent issues.	Publication of all patent applications no later than 18 months after the priority date.
4 Examination of the application by the Patent Office is automatic. No request necessary.	Examination must be requested. Request must be made within 7 years of filing the application.
5 Term of exclusivity is 17 years from the date of issue.	Term of exclusivity is 20 years from the date of application.
6 No maintenance fees or renewal fees are payable.	Maintenance and renewal fees are payable.
7 Impeachment proceedings in the Federal Court of Canada.	Also provides for re-examination by the Patent Office.
8 Marking is required.	Marking is not required (but still recommended).
9 Supplementary disclosure is possible.	No supplementary disclosure.
Source: Dimock, 1994.	

BIBLIOGRAPHY

PATENTS

- Aghion, P., and P. Howitt. 1992. "A Model of Growth through Creative Destruction." *Econometrica* 60, 2: 323-351.
- Aoki, R., and Y. Spiegel. 1998. "Public Disclosure of Patent, R&D, and Welfare." Tel Aviv: Tel Aviv University (Berglas School of Economics). Unpublished paper.

- Arrow, K. 1962. "Economic Welfare and the Allocation of Resources for Inventions." In *The Rate and Direction of Inventive Activity*. Edited by R. Nelson. Princeton, N.J.: Princeton University Press.
- Barro, R. 1991. "Economic Growth in a Cross-Section of Countries." *Quarterly Journal of Economics* 106: 407-433.
- Binkley, G.P. 1999. "Patent Rights and New Product Development in Canada." *Canadian Intellectual Property Review* 15, 2 (March): 231-238.
- Braga, H.C., and L.N. Willmore. 1991. "Technological Imports and Technological Effort: An Analysis of their Determinants in Brazilian Firms." *The Journal of Industrial Economics* 39 (June): 421-433.
- Brown, D.K. 1991. "Tariffs and Capacity Utilization by Monopolistically Competitive Firms." *Journal of International Economics* 30: 371-381.
- Cadot, O., and S. Lippman. 1995. "Barriers to Imitation and the Incentive to Innovate." INSEAD. Mimeo.
- Caves, R.E., H. Crookell and J.P. Killing. 1983. "The Imperfect Market for Technology Licenses." *Oxford Bulletin of Economics and Statistics* 45: 249-267.
- Chang, H.F. 1995. "Patent Scope, Antitrust Policy and Cumulative Innovation." *The RAND Journal of Economics* 26: 34-57.
- Cockburn, I.M., and P. Chwelos. 1999. "Intellectual Property Rights and the Transition to the Knowledge-Based Economy." Canada: University of British Columbia. Faculty of Commerce. Unpublished paper.
- Contractor, F.J. 1980. "The 'Profitability' of Technology Licensing by U.S. Multinationals: A Framework for Analysis and an Empirical Study." *Journal of International Business Studies* 11: 40-63.
- Deardroff, A.V. 1990. "Should Patent Protection be Extended to All Developing Countries?" *The World Economy* 13 (December): 497-508.
- . 1992. "Welfare Effects of Global Patent Protection." *Economica* 59: 33-51.
- DeBrock, L.M. 1985. "Market Structure, Innovation and Optimal Patent Life." *Journal of Law and Economics* 28: 223-244.
- De Laat, E.A.A. 1996. "Patents or Prizes: Monopolistic R&D and Asymmetric Information." *International Journal of Industrial Organization* 15: 369-390.
- Dimock, R.E. 1994. "Patent Anticipation or What's New, Patent Act?" in Henderson et al. (Eds.), *Patent Law of Canada*, Carswell Thomson Professional Publishing: Toronto, Canada.
- Eswaran, M., and N. Gallini. 1996. "Patent Policy and the Direction of Technological Change." *The RAND Journal of Economics* 27: 722-746.
- Ferrantino, M.J. 1993. "The Effect of Intellectual Property Rights on International Trade and Investment." *Weltwirtschaftliches Archiv* 129: 300-331.
- Flam, H., and E. Helpman. 1987. "Industrial Policy under Monopolistic Competition." *Journal of International Economics* 22: 79-102.
- Gallini, N. 1992. "Patent Policy and Costly Imitation." *The RAND Journal of Economics* 23: 52-63.
- Gallini, N., and B.D. Wright. 1990. "Technology Transfer under Asymmetric Information." *The RAND Journal of Economics* 21: 147-160.
- Gilbert, R., and C. Shapiro. 1990. "Optimal Patent Protection and Breadth." *The RAND Journal of Economics* 21: 106-112.

- Ginarte, J., and W.G. Park. 1997. "Determinants of Patent Rights: A Cross-National Study." *Research Policy* 26: 283-301.
- Gould, D., and W. Gruben. 1996. "The Role of Intellectual Property Rights in Economic Growth." *Journal of Economic Development* 48: 323-350.
- Green, J., and S. Scotchmer. 1995. "On the Division of Profit in Sequential Innovation." *The RAND Journal of Economics* 26: 20-33.
- Grossman, G., and E. Helpman. 1991. *Innovation and Growth in the Global Economy*. Cambridge, MA: MIT Press.
- Gruben, W.C. 1992. "Trade Policy and Intellectual Property Protection: The North-South Dispute." *Federal Reserve Bank of Dallas Economic Review* 4: 19-29.
- Hayhurst, W.L. 1986. "Differences Between U.S. and Canadian Intellectual Property Laws – Real and Apparent." *Canada-United States Law Journal* 11: 91-140.
- Helpman, E. 1993. "Innovation, Imitation, and Intellectual Property Rights." *Econometrica* 61: 1247-1280.
- Henderson, G.F., H.P. Knopf, J.R. Rudolph, D. Watson, J.D. Kokonis and D.M. McRae. 1994. *Patent Law of Canada*. Toronto: Carswell Thomson Professional Publishing.
- Horstmann, I.J., and J.R. Markusen. 1987. "Licensing versus Direct Investment: A Model of Internalization by the Multinational Enterprise." *Canadian Journal of Economics* 20: 464-481.
- Hunt, R.M. 1999. *Nonobviousness and the Incentive to Innovate: An Economic Analysis of Intellectual Property Reform*. Working Paper No. 99-3. Federal Reserve Bank of Philadelphia.
- Jaffe, A.B. 1986. "Technological Opportunity and Spillovers of R&D: Evidence from Firms' Patents, Profits and Market Value." *American Economic Review* 76, 5: 984-1001.
- . 1999. "The U.S. Patent System in Transition: Policy Innovation and Innovation Process." *Technical Report*.
- Klemperer, P. 1990. "How Broad Should the Scope of Patent Protection Be?" *The RAND Journal of Economics* 21: 113-130.
- Kortum, S., and J. Lerner. 1998. "Stronger Protection or Technological Revolution: What Is Behind the Recent Surge in Patenting?" *Carnegie-Rochester Series on Public Policy* 48: 247-304.
- La Manna, M.M. 1992. "Optimal Patent Life Versus Optimal Patentability Standards." *International Journal of Industrial Organization* 10, 1: 81-89.
- Mansfield, E. 1986. "Patents and Innovation: An Empirical Study." *Management Science* (February): 173-181.
- . 1994. *Intellectual Property Protection, Foreign Direct Investment, and Technology Transfer*. IFC Discussion Paper No. 19. Washington, D.C.: The World Bank and International Finance Corporation.
- Mansfield, E., J. Rapoport, A. Romeo, S. Wagner and G. Beardsley. 1977. "Social and Private Rates of Return from Industrial Innovations." *The Quarterly Journal of Economics* 91 (May): 221-240.
- Maskus, K.E., and D. Eby-Konan. 1994. "Trade-related Intellectual Property Rights: Issues and Exploratory Results." In *Analytical and Negotiating Issues in the Global Trading System*. Edited by A.V. Deardorff and R.M. Stern. Ann Arbor, MI: University of Michigan Press, p. 401-454.

- Maskus, K.E., and M. Penubarti. 1991. "Comparing International Trade Data and Product, and Product and National Characteristics Data for the Analysis of Trade Models." In *International Economic Transactions: Issues in Measurement and Empirical Research*. Edited by P. Hooper and J.D. Richardson. Chicago, IL: University of Chicago Press.
- . 1995. "How Trade-Related are Intellectual Property Rights?" *Journal of International Economics* 39: 227-248.
- . 1997. "Patents and International Trade." In *Quiet Pioneering: Robert M. Stern and His International Economic Legacy*, Edited by K. Maskus, and R.M. Stern. Ann Arbor, MI: University of Michigan Press, Chapter 5, pp. 95-118.
- Matutes, C., P. Regibeau and K. Rockett. 1996. "Optimal Patent Design and the Diffusion of Innovations." *The RAND Journal of Economics* 27: 60-83.
- Merges, R.P. 1988. "Commercial Success and Patent Standards: Economic Perspectives on Innovation." *California Law Review* 76: 805-876.
- . 1992. "Uncertainty and the Standard of Patentability." *High Technology Law Journal* 7: 1-70.
- McFetridge, D. 1995. *Science and Technology: Perspectives for Public Policy*. Industry Canada, Micro-Economic Policy Analysis Branch. Occasional Paper No. 9. Ottawa: Industry Canada.
- Nogues, J. 1990. *Notes on Patents, Distortions, and Development*. Working Paper No. 315. Washington, D.C.: The World Bank.
- Nordhaus, W.D. 1969. *Invention, Growth and Welfare*. Cambridge, MA: MIT Press.
- O'Donoghue, T. 1998. "A Patentability Requirement for Sequential Innovation." *The RAND Journal of Economics* 29: 654-679.
- Park, W.G. 1997. *Issues in International Patenting*. Prepared for the Working Group on Innovation and Technology Policy. Paris: OECD, Directorate for Science and Technology.
- Park, W.G., and J. Ginarte. 1997. "Intellectual Property Rights and Economic Growth." *Contemporary Economic Policy* 15, 3 (July): 51-61.
- Rafiquzzaman, M. 1987. "The Optimal Term under Uncertainty." *International Journal of Industrial Organization* 5: 233-246.
- . 1988. "Invention, Market Structure, Cost Reduction Uncertainty and the Optimal Patent Term." *Journal of Economics* 48, 3: 303-312.
- . 1999. "Impact of Intellectual Property Rights on International Trade: Evidence from Canada." Industry Canada, Micro-Economic Policy Analysis Branch. Unpublished paper.
- Rafiquzzaman, M., and L. Whewell. 1998. *Recent Jumps in Patenting Activities: Comparative Innovative Performance of Major Industrial Countries, Patterns and Explanations*. Industry Canada, Micro-Economic Policy Analysis Branch. Working Paper No. 27. Ottawa: Industry Canada.
- Rapp, R.T., and R.P. Rozek. 1990. "Benefits and Costs of Intellectual Property Protection in Developing Countries." *Journal of World Trade* 24, 5 (October): 75-102.
- Rivera-Batiz, A. Luis, and P.M. Romer. 1991. "International Trade with Endogenous Technological Change." *European Economic Review* 35: 971-1004.
- Romer, P.M. 1990. "Endogenous Technological Change." *Journal of Political Economy* 98, 5: s71-s102.

- Sakakibara, M., and L. Branstetter. 1999. *Do Stronger Patents Induce More Innovation? Evidence from the 1988 Japanese Patent Law Reforms*. NBER Working Paper No. 7066.
- Saunders, R.H. 1999. "Does Canadian Patent Practice Impair Technological Development?" *Canadian Intellectual Property Review* 15, 2 (March): 265-274.
- Scherer, F.M. 1972. "Nordhaus' Theory of Optimal Patent Life: A Geometric Reinterpretation." *American Economic Review* 62 (June): 422-427.
- Scherer, F.M., and S. Weisburst. 1995. "Economic Effects of Strengthening Pharmaceutical Patent Protection in Italy." *IIC: The International Review of Industrial Property and Copyright Law* 26, 6: 1009-1024.
- Schumpeter, J. 1934. *The Theory of Economic Development*. Cambridge, MA: Harvard University Press.
- Schwartz, M. 1991. "Patent Protection through Discriminatory Exclusion of Imports." *Review of Industrial Organization* 6: 231-246.
- Scotchmer, S. 1996. "Protecting Early Innovators: Should Second Generation Products Be Patentable?" *The RAND Journal of Economics* 27: 322-331.
- . 1999. *Cumulative Innovation in Theory and Practice*. Working Paper. Berkeley, CA: University of California.
- Scotchmer, S., and J. Green. 1990. "Novelty and Disclosure in Patent Law." *The RAND Journal of Economics* 21: 131-146.
- Seyoum, B. 1996. "The Impact of Intellectual Property Rights on Foreign Direct Investment." *Columbia Journal of World Business* 31, 1 (Spring): 50-58.
- Sherwood, R.M. 1990. *Intellectual Property and Economic Development*. Boulder, CO: Westview Press.
- . 1997. "Intellectual Property Systems and the Investment Stimulation: The Rating of Systems in Eighteen Developing Countries." *IDEA: The Journal of Law and Technology* 37, 2: 261-370.
- Smith, P.J. 1999. "Are Weak Patent Rights a Barrier to U.S. Exports?" *Journal of International Economics* 48, 1 (June): 151-177.
- Solow, R.M. 1957. "Technical Change and the Aggregate Production Function." *Review of Economics and Statistics*: 312-320.
- Taylor, M.S. 1993. "TRIPs, Trade, and Technology Transfer." *Canadian Journal of Economics* 26: 625-638.
- . 1994. "TRIPs, Trade, and Growth." *International Economic Review* 35: 361-382.
- Thompson, M.A., and F.W. Rushing. 1996. "An Empirical Analysis of the Impact of Patent Protection on Economic Growth." *Journal of Economic Development* 21, 2 (December): 61-79.
- Torstensson, J. 1994. "Property Rights and Economic Growth: An Empirical Study." *Kyklos* 47, 2: 231-247.
- Trefler, D. 1999. "Does Canada Need a Productivity Budget?" *Policy Options* (July-August): 66-71.
- World Bank. 1993. *World Tables 1993*. Baltimore, MD: Johns Hopkins University Press.
- Yang, G., and K.E. Maskus. 1998. "Intellectual Property Rights and Licensing: An Econometric Investigation." Boulder, CO: University of Colorado, Department of Economics. Unpublished Paper (November version).

TRADE-MARKS

- Allegrazza, Serge, and Alexandra Guard-Rauchs. 1999. "The Determinants of Trademark Deposits: An Econometric Investigation (A Case Study of the BENELUX)." *Applied Economics* 52: 51-68.
- Bates, Timothy. 1995. "A Comparison of Franchise and Independent Small Business Survival Rates." *Small Business Economics* 7: 377-388.
- Choi, Chung Ju, Soo Hee Lee and Donghoon Oh. 1995. "The Strategy of Grouping and Reputation Linkage in Clubs and Multi-Product Firms." *European Journal of Political Economy* 11, 3: 521-533.
- Giddens, Paul H. 1973. "Historical Origins of the Adoption of the Exxon Name and Trademark." *Business History Review* 47: 353-366.
- Higgins, David, and Geoffrey Tweedale. 1995. "Asset or Liability: Trade Marks in the Sheffield Cutlery and Tool Trades." *Business History* 37: 1-27.
- Landes, William M., and Richard Posner. 1987. "Trademark Law: An Economic Perspective." *Journal of Law and Economics* 30: 265-309.
- Lane, Walter J. 1988. "Compulsory Trademark Licensing." *Southern Economic Journal* 54: 643-655.
- Opderbeck, David W. 2000. "An Economic Perspective on Product Configuration Trade Dress." *Seton Hall Legislative Journal* 24: 327.
- Pashigian, B. Peter, and Brian Bowen. 1994. "The Rising Cost of Time of Females, the Growth of National Brands, and the Supply of Retail Services." *Economic Inquiry* 32: 33-65.
- Perry, Martin K., and Robert H. Groff. 1986. "Trademark Licensing in a Monopolistically Competitive Industry." *The RAND Journal of Economics* 17: 189-200.
- Rubin, Paul. 1978. "The Theory of the Firm and the Structure of the Franchise Contract." *Journal of Law and Economics* 21: 22-33.
- Veall, Michael R. 1992. "Brand/Product Innovation and the Optimal Length of Trademark/Patent Protection." *Economics Letters* 40 (December): 491-496.
- Wilkins, Mira. 1992. "The Neglected Intangible Asset: The Influence of the Trade Mark on the Rise of the Modern Corporation." *Business History* 34: 66-95.

COPYRIGHT

- Adelstein, Richard P., and Steven I. Peretz. 1985. "The Competition of Technologies in Markets for Ideas: Copyright and Fair Use in Evolutionary Perspective." *International Review of Law and Economics* 5: 209-238.
- Berg, Sanford V. 1971. "Copyright, Conflict, and a Theory of Property Rights." *Journal of Economics Issues* 5: 71-79.
- Besen, Stanley M., Willard G. Manning and Bridger M. Mitchell. 1978. "Copyright Liability for Cable Television: Compulsory Licensing and the Coase Theorem." *Journal of Law and Economics* 21: 67-95.
- Besen, Stanley M., and Leo J. Raskind. 1991. "An Introduction to the Law and Economics of Intellectual Property." *Journal of Economic Perspectives* 5, 1: 3-27.
- Cohen, Julie. 2000. "Copyright and the Perfect Curve." *Vanderbilt Law Review* 53: 1799-1819.

- Dam, Kenneth W. 1995. "Some Economic Considerations in the Intellectual Property Protection of Software." *Journal of Legal Studies* 24: 321-377.
- Frank, Bjorn. 1996. "On an Art without Copyright." *Kyklos* 49: 3-15.
- Goff, Brian L., William F. Shughart II, Robert D. Tollinson and Stephen B. Pociask. 1987. "The Incentive to Cite." *Journal of Institutional and Theoretical Economics* 143, 3: 467-476.
- Hansmann, Henry, and Marina Santilli. 1997. "Authors' and Artists' Moral Rights: A Comparative Legal and Economic Analysis." *Journal of Legal Studies* 26: 95-143.
- Hollander, Abraham. 1984. "Market Structure and Performance in Intellectual Property: The Case of Copyright Collectives." *International Journal of Industrial Organization* 2: 199-216.
- Globerman, Steven, and Mitchell Rothman. 1982. "Should Performers Have a Copyright?" *Canadian Public Policy — Analyse de politiques* 8: 165-180.
- Hurt, Robert M., and Robert M. Schuchman. 1966. "The Economic Rationale of Copyright." *American Economic Review* 56: 421-432.
- Kobayashi, Bruce H., and Ben T. Yu. 1995. "An Economic Analysis of Performance Rights: Some Implications of the Copyright Act of 1976." *Research in Law and Economics* 17: 237-270.
- Koboldt, Christian. 1995. "Intellectual Property and Optimal Copyright Protection." *Journal of Cultural Economics* 19: 131-155.
- Landes, William M. 1992. "Copyright Protection of Letters, Diaries, and Other Unpublished Words: An Economic Approach." *Journal of Legal Studies* 21: 79-113.
- Landes, William M., and Richard A. Posner. 1989. "An Economic Analysis of Copyright Law." *Journal of Legal Studies* 18: 325-363.
- Mannering, Fred L. 1994. "Assessing the Impacts of Audio Home Copying Restrictions." *Quarterly Journal of Business and Economics* 33: 30-46.
- Novos, Ian E., and Michael Waldman. 1984. "The Effects of Increased Copyright Protection: An Analytic Approach." *Journal of Political Economy* 92: 236-246.
- O'Hare, Michael. 1982. "Copyright and Protection of Economic Rights." *Journal of Cultural Economics* 6: 33-48.
- . 1985. "Copyright: When Is a Monopoly Efficient?" *Journal of Policy Analysis and Management* 4: 407-418.
- Rushton, Michael. 1997. "When in Rome... Amending Canada's Copyright Act." *Canadian Public Policy — Analyse de Politiques* 23: 317-330.
- . 1998. "The Moral Rights of Artists: Droit moral ou droit pécuniaire?" *Journal of Cultural Economics* 22: 15-32.
- Smith, Douglas A. 1988. "Recent Proposals for Copyright Revisions: An Evaluation." *Canadian Public Policy — Analyse de Politiques* 14: 175-185.
- Takeyama, Lisa N. 1997. "The Intertemporal Consequences of Unauthorized Reproduction of Intellectual Property." *Journal of Law and Economics* 44: 511-522.
- Towse, Ruth. 1999. "Copyright and Economic Incentives: An Application to Performers' Rights in the Music Industry." *Kyklos* 52: 369-390.
- Walther, Dale J. 1975. "Antitrust Aspects of International Copyright Law." *The Antitrust Bulletin* 2: 449-469.
- Waterson, Michael. 1990. "Economics of Product Patents." *American Economic Review* 80: 860-869.

- Wiegand, John P. 1996. "Competitive Effects of Cable Copyright Law." *The Antitrust Bulletin* 41: 61-78.

OTHER REFERENCES

PATENTS

- Aoki, R. 1997. "Recent Trends in the Japanese Industrial Property System." Prepared for the conference *Intellectual Property: Japan and the New Asia*, Japan Information Access Project. Washington, D.C.: SUNY, Stony Brook. Manuscript.
- Aoki, R., and T.J. Prusa. 1996. "Product Development and the Timing of Information Disclosure under U.S. and Japanese Patent Systems." *Journal of Japanese and International Economics* 10: 233-249.
- Arundel, A., and I. Kabla. 1998. "What Percentage of Innovations are Patented? Empirical Estimates for European Firms." *Research Policy* 27, 2: 127-141.
- Baldwin, J.R. 1997. *Innovation and Intellectual Property*. Ottawa: Statistics Canada. Catalogue No. 88-515-XPE.
- Baldwin, J.R., and J. Johnson. 1995. *Human Capital Development and Innovation: The Case of Training in Small and Medium Sized-Firms*. Ottawa: Statistics Canada, Analytical Studies Branch, Research Paper No. 11F0019MIE1995074.
- Barro, R. 1997. *Determinants of Economic Growth: A Cross-Country Empirical Study*. Cambridge and London: MIT Press.
- Bouleware, M., J. Pyle and F. Turner. 1994. "An Overview of Intellectual Property Rights Abroad." *Houston Journal of International Law* 16: 441-507.
- Brascoupé, S. and K. Endemann. 1999. "Intellectual Property and Aboriginal People: A Working Paper." Indian and Northern Affairs Canada, Strategic Research and Analysis Directorate, and Industry Canada, Intellectual Property Directorate.
- Bussy, J., C. Carpentier and I. Kabla. 1996. "The Utilization by French Firms of the European Patent." *The Patents*. Studies in Economics and Statistics No. 1, Paris: INSEE (March): 12-29.
- Clemente, C.L. 1988. "Intellectual Property: The Patent on Prosperity." *The Economist* (November 7): 55.
- Curci, F., and T. Takura. 1995. "Selected Aspects of Japanese Intellectual Property Law." *Transnational Lawyer* 8: 63-85.
- Dimock, R.E. 1994. "Patent Anticipation or What's New, Patent Act?" In *Patent Law of Canada*. Edited by Gordon F. Henderson et al. Toronto: Carswell Thomson Professional Publishing.
- Doane, M. 1994. "TRIPs and International Intellectual Property Protection in an Age of Advancing Technology." *The American University Journal of International Law and Policy* 9: 465-497.
- Dunning, J.H. 1979. "Explaining Changing Patterns of International Production: In Defence of the Electric Theory." *Oxford Bulletin of Economics and Statistics* 41: 269-295.

- Evenson, R.E. 1990. "Intellectual Property Rights, R&D, Inventions, Technology Purchase, and Piracy in Economic Development: An International Comparative Study." In *Science and Technology: Lessons for Development Policy*. Edited by R.E. Evenson and G. Rains. Boulder and San Francisco: Westview Press.
- Glass, A.J., and K. Saggi. 1995. *Intellectual Property Rights, Foreign Direct Investment and Innovation*. Working Paper No. 95-06. Ohio State University.
- Govaere, I. 1991. "The Impact of Intellectual Property Protection on Technology Transfer between EC and Central and Eastern European Countries." *Journal of World Trade* 25, 5: 57-76.
- Griliches, Z., W.D. Nordhaus and F.M. Scherer. 1989. "Patents: Recent Trends and Puzzles." *Brookings Papers on Economic Activity: Microeconomics*, 291-330.
- . 1990. "Patent Statistics as Economic Indicators: A Survey." *Journal of Economic Literature* 28, 4: 1661-1707.
- Hu, F. 1997. "FDI and Market Growth." In *World Competitiveness Report*. World Economic Forum, p. 28-48.
- Kabla, I. 1996. "The Patent as Indicator of Innovation," *The Patents*. Studies in Economics and Statistics No. 1. Paris: INSEE (March): 56-71.
- Kelley, L.C. 1999. "Using Patents in Growth Models." London School of Economics, Centre for Economic Performance. Unpublished paper.
- Kondo, E.K. 1995. "The Effect of Patent Protection on Foreign Direct Investment." *Journal of World Trade* 29, 6 (December): 97-122.
- Kotabe, M. 1992. "A Comparative Study of U.S. and Japanese Patent Systems." *Journal of International Business Studies* 23: 147-168.
- Lai, E.L.C. 1998. "International Intellectual Property Rights Protection and the Rate of Product Innovation." *Journal of Development Economics* 55, 1: 133-153.
- Lee, J.Y., and E. Mansfield. 1996. "Intellectual Property Protection and U.S. Direct Investment." *The Review of Economics and Statistics* 78, 2: 181-186.
- Lehmann, M. 1985. "The Theory of Property Rights and the Protection of Intellectual and Industrial Property." *International Review of Industrial Property and Copyright Law* 16, 5: 525.
- MacCordy, E.L. 1994. "The Threat of Proposed Patent Law Changes to the Research University." *Journal of College and University Law* 20, 3: 295-308.
- Machlup, F. 1958. *An Economic Review of the Patent System*. Subcommittee on Patents, Trademarks and Copyright. Washington, D.C.: Government Printing Office.
- Markusen, J.R. 1998. *Contracts, Intellectual Property Rights, and Multinational Investment in Developing Countries*. Working Paper. Boulder, CO: University of Colorado.
- Maskus, K.E., and C. McDaniel. 1999. *Impact of the Japanese Patent System on Productivity Growth*. Working Paper No. 99-1. Boulder, CO: University of Colorado, Department of Economics.
- Organisation for Economic Co-operation and Development. 1997. *Patents and Innovation in the International Context*. Paris: OECD.
- . Various issues. *Main Science and Technology Indicators*. Paris: OECD.
- Papovich, J. 1997. "New and Unresolved U.S.-Japan Intellectual Property Rights Issues." Washington, D.C.: Office of the U.S. Trade Representative. Manuscript.

- Ragusa, A.P. 1992. "Eighteen Months to Publication: Should the United States Join Europe and Japan by Promptly Publishing Patent Applications?" *George Washington Journal of Law and Economics* 26: 143-180.
- Reichman, J.H. 1994. "Legal Hybrids between the Patent and Copyright Regimes." *Columbia Law Review* 94: 2415-2485.
- Reichman, J.H., and Pamela Samuelson. 1997. "Intellectual Property Rights in Data." *Vanderbilt Law Review* 50: 51-166.
- Schmookler, J. 1966. *Invention and Economic Growth*. Cambridge, MA: Harvard University Press.
- Segerstrom, P. 1991. "Innovation, Imitation, and Economic Growth." *Journal of Political Economy* 99, 4 (August): 807-827.
- Segerstrom, P., T. Anant and E. Dinopoulos. 1990. "A Schumpeterian Model of the Product Life Cycle." *American Economic Review* 80, 5: 1077-1091.
- Taylor, C.T., and Z.A. Silberston. 1973. *The Economic Impact of the Patent System: A Study of the British Experience*. Cambridge: Cambridge University Press.
- Thurrow, L. 1991. *Head to Head: The Coming Economic Battle Among Japan, Europe and America*. New York: William Morrow & Co.
- United Nations Conference on Trade and Development (UNCTAD). 1996. *The TRIPs Agreement and Developing Countries*. Geneva: United Nations Conference on Trade and Development.
- U.S. Chamber of Commerce. 1988. International Division. *The Omnibus Trade and Competitiveness Act of 1988: A Straightforward Guide to its Impact on U.S. and Foreign Business*. Washington, D.C.
- Vernon, R. 1966. "International Investment and International Trade in the Product Cycle." *Quarterly Journal of Economics* 80: 190-207.
- Wallerstein, M.B., M.E. Mogee and R.A. Schoen. 1993. *Global Dimensions of Intellectual Property Rights in Science and Technology*. Washington, D.C.: National Academy Press.
- Wineberg, A. 1988. "The Japanese Patent System: A Non-Tariff Barrier to Foreign Barrier to Foreign Business?" *Journal of World Trade Law* 22: 11-22.
- World Intellectual Property Organization (WIPO). WIPO Industrial Property Statistics Online Directory. Geneva: WIPO.[www.wipo.int/ipstats/en/links/about.html].

TRADE-MARKS

- Brown, Catherine A. 1995. "The 1995 Canada-US Protocol: The Scope of the New Royalty Provisions." *Canadian Tax Journal* 43: 592-609.
- DeAlessi, Louis, and Robert J. Staaf. 1994. "What Does Reputation Really Assure? The Relationship of Trademarks to Expectations and Legal Remedies." *Economic Inquiry* 32: 477-485.
- DeSouza, Glenn. 1997. "Royalty Methods for Intellectual Property." *Business Economics* 32: 46-52.
- Gallini, Nancy T., and Aidan Hollis. 1999. "A Contractual Approach to the Gray Market." *International Review of Law and Economics* 19: 1-21.
- Grossman, Gene M., and Carl Shapiro. 1988. "Foreign Counterfeiting of Status Goods." *Quarterly Journal of Economics* 103: 79-100.

- Jones, Traci L. 1996. "Remedy Holes and Bottomless Rights: A Critique of the Intent-to-Use System of Trademark Registration." *Law and Contemporary Problems* 59: 158-180.
- Kingston, William. 1995. "Reducing the Cost of Resolving Intellectual Property Disputes." *European Journal of Law and Economics* 2: 85-92.
- Lange, David L. 1996. "The Intellectual Property Clause in Contemporary Trademark Law: An Appreciation of Two Recent Essays and Some Thoughts about Why We Ought to Care." *Law and Contemporary Problems* 59: 213-244.
- Lutz, Nancy A. 1995. "Ownership Rights and Incentives in Franchising." *Journal of Corporate Finance: Contracting, Governance and Organization* 2: 103-131.
- Rozek, Richard P. 1982. "Brand Identification and Advertising: The Case of a Generic Trademark." *Applied Economics* 14: 235-248.

COPYRIGHT

- Adess, Melvin S., and Barbara M. Angus. 1993. "Knowledge and Technology Transfers to and from the United States: Characterization of Transfers of Computer Software." *Bulletin for International Fiscal Documentation* 47: 414-423.
- Bugos, Glenn E. 1992. "Intellectual Property Protection in the American Chicken-Breeding Industry." *Business History Review* 66: 127-168.
- Noam, Eli M., and Joel C. Millonzi (eds.). 1993. *The International Market in Film and Television Programs*. Norwood, N.J.: Ablex.
- Samuelson, Pamela. 1999. "Implications of the Agreement on Trade Related Aspects of Intellectual Property Rights for Cultural Dimensions of National Copyright Laws." *Journal of Cultural Economics* 23: 95-107.
- Soon, Jason. 1999. "An Economic Perspective on Intellectual Property: The Case of Copyright." *Policy* 15: 38-41.
- Tan, L.T. Leslie, and Chien-Yi Chang. 1994. "Copyright Protection with Endogenous Precaution Choice." *Academia Economic Papers* 22: 185-197.
- Waterson, Michael, and Norman Ireland. 1998. "An Auction Model of Intellectual Property Protection: Patent versus Copyright." *Annales d'économie et de statistique* 49-50: 247-263.
- Yang, Yong. 1998. "Why Do Southern Countries Have Little Incentive to Protect Northern Intellectual Property Rights?" *Canadian Journal of Economics* 31: 800-816.



Petr Hanel
University of Sherbrooke and
Centre interuniversitaire de la recherche sur la science et la technologie (CIRST)

4

Current Intellectual Property Protection Practices of Manufacturing Firms in Canada

INTRODUCTION

THE ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD) estimates that between 1970 and 1995, more than half of the total growth in output of the developed world resulted from innovation, and the proportion is increasing as the economy becomes ever more knowledge intensive (European Commission, 2001). Protection of intellectual property (IP) is the oldest and one of the principal instruments of innovation policy. The objective of this study is to determine how the utilization of intellectual property rights (IPRs) by Canadian manufacturing firms is related to their characteristics, activities, competitive strategies and the industry sector in which they operate. One related question also addressed is the extent to which Canadian firms patent in Canada and abroad, especially in the United States.

Patents and other IPRs were once believed to provide an effective protection for inventions and innovations against imitation and thus to offer strong incentives for innovative activity. A path-breaking study on the appropriation of benefits from innovation in U.S. manufacturing industries by Levin, Klevorick, Nelson and Winter (1987) has shown that, in fact, industry experts rarely consider patents and other IPRs as effective means of protecting intellectual property. Other strategies, such as being first on the market, are often a more effective means of appropriating the benefits from innovation. Since the protection of intellectual property is one of the cornerstones of innovation policy in all industrial countries, questions regarding the use of intellectual property and its effectiveness are now routinely included in innovation surveys conducted by statistical agencies.

The concept of innovation used in these surveys covers a broad range of innovations, from the introduction of major, original, path-breaking new products or production processes to incremental improvements and introduction of new products and processes new to the firm but already in existence in Canada or abroad. These surveys are based on a common methodology¹ and typically ask firms: “Did your firm offer new or significantly improved products (goods or services), or did your firm introduce a new or significantly improved production/manufacturing process?”

This broad definition of innovation not subject to strict objective criteria and relying on the self-evaluation of surveyed firms may lead to inflated statistics on the incidence and originality of innovation. On the other hand, it has the advantage of recognizing that even though research and development (R&D) activity is one of the most important *input* to the innovation process, it is not the necessary nor the sufficient condition for innovation to take place. Thus, for example, almost one third of manufacturing firms that introduced an innovation in Canada during the 1997-99 period did so without conducting any form of R&D. On the other hand, over 7 percent of firms that conducted R&D did not introduce any innovation. The realization that innovation is far from being synonymous with R&D is one of the reasons behind the recent interest in innovation surveys as a means of better understanding how firms innovate, the information sources and strategies they use, and the impact innovation has on their activities.

The main source of information used in the present study is the most recent Statistics Canada Survey of Innovation (1999), which included several questions on the protection of IP. Complementary information comes from the earlier Statistics Canada Survey of Innovation and Advanced Technology (1993). Since the two surveys were addressed to different target populations and were different in several other important respects, we present a brief methodological overview in note 11 to help the reader interpret correctly the findings of both surveys.

ELEMENTS OF THE CONCEPTUAL FRAMEWORK USED IN THE PRESENT STUDY

THE ECONOMIC THEORY OF INNOVATION and intellectual property and earlier empirical studies suggest a conceptual framework that is used for the descriptive analysis of the 1999 Survey of Innovation. The following notes summarize the principal relationships that will be examined.

Relationship between the use of IPRs and innovation status. The use of patents and other statutory instruments of IP protection by manufacturing firms is closely but not exclusively related to their innovation status. Innovating firms create new knowledge and IP and, in order to appropriate the benefits

from innovation, they are more likely to protect it by various IPRs and other strategies than firms that do not innovate. The overwhelming majority (about 80 percent) of chief executive officers (CEO) and head-office officials surveyed in 1999 declared that their firm had introduced an innovation in the preceding three years. The present study contrasts the use of IPRs by firms that introduced an innovation in the 1997-99 period, with those that attempted but did not succeed, and those that were not involved in innovation.

Type of innovation. Patents usually protect more efficiently product inventions than process inventions. New or improved production processes are often better protected by trade secrets. Firms typically use a combination of IPRs. Their composition varies with the stage of the innovation process and the combination of protectable elements in the innovation (Cohen, Nelson and Walsh, 2000). To illustrate the ways Canadian manufacturing firms protect their IP, the use of IPRs is broken down by type and originality of innovation.

Originality of innovation. The value of IP is, to an important extent, a function of its originality. By definition, patents are granted only to authors of original, world-first inventions. Firms that introduce a world-first innovation are therefore more likely to use a patent than firms that realize a Canadian-first or those that imitate a new process or product already existing in Canada. Firms that introduce the two less original types of innovation may, however, acquire or licence patents or other IPRs as part of a technology transfer, and thus also report using IPRs. The type of innovation and its originality are therefore potentially important determinants of the use of IPRs. The results of the survey are presented so as to contrast them by type and originality of innovation.

Use of IPRs and firm size. The need to protect IP varies according to the size of the firm for at least two reasons. One is related to the innovative activity, the other to financial constraints. Small firms are less likely to innovate than larger ones. When they innovate, small firms introduce less frequently than larger firms original innovations that contain most of the IP worth protecting. It is thus likely that the use of IP protection instruments is positively related to firm size. The cost aspects of IP protection are also biased in favour of large firms. The costs of IP protection — including the cost of learning and the administrative costs involved in obtaining and maintaining statutory IPRs — impose, in relative terms, a heavier burden on small- and medium-size enterprises (SMEs) than on large firms. SMEs face another disadvantage when it comes to the enforcement of their IPRs. Since a patent is no more than a *licence to litigate*,

the cost of monitoring whether infringement takes place and the prospective cost of litigation can be too high for SMEs in terms of both time and money (European Commission, 2001). For all these reasons, it is expected that the use of IPRs will be closely related to firm size. This pattern has been observed in Canadian manufacturing over the 1989-91 period, and it is also reported in Europe (European Commission, 2001). To find out whether the use of IPRs remains closely related to firm size in the most recent 1997-99 period, we show the use of IPRs by firm size.

The use of IPRs varies among industries. Firms operating in different manufacturing industries create different types of innovation and rely on a different mix of IPRs. These differences are related to (1) industry differences in technological opportunity and (2) to industry differences in the use of statutory IPRs. Technological opportunity, a term designating the potential contribution of advances in science and technology to innovation, varies from industry to industry, as do the competitive conditions. These differences explain to a large extent the significant interindustry differences in innovation performance which impact on the use of IPRs. The second source of industry differences — that observed in the use of IPRs — is directly related to each specific IPR.

Levin et al. (1987) found that in the chemical and pharmaceutical industries, patents are considered a more effective means of appropriating innovation benefits and are used more frequently than in other industries. According to Cohen, Nelson and Walsh (2000) the reasons for patenting differ between industries that usually introduce *discrete* products (a new substance developed by a chemical or pharmaceutical firm) and those that introduce *complex* product innovations (electronic or telecommunication products typically comprising a large number of patentable elements). That study shows that the reasons for patenting in general and for protecting discrete or complex innovations in particular also include other motives than preventing copy (negotiations, cross-licensing, generating licensing revenues, preventing lawsuits, enhancing reputation, etc.).

Technology sectors. A comprehensive study of innovation in the United Kingdom by Robson, Townsend and Pavitt (1988) found that different groups of industries play different roles in the innovation process. Based on observed patterns of sources and use of innovation in manufacturing industries, the authors established a taxonomy encompassing three technology sectors (core, secondary and other). The *core* sector (chemicals, electronics, machinery and instruments) includes industries at the forefront of technological change whose product innovations are used in the *secondary* and *other* sectors and in the rest of the economy. The *secondary*

sector (metal industries, metal products, rubber and plastics, non-metallic minerals, transport equipment) is a user of product innovations from the core sector, and at the same time source of innovations used in the *other* sector and the rest of the economy. Consumer product industries and some bulk material industries that use innovations introduced by the two upstream sectors are included in the *other* sector (the food, beverages and tobacco; textiles, clothing, leather and footwear; and wood and paper industries belong to this sector). The usefulness of Robson, Townsend and Pavitt's taxonomy to synthesize the interindustry patterns of innovation and the use of IPRs is demonstrated in Baldwin and Hanel (2003). It is used in the present study to point out the main differences in the use of IPRs among the three technology sectors.

Firms often use a combination of IPRs. Trade secret may supplement a patent or it may be used as a substitute for patent protection. Inventors choose trade secret when they believe that patent protection is too costly relative to the value of their invention, or that it will give them a reward substantially less than the benefits of their invention (as reflected, in part, in the length of time before anyone else could copy it), either because the invention is not patentable or because the length (or other conditions) of patent protection is insufficient (Friedman, Landes and Posner, 1991). Trade-marks are often used along with trade secrets and/or patents and industrial designs. Trade-marks are used to a certain extent by all industries but more intensively by those producing consumer goods such as leather and clothing, or beverages and drugs.

Other IPRs such as copyright are used frequently in industries concerned with protecting printed material, recordings and software.

Structure of the Study

The study proceeds with an overview of the main results of other major surveys on the use of IPRs in Canada. The most complete of these is Statistics Canada 1993 Survey of Innovation and Advanced Technology, which included an extensive section on IP. As that survey included questions not asked in the 1999 Survey of Innovation, the relevant results are reported with some detail here. The second part of the study presents a descriptive statistical analysis of the main findings of the 1999 survey. It is based on the conceptual framework introduced above. In order not to overburden the text, a series of tables has been relegated to Appendices A and B. The use of IPRs is to a large extent correlated with basic economic characteristics of firms, their activities and the industry environment in which they operate. To draw in a concise way as much information as possible from the rich survey data, a series of multivariate models

that identify the determinants of the use of IPRs and their statistical association with the occurrence of innovation is presented in the third part of the study, followed by conclusions and policy suggestions.

REVIEW OF THE PRINCIPAL FINDINGS OF PREVIOUS SURVEYS

TO PUT THE STATISTICS CANADA 1999 Survey of Innovation in a proper perspective, we review in some detail the findings of other major Canadian surveys of IP use conducted in the last 20 years.

The Economic Council of Canada (ECC) survey (De Melto, McMullen and Wills, 1980) looked at innovation and patenting in five Canadian manufacturing industries and concluded that most of the 283 major innovations introduced in Canada in the preceding 20 years were not patented. The ECC survey included only innovations considered *major* by the firms that introduced them. Over the 20-year period covered by the ECC survey, only 32 percent of reported major innovations were patented. The study covered five industries and revealed important interindustry differences in the propensity to patent. These were related to structural characteristics of industries. The survey reported that: (1) The propensity to patent innovations was monotonically increasing with the size of the innovating firm. (2) Foreign controlled firms (and even more so those under U.S. control) patented significantly more (39 percent) than their domestically controlled counterparts (23 percent). (3) Innovations based on imported technology were more often patented in Canada than innovations based on technology developed in-house. (4) There was a clear positive link between the cost of an innovation and patenting; the more costly innovations were more likely to be patented.

The long-term coverage of the survey shows that except in the telecommunications industry, the rate of patenting declined over time, especially in the second half of the 70s. The tendency of firms to rely progressively less on the patent system to protect their major innovations was noted also in the United States and motivated the influential study by Levin et al. (1987).

A report commissioned by Industry, Science and Technology Canada, Consumer and Corporate Affairs Canada, and the Science Council of Canada (Industry, Science and Technology Canada, 1989) examined the attitudes, practices and interests of Canadian industry with respect to IPRs.² It found that even though the majority of respondents were satisfied with Canadian IPRs, there was an important variance by industry sector and firm size. Smaller firms³ and firms operating in *new economy* sectors, such as software development and biotechnology, expressed the most dissatisfaction with Canadian IPRs.⁴

The second major finding of the study was the high reported degree of infringement and counterfeiting. Between 32 percent and 40 percent of firms in the four groups indicated that their IPRs had been violated in the four years preceding the study. A large proportion of firms complained that litigation was too expensive, especially for smaller firms, and the penalties insufficient to prevent infringement. A significant number of firms stated that they had insufficient knowledge or expertise with respect to IPRs. Finally, with the exception of copyright users, firms from all other sectors expressed that they had difficulties in terms of the time and cost involved in registering and obtaining IPRs.

THE 1993 SURVEY OF INNOVATION AND ADVANCED TECHNOLOGY

THE STUDY BASED ON THE 1993 SURVEY found that there are substantial differences in the use of trade-marks, patents, trade secrets, industrial designs and copyright between firms that had innovated in the preceding three years and those that had not. Trade-marks were the most popular form of protection, followed by patents and trade secrets, industrial designs and copyright (Baldwin, 1997).⁵ The survey found that firms with gross business income over \$250,000 and employing more than 20 persons used IPRs as shown in Table 1.

Baldwin's study corroborated earlier findings by showing that:

1. The use of IPRs increases with firm size. As in the 1960-80 period surveyed by De Melto, McMullen and Wills (1980), the larger the firm size category, the larger the percentage of firms using IPRs. Almost two thirds of firms employing more than 500 persons used at least one statutory form of IPR in the 1997-99 period. The ratio was less than one in five among the smallest firms.

TABLE 1

USE OF INTELLECTUAL PROPERTY BY INNOVATORS AND ALL MANUFACTURING FIRMS, 1989-91 (PERCENTAGE OF FIRMS*)

	INTELLECTUAL PROPERTY RIGHT							
	PATENT	TRADE-MARK	COPYRIGHT	TRADE SECRET	INTEGRATED CIRCUIT DESIGN	INDUSTR. DESIGN	PLANT BREEDER'S RIGHT	OTHER
Innovators	24.66	31.31	9.44	17.99	1.99	13.48	0.451	1.02
All	16.32	22.96	6.35	11.70	1.14	9.05	0.51	0.82

Source: Special tabulation from Statistics Canada 1993 Survey of Innovation and Advanced Technology.

Note: * This special tabulation is representative of firms included in the Business Register. In contrast to this tabulation of IPR use by the group called "larger" firms, Baldwin's (1997) results are representative of firms of all sizes, i.e. his sample includes also the smallest firms, and thus his results are different.

2. The use of IP protection varies significantly between industries. The interindustry differences in the use of IPRs are determined at least in part by the technology sector (Robson, Townsend and Pavitt, 1988),⁶ the nature of the products, their stage in the life cycle and competitive conditions. Thus, patenting is most widespread in core sector industries feeding innovations to the rest of the economy, specifically in the chemical and machinery industries. In contrast, food and beverages, wood, clothing and textile firms rarely patent their products, but they frequently protect them by trade-marks and/or trade secrets.
3. Product innovations (with or without a change in production process) were more than twice as likely as pure process innovations to be patented. Process innovations lend themselves better to protection through secrecy.
4. Large firms are more likely than small ones to introduce a world-first innovation. Some 15 percent of innovations of large firms are world-firsts. Firms that introduced world-first innovations made in general much greater use of IPRs than for less original innovations. About 80 percent of world-first innovators used at least one form of statutory protection either in Canada or abroad.
5. Foreign-owned firms, irrespective of their size, industry or type of innovation, had more often recourse to IP protection instruments than Canadian-owned firms.

Effectiveness of IP Protection

The results of the 1993 Survey of Innovation and Advanced Technology (Baldwin, 1997) show that the findings by Levin et al. (1987) suggesting that U.S. firms tend to value alternate strategies more highly than the statutory forms of IP protection also apply to Canada. Moreover, manufacturing firms as a whole rank such strategies as patent protection as less than *effective*.⁷ However, these rankings depend very much on the characteristics of the firm. If a firm is innovative, large, foreign-owned, and operates in an industry that tends to produce more innovations, the score given to statutory forms of protection like patents increases greatly. On average, users of patents find them effective; so too do large foreign firms.

The IP protection section of the 1993 survey asked the firm's IP expert to rank the seven forms of IP protection on a scale of 1 to 5, where 1 is "not very effective", 2 is "somewhat effective", 3 is "effective", 4 is "very effective", and 5 is "extremely effective". The average scores given to copyright, patent, industrial design, trade secret, trade-mark, integrated circuit design, and plant breeders' right are shown in column 1 of Table 2. None of the statutory IPRs was considered to provide an effective protection. It is thus not surprising that many firms use alternate strategies to appropriate the benefits from their innovations. "Complexity of product design" and, even more, "Being first in the market" received the highest average scores — 2.6 and 3.2, respectively (last three lines of Table 2). They are considered more effective for reaping the benefits of innovation than statutory IPRs.

When the sample was restricted to firms using the forms of IP protection considered (specific users), the scores increased notably (column 2). There is a difference between those who used a particular form of protection and those who did not in almost all categories. Innovators who use IP protection ranked this protection well above those who do not use it. This shows that the low average score given by the population of manufacturing firms to the effectiveness of IPRs was due to the large number of non-users that did not regard them as effective.

TABLE 2			
EFFECTIVENESS OF INTELLECTUAL PROPERTY PROTECTION			
AVERAGE SCORE*			
IPRS AND OTHER STRATEGIES	ALL FIRMS	USERS OF SPECIFIC STATUTORY RIGHT	NON-USERS OF SPECIFIC STATUTORY RIGHT
		1	2
Statutory Rights			
Copyright	1.6	2.8	1.4
Patent	1.9	3.0	1.5
Industrial Design	1.6	2.5	1.4
Trade Secret	2.1	3.2	1.6
Trade-mark	2.0	3.1	1.5
Integrated Circuit Design	1.3	3.2	1.2
Plant Breeders' Right	1.2	2.3	1.2
Other	1.4	3.3	1.3
Other Strategies			
Complexity of Product Design	2.6		
Being First in the Market	3.2		
Other	2.3		
Source: Baldwin, 1997.			
Note: * Scored by firm's IP experts as 1: not at all effective; 2: somewhat effective; 3: effective; 4: very effective; 5: extremely effective.			

Invariably, users of IP instruments were more positive in their opinion on the effectiveness of various forms of protection. These consistent differences suggest that the use of IPRs — like any other strategy — involves acquired skills that only develop with practice. As firms innovate, they learn which strategies can best protect their knowledge assets. The study also suggests that these skills, as they are associated with size, are part of the growth experience and tend to increase as a firm successfully masters a range of strategies and expands.

USE OF INTELLECTUAL PROPERTY RIGHTS AND INNOVATION – RESULTS OF THE 1999 SURVEY

THE MOST RECENT SURVEY OF INNOVATION in Canadian manufacturing was conducted by Statistics Canada in 1999. It asked CEOs or their representative two questions on the use of IPRs. The objective of this section is to provide a descriptive analysis of the key results of that survey on the use of IPRs.

In response to the first question: "... which of the following methods have been used by your firm to protect its IP (patents, trade-marks, copyrights, confidentiality agreements, trade secrets, and other)⁸ during the past three years (1997 to 1999)", about two thirds of manufacturing firms (66.1 percent) responded that they used at least one form of IPR listed above. The question was addressed at all firms since even those not involved in innovation or those that did not succeed in introducing an innovation during the three-year period could well have used IPRs to protect innovations introduced earlier or other intangible assets not directly related to a recent innovation. Thus, the first interesting information is the overall pattern of IPR use by firms, broken down into three categories according to their innovation status:

1. Firms that innovated successfully (i.e. firms that introduced a significantly improved or new product and/or significantly improved or new production/manufacturing process.
2. Firms that attempted to innovate but were not successful or have not completed the innovation.
3. Firms that were not involved in innovation over the 1997-99 period.⁹

USE OF IPRs BY ALL MANUFACTURING FIRMS

AS INDICATED IN THE LAST COLUMN OF TABLE 3, successful innovators¹⁰ used IPRs more often than unsuccessful ones, and these still more frequently than firms that did not attempt to innovate in the three-year period. Even though firms have a choice of several statutory IPRs, confidentiality agreements are the

most frequently reported way of protecting a firm's knowledge assets. Such agreements signed by employees of the firm and its business partners are reported by almost half of all manufacturing firms (43.2 percent).

In comparison with the earlier 1989-91 period, successful innovators appear to now use all IPRs more frequently. For example, according to the 1999 survey, 29.6 percent of successful innovators reported using patents, whereas about one quarter of innovators (24.7 percent) used patents according to the 1993 survey (Table 1). However, part of this difference in IPR use reflects methodological differences between the two surveys.¹¹

Statutory instruments of IP protection involve administrative procedures of various complexity and monetary costs. They are thus used less than trade secrets and confidentiality agreements. The choice of an instrument of IP protection depends on the originality and type of innovation, the characteristics of the firm and the industry. Trade-marks are the most frequently reported statutory IPR, as it is used by more than a third of all manufacturing firms.

Only some products and processes satisfy the patenting criteria of novelty, usefulness and non-obvious improvement. About one quarter of all manufacturing firms used patents to protect their inventions. When a firm patents an invention, it reveals the substance of the invention in exchange of a statutory temporary monopoly. Since, as indicated above, the efficacy of patent protection is far from perfect, some inventions, particularly new and improved production processes, are often better protected by secrecy.¹² Trade secrets were used about as frequently as patents (24.7 percent). Copyright is mainly used to protect works of art and software, as well as other types of expressions possibly relevant to a firm. The use of copyright is therefore distributed rather unevenly among industries. On average, only 12 percent of manufacturing firms reported using copyright.

TABLE 3

**USE OF INTELLECTUAL PROPERTY RIGHTS BY INNOVATION STATUS
(PERCENTAGE OF ALL MANUFACTURING FIRMS)**

STATUS	SHARE OF POPULATION	PATENT	TRADE- MARK	COPYRIGHT	TRADE SECRET	CONFIDEN- TIALITY	OTHER	ANY IPR
Innovation	80.7	29.3	39.8	13.6	28.4	48.4	2.7	72.6
Unsuccessful	7.2	14.1	25.3	6.4	14.4	32.6	1.8	49.7
Not Involved	12.1	8.3	19.1	4.5	7.5	16.9	2.3	35.9
All	100.0	25.7	36.0	12.0	24.7	43.2	2.5	66.1

Source: Preliminary results of Statistics Canada 1999 Survey of Innovation.

Note: The statistics from the 1999 survey presented in this and all other tables and figures are weighted by the gross business income and are representative of the population of Canadian manufacturing "provincial enterprises".

USE OF IPRS BY INNOVATING FIRMS

ABOUT 80 PERCENT OF FIRMS INNOVATED in the last three years. Firms involved in an innovation process protected their IP more frequently than the overall population of manufacturing firms; almost three quarters (72.6 percent) of successful innovating firms reported having used at least one IPR instrument. About one half of firms that attempted unsuccessfully to introduce an innovation during the three-year period under study reported to have used IPRs. The lowest proportion (35.9 percent) of users of any IPR is found among firms that were not involved in innovation between 1997 and 1999 (last column of Table 3). A roughly similar pattern is observed for each specific IPR.

USE OF IPRS AND TYPE OF INNOVATION

AS INDICATED IN THE INTRODUCTION, the choice of the IPR instrument depends on the type of invention and innovation. Patents are considered to be more suitable for protecting product inventions and innovations, while secrecy is found to be a more effective way of appropriating innovation benefits from process inventions and innovations. However, one should not read too much into the difference between product and process innovations in the 1999 survey because two thirds (66.8 percent) of firms reported introducing a combination of one or more product and process innovations. Firms that introduced a combination of innovations used IPRs more frequently than those that produced product- or process-only innovations. The largest difference between product and process innovators concerns patent protection. Product innovators are three times as likely to protect their new or improved products by patents as process innovators.

Our results do not support an earlier finding by Baldwin (1997) and other studies that process innovations are more likely to be protected by trade secrets than product innovations. The results of our survey show that if there is any difference between the two groups, it is that trade secrets are used more frequently by firms introducing pure product innovation rather than the other way around. The most frequent users of trade secrets are firms that introduced a combination of both types of innovation. (See Table 4.)

TABLE 4

USE OF IPRs BY TYPE OF INNOVATION (PERCENTAGE OF INNOVATING FIRMS)

	TYPE OF INNOVATION			
	PERCENTAGE OF ALL INNOVATIONS			
	BOTH	PRODUCT	PROCESS	ALL
IPRs	67.0	17.6	15.4	100.0
Patent	32.7	34.1	11.1	29.6
Trade-mark	43.4	44.7	18.6	39.8
Copyright	15.0	14.8	6.7	13.7
Trade Secret	32.1	24.4	17.5	28.5
Confidentiality	52.6	46.6	36.3	49.0
Other	2.9	2.2	2.8	2.7
At Least One	77.0	75.1	52.7	72.9

Source: Author's tabulation based on Statistics Canada 1999 Survey of Innovation.

USE OF IPRs BY ORIGINALITY OF INNOVATION

THE DEFINITION OF INNOVATION includes contributions of very different importance and originality. Firms were asked to classify their most important innovation into three categories according to their originality: world-first, Canada-first, and innovation previously existing in Canada but new to the firm. A majority of innovators (88.3 percent) described their most important innovation so we have information on the novelty of innovation for this subset of innovators. A small proportion of firms (about 3 percent) responded that they were not able (or perhaps not willing) to classify their innovation.

A minority (14.5 percent) of innovators that gave information on the novelty of their most important innovation introduced a world-first innovation. The proportion of firms that were first to introduce an innovation from abroad in Canada is almost twice as important (24.5 percent). The largest proportion of firms (61 percent) introduced improved or new products or processes already used elsewhere in Canada (firm-first; see the first line of Table 5).

As expected, firms that introduced a world-first innovation use all instruments of IPR more frequently than those that introduced an innovation in Canada. Firms that introduced an innovation already used elsewhere in Canada obviously did not have to fear imitation and they used all forms of IPR protection less than the first two groups. The use of each IPR within each *originality* class is shown in the lower section of Table 5. Even though this pattern applies to all IPR instruments, it is most pronounced for patents. Almost two thirds of firms that introduced a world-first innovation in the three-year period used patents.¹³ About 40 percent of firms that introduced innovations from abroad in Canada used patents. In contrast, only one in five firms that introduced a

TABLE 5			
USE OF INTELLECTUAL PROPERTY RIGHTS BY ORIGINALITY OF INNOVATION (PERCENTAGE OF INNOVATING FIRMS)			
	ORIGINALITY (PERCENTAGE OF INNOVATING FIRMS THAT CLASSIFIED THEIR INNOVATION IN ONE OF THE THREE CATEGORIES)		
	WORLD-FIRST	CANADA-FIRST	FIRM-FIRST
	14.5	24.5	61.0
(PERCENTAGE OF FIRMS THAT INTRODUCED WORD-FIRST, CANADA-FIRST OR FIRM-FIRST INNOVATIONS)			
USE OF IPRs			
Patent	62.8	40.7	20.8
Trade-mark	57.9	49.1	32.9
Copyright	26.7	18.7	9.6
Trade Secret	44.3	37.5	23.3
Confidentiality	72.1	60.1	42.7
Other	2.9	2.6	3.1
Any of the Above	93.3	83.9	66.8
Source: Author's tabulation from Statistics Canada 1999 Survey of Innovation.			
Notes: 1 88.3 percent of innovators answered the question on the novelty of their most important innovation. The table above presents the distribution of innovators that replied to the question on novelty and were able to classify their innovation in one of the three categories.			
2 The classification of an innovation in a particular class is exclusive and not cumulative, i.e. if an innovation is classified as a world-first, it is not classified at the same time as a Canada-first and as a firm-first, etc.			

new product or process already known elsewhere in Canada used patents. In this case, it is likely that the reporting firm licensed the use of patents as a part of a technology transfer. Unfortunately, the survey did not ask respondents whether they used a particular IPR to protect their most profitable innovation; the information on *IPR use* is describing the firm's *general* behaviour with respect to IPRs. The cross-tabulation then shows the use of IPRs by innovators according to the originality of their most profitable innovation.

The novelty-related differences in the use of other instruments than patents are less pronounced but the pattern is similar. Less original innovators have less IP to protect and therefore use all instruments of IPR protection less often than world-first innovators. This confirms Baldwin's (1997) results for Canada and is consistent with what is expected.

DO LARGE FIRMS USE IPRs MORE FREQUENTLY THAN SMALL FIRMS?

INDEED, THEY DO FOR TWO REASONS. Small firms are less likely to innovate than large ones and when they do, they are less likely to introduce the most original innovations, which are most frequently protected by IPRs. The cost of IP protection also imposes a larger burden on SMEs. Small firms are thus less

TABLE 6**USE OF IPRs BY TYPE OF INNOVATORS AND BY FIRMS' EMPLOYMENT SIZE
(PERCENTAGE OF INNOVATING FIRMS)**

IPRs / SIZE	20-49	50-99	100-499	500 +
Patent	21.2	25.7	36.8	50.6
Trade-mark	32.8	35.5	47.8	52.4
Copyright	9.9	11.4	17.1	24.2
Trade Secret	25.2	26.5	31.2	39.8
Confidentiality	39.5	44.3	58.3	67.0
At Least One	65.2	69.2	80.4	87.3

Source: Author's tabulation based on Statistics Canada 1999 Survey of Innovation.

likely to use IPRs than large firms. Data from the 1999 survey confirm this pattern for Canada.

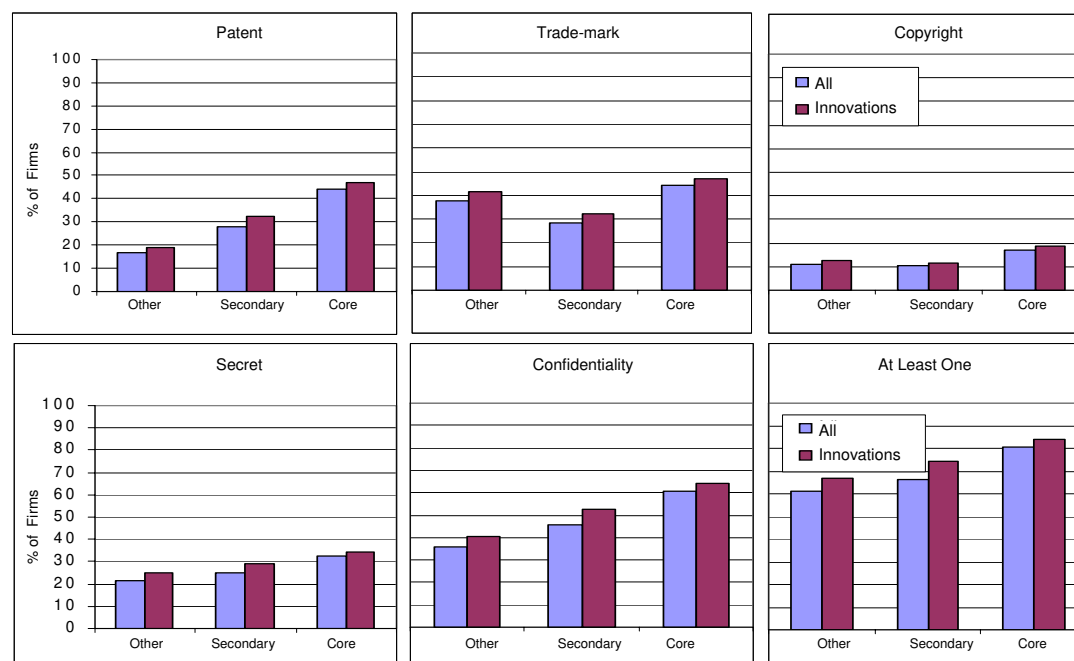
The data presented in Table 6 show that the use of IPRs is positively correlated with firm size. The use of at least one IPR is increasing monotonically with firm size, going from 65.2 percent in the smallest firm category to 87.3 percent in the largest category. This pattern is replicated for each IPR and, with some minor exceptions, for each type of innovation (product, process and both). Larger firms are more likely to use each IPR instrument than smaller ones, and innovating firms use them proportionally more than all manufacturing firms within each size category. The use of IPRs by unsuccessful innovators, by non-innovating firms and by all manufacturing firms follows a similar pattern within each size category (see Table B-1 of Appendix B).

SECTORAL DIFFERENCES

AS EXPECTED, FIRMS IN THE CORE SECTOR with high technological opportunity feeding innovations to other manufacturing firms, and for that matter to the rest of economy, have generally more knowledge assets at stake than firms in technologically less progressive industries. When firms are grouped according to the three-technology sectors taxonomy¹⁴ of Robson, Townsend and Pavitt (1988) — *core*, *secondary* and *other* — the frequency of use of all IPRs is unequivocally descending from the former to the latter group except for trademarks, which are used least frequently in the secondary sector (Figure 1). Again, successful innovators are using each IPR more frequently than non-successful ones, and the latter more frequently than non-innovators (see Table B-2 of Appendix B).

FIGURE 1

USE OF IPRs BY INNOVATION STATUS AND BY SECTOR



Source: Author's tabulation based on Statistics Canada 1999 Survey of Innovation.

Technological competition is most intense in core sector industries. Core sector firms, especially those that introduced world-first innovations, seek patent protection more often than firms in the secondary sector, and the latter more than firms in the *other* sector. They also use more often all other statutory instruments of IPR protection than firms in the technologically less competitive secondary and *other* sectors.

Within each technology sector the use of any instrument of IPRs is increasing with firm size and more original innovators use them more frequently (see Table B-3 of Appendix B). Large firms presumably generate a sufficient volume of innovation sales to justify the allocation of adequate resources to development of specific competencies in the field of IPR protection and to their defence by litigation. All firms employing more than 500 persons that introduced a world-first innovation used at least one instrument of IPRs. More than 80 percent of them used patents, compared to only about 55 percent for small firms (20 to 100 employees).

INTERINDUSTRY DIFFERENCES IN THE USE OF IPRs BY INNOVATING FIRMS

EVEN THOUGH THE IPR STRATEGIES of firms belonging to the same technology sector are fairly similar, there are still significant interindustry differences within each sector. These differences are mainly due to interindustry differences in the perceived effectiveness of various IPRs (Cohen, Nelson and Walsh, 2000). As the description of the interindustry pattern would be too fastidious, we only report highlights from Table B-4 of Appendix B. As in other countries, pharmaceutical firms in Canada protect their IP most intensively. Almost 19 out of 20 (94.2 percent) pharmaceutical firms used at least one IPR, most frequently confidentiality agreements, trade-marks and patents.

The use of patents varies significantly from one industry to another. The top users of patents are somewhat surprisingly not pharmaceutical and chemical industries, which perceived patents as the most effective means of appropriation (Levin et al., 1987; and Cohen, Nelson and Walsh, 2000) and which indeed were the most frequent users of patents in Canada according to the 1993 survey (Baldwin, 1997). According to the 1999 survey, the highest proportion of innovating firms using patents was found in agricultural, construction and mining machinery and equipment (72.3 percent of innovating firms using any IPR), and electrical equipment, appliances and components manufacturing (66.1 percent), followed by pharmaceuticals (59.4 percent).

In the computer and peripheral equipment industry, almost all innovating IPR users (94.9 percent) protect their IP by confidentiality agreements, but only less than half of them use patents and/or trade secrets. Among the reasons for the relatively low use of patents may be that Canadian firms in this field are not at the forefront of technological change (Trajtenberg, 2000) and introduce

primarily less original innovations that are less likely to require the use of IPRs than world-first innovations. Another and perhaps more plausible explanation is that the rate of technological change in computer and peripheral equipment manufacturing is so fast that the conventional statutory IPRs are considered relatively less efficient than alternative strategies (Levin et al., 1987).¹⁵ The recent U.S. survey of the effectiveness of IPRs in the computer industry ranks patents well behind the effectiveness of being first in the market (Cohen, Nelson and Walsh, 2000).¹⁶ Since software is often an integral part of computer and peripheral equipment and can be protected by copyright, the computer industry is the most frequent user of copyright (47.7 percent of innovating IPR users).

The top users of trade secrets are producers of semiconductors and other electronic equipment manufacturers, followed by petroleum, chemical, and pharmaceutical firms in the core sector, and beverages and tobacco producers.

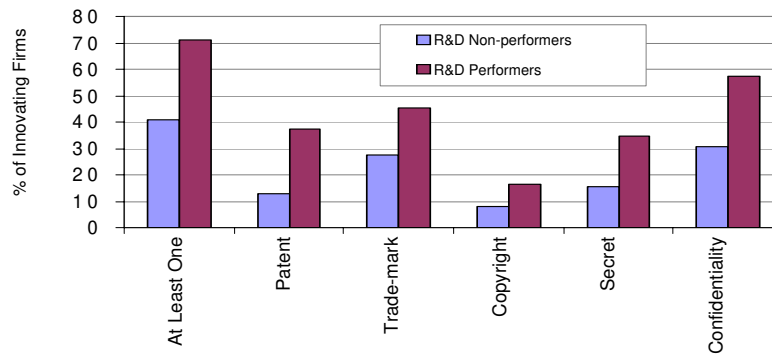
At the low end of the spectrum are firms belonging to the *other* sector, most notably those transforming and fabricating wood products. This industry produces mainly standard industrial materials and components for further transformation in downstream industries and services (construction), which are relying more on price competition than on product differentiation and technological characteristics. Less than half of firms use any IPR. When they do, they rely on trade-marks, trade secrets and, to a lesser extent, on patents.

R&D ACTIVITY AND USE OF IPRs

INNOVATIVE IDEAS AND SOLUTIONS come from various sources, both from within the firm and from outside. Even though R&D is not always the most important source of innovative ideas, the majority of innovative firms that protected their IP acknowledged that R&D played an important role in their innovation process. An overview of all firms (innovators and non-innovators) shows that, indeed, firms carrying out R&D¹⁷ use all IP protection instruments more often than firms that do not carry out R&D. To illustrate this, we show the relationship between the use of IPRs for the sub-population of innovating firms, separately for those that carry out R&D and those that do not (Figure 2). This pattern remains true for each firm-size category and each technology sector. Thus, it appears that firms that pursue active innovative strategies based on R&D need to protect their IP and develop the competency to do so. This is particularly notable for firms that collaborate often with universities and colleges. These firms use IPRs, especially patents, more often than other firms.¹⁸

FIGURE 2

USE OF IPRs BY PERFORMERS AND NON-PERFORMERS OF R&D,
INNOVATING FIRMS ONLY



Source: Author's totalisation based on Statistics Canada 1999 Survey of Innovation.

R&D activity is, however, not a necessary condition for innovation. Less than two thirds (about 59 percent) of all manufacturing firms carried out R&D activities. Almost two thirds of firms that did not carry out R&D nonetheless innovated successfully.¹⁹ As innovation surveys show, R&D is only one of the main sources of innovative ideas and technical solutions. Firms frequently use ideas coming from management and the production department, from customers, suppliers, affiliated firms and competitors, and from institutions of the technological infrastructure. (See Table 7.)

TABLE 7

RELATIONSHIP BETWEEN INNOVATION AND R&D

INNOVATION	R&D		TOTAL
	NO	YES	
	%	%	
No	14.8 (76.9)	4.5 (23.1)	19.3 (100.0)
	(36.6)	(7.5)	
Yes	25.7 (31.8)	55.0 (68.16)	80.7 (100.0)
	(63.4)	(92.5)	
Total	40.6	59.4	100.0
	(100.0)	(100.0)	

Source: Author's tabulation based on Statistics Canada 1999 Survey of Innovation.

Note: The chi-square tests reject the hypothesis of independence between R&D and the use of all IPRs beyond the 0.001 level of significance.

Firms that did not carry out R&D activities had much less use for all forms of IP protection. This suggests that innovators that did not carry out R&D introduced mostly incremental, imitative innovations with lower IP value. This is illustrated in Figure 2, where the use of IPRs is contrasted for firms that perform R&D and those that do not. Since the most original innovations depend on R&D more than imitative ones, the difference in the use of IPRs between performers and non-performers of R&D is most notable — three to one — in the case of patents.

THE EXTENT OF PATENTING

THE TEMPORARY MONOPOLY PROTECTION granted by a patent may encourage firms to apply for as many patents as possible. The accelerating pace of technological change and innovation, as well as the recent introduction in Canada of a *first-to-file* patent system has increased the propensity to file patent applications (Rafiquzzaman and Whewell, 1998). Firms adopt various patenting strategies and the number of patentable innovations varies significantly from firm to firm. Given the high degree of economic integration between Canada and the United States, many firms patent their inventions in both countries. Some apply for patents in the United States only and a small minority files patent applications in other foreign countries.

In addition to the question about the use of IPRs, firms were also asked to provide information on (1) the extent and geographical pattern of their patent applications and (2) the number of patent applications they filed in Canada and the United States.

Extent and Geographical Pattern of Patenting

As far as the extent of patenting is concerned, almost one in five manufacturing firms (19 percent) applied for at least one patent during the 1997-99 period (first column of Table 8). As can be expected, the proportion of firms that applied for patents is larger in the group of innovating manufacturers (22.4 percent).²⁰ The rest of the table shows the geographical pattern of patenting. It indicates convincingly that even though two thirds of Canadian firms applied for patents both in Canada and the United States, the majority (85 percent) filed patents in Canada and about 20 percent filed in Canada only. Only about 10 percent of firms that applied for a patent did not bother to file an application in Canada and applied only in the United States. One would expect that these are mainly U.S. affiliates.²¹ A small group of firms (5 percent) applied in other countries than Canada or United States.

The percentages of all manufacturing firms and of successful innovators that applied for patents in Canada and elsewhere (comparing the two lines of Table 8) seem implausibly similar. An industry-by-industry comparison shows,

TABLE 8

APPLICATIONS FOR PATENTS IN CANADA AND THE UNITED STATES, 1997-99

	APPLIED FOR AT LEAST ONE PATENT	OF THESE, PERCENTAGE THAT APPLIED FOR PATENTS IN					NEITHER CANADA NOR UNITED STATES
		CANADA	UNITED STATES	BOTH CANADA AND UNITED STATES	CANADA ONLY	UNITED STATES ONLY	
%							
MANUFACTURING INDUSTRIES							
All Firms	19.0	85.1	75.6	65.8	19.3	9.8	5.1
Innovators	22.4	85.2	75.4	65.8	19.5	9.6	5.1
Source: Preliminary results of Statistics Canada 1999 Survey of Innovation.							

however, that these average percentages for the manufacturing sector are often hiding significant interindustry differences which tend to cancel out. The similarity of the results in the two lines is also due to the high proportion of manufacturing firms that innovate, rather than to an error.²²

How Many Patent Applications Are Filed?

Firms were asked to indicate not only whether they applied for a patent in Canada and/or the United States, but to indicate the number of applications in each country. There are significant interindustry differences in the propensity to patent. The largest proportion of firms that applied for at least one patent over the 1997-99 period is found in the agricultural, construction and mining machinery group of industries (54.1 percent). The pre-eminence of patenting among natural resource-oriented equipment producers appears to be an extension of Canada's comparative advantage in this area. In second place, we find the communication equipment industry (48.2 percent), followed by the semiconductor and other electronic equipment industry (about 40 percent). Pharmaceutical firms, which in other countries usually lead the patent application ranking, are behind; only 30 percent applied for a patent. This suggests that much of the pharmaceutical research done in Canada does not lead to the introduction of original products and processes. The lowest proportion of firms that applied for at least one patent is in clothing and wood product industries. The ranking of industries is similar to that revealed by the responses to the question on the use of patents. Detailed statistics on the distribution of patent applications by industry are presented in Table B-6 of Appendix B.

Most firms applied for one patent only (41.6 percent in Canada and 34.4 percent in the United States) (see Table 9). These proportions were again

TABLE 9								
NUMBER OF PATENT APPLICATIONS IN CANADA AND THE UNITED STATES, 1997-99								
	OF THESE, NUMBER OF PATENTS APPLIED FOR							
	1	2	3	4	5 TO 9	10 OR MORE PATENTS	UN-KNOWN	
%								
All Manufacturing Firms								
Applied for at Least One Patent	19.0							
Of These, Percentage that Applied for Patents in:								
Canada	85.1	41.6	17.7	11.3	4.2	9.4	9.6	6.2
United States	75.6	34.4	15.7	13.4	3.7	11.8	13.4	7.6
Innovators in Manufacturing								
Applied for at Least One Patent	22.4							
Of These, Percentage that Applied for Patents in:								
Canada	85.2	40.3	18.1	11.8	4.4	9.6	9.6	6.3
United States	75.4	32.9	16.1	13.7	3.9	12.0	13.7	7.7
Source: Preliminary results of Statistics Canada 1999 Survey of Innovation.								

rather similar for innovating firms (40.3 percent in Canada and 32.9 percent in the United States). The percentage of firms that applied for more than one patent declines rapidly with the number of applications. Firms, mainly larger, that patent most frequently, apply for patents more in the United States than in Canada. For instance, a larger proportion of firms that applied for more than ten patents did so in the United States (13.4 percent) rather than in Canada (9.6 percent).

Further analysis of the propensity to patent in Canada and the United States shows that firms that were found in the preceding sections to be more likely to use patents (large firms performing R&D, active in the core sector and having introduced original innovations) also tend to apply for more than one patent. Detailed tables and figures are available on request and we present here only the main conclusions.

The number of patent applications filed by firms is increasing from the *other* sector to the secondary sector and to the core sector.

1. The frequency distribution of the number of patent applications in Canada and the United States by firm size shows that, in each size category, firms that rarely patent (say less than three patents) tend to patent more often in Canada than in the United States. However, firms that apply for a larger number of patents do so more frequently

in the United States than in Canada. This trend is most notable for the largest firms that apply for a large number of patents. Forty percent of these firms applied for more than ten patents in the United States but only 31 percent in Canada.

2. The preference for patent applications in the United States is most notable among firms that apply for a large number of patents in the technologically most progressive core sector. The observed pattern suggests that leading-edge firms that patent most frequently apply for patents in both countries — but in the United States more often than in Canada. The tendency of the most active patentees in the core sector to file more often in the United States than in Canada may reflect the more extensive protection of new technologies and the more inventor-friendly treatment provided in the former (see the study by Maskus in this series).

In the next section of the study, the geographical pattern of patent filing is further explored in three multivariate probability models.

RELATIONSHIP BETWEEN THE PROTECTION OF INTELLECTUAL PROPERTY AND THE PROFITABILITY OF INNOVATION

FIRMS USE IPRs PRESUMABLY TO APPROPRIATE the benefits from their innovations. If this hypothesis is true, innovators who protect their IP are expected to be more profitable than those who do not. This hypothesis can be tested using survey information on the impact of innovation and on the use of IPRs. Respondents scored on a scale from 1 to 5 their strong disagreement (1) or strong agreement (5) with a series of statements regarding the impact of new or improved products or production processes they introduced during the 1997-99 period. They could select two outcomes concerning innovations' impact on profits. The first states that the innovation allowed the firm to maintain its profit margin, the second that innovation increased the firm's profitability. Responses scored 1 and 2 were considered as an indication that the innovation activity did not contribute to profitability, and those scored 4 and 5 as evidence of a positive contribution to profitability.

Both answers were tabulated in a series of two-way contingency tables classifying firms according to the impact of innovation on profitability, and between users and non-users of each IPR. For every IPR, the chi-square statistics reject the test of homogeneity (i.e. the hypothesis that either impact of innovation on profitability is independent of the use of the particular IPR). The statistical tests show that IPR users reported more often than non-users that their innovation allowed them to maintain or to increase profitability.²³ This positive relationship is not very strong, but it is statistically very significant. It holds for

all innovating firms, although there are some sectoral differences. The positive relationship between the use of patents and profitability obtains for the core and secondary sector but not for the *other* sector. By way of contrast, firms that found innovation profitable in the *other* sector are more frequently using trade secrets and confidentiality agreements. Trade-mark users report maintained or increased profitability more frequently than non-users in all three sectors (for details, see Table B-7 of Appendix B).

Overall, these results provide statistically significant evidence that innovators who protected their IP found their innovations contributing to the profitability of the firm.

PROBABILITY MODELS OF INNOVATION AND INTELLECTUAL PROPERTY USE

THE STATISTICAL DESCRIPTION PRESENTED in the previous sections is of limited use when we are interested in considering the possible interactions between the characteristics, strategies and activities of firms and their use of IPRs. This task is better fulfilled by multivariate probability regression models. These models relate the probability that a particular event takes place — say, the probability that a firm uses a patent — to a series of explanatory variables.

We first present briefly the theoretical formulation of these models. This is followed by the specification of the dependent and explanatory variables used for estimating several multivariate logit models. In the first set of models, we estimate the probability that a firm uses a particular IPR. The second set of models explores the variables associated with the probability that a firm innovates. These models also show whether the use of IPRs affects the probability that a firm innovate. Since these two sets of decisions are not entirely independent, a single-equation approach may produce biased results. We thus used both a single equation and a simultaneous two-equation method of estimation. The latter takes into account the possible interdependent nature of the decision to innovate and leads to unbiased estimates. Finally, we present three models that seek to determine which firm and industry characteristics are likely to be associated with a particular geographical pattern of patenting.

THE LOGIT MODEL

FIRMS INNOVATE IN THE EXPECTATION that the new or improved product or process will increase their profits. Even though successful completion of the innovation process is a necessary condition, it is not sufficient to ensure that the firm will benefit from it. To reap the expected benefits from an innovation, the firm has to be able to appropriate them, i.e. to prevent its competitors from imitating the innovation. To appropriate the benefits from innovation, firms

may use various IPRs. Thus, the decision to innovate may be related to the decision about how to best appropriate its expected benefits. Even though these two decisions may not be made at the same time, they are probably not independent.

The expected post-innovation return²⁴ to innovation activity, r_i^* , for firm i is taken to be a function of a set of firm-specific and industry-specific k exogenous variables, x_i . This may be formally written as:

$$(1) \quad r_i^* = bx_i + u_i.$$

While r_i^* is not directly observable, we know whether firm i innovated. We assume that when the expected return from innovation is positive, firms successfully innovate ($I=1$). The observable binary variable I_i takes the value 1 when the firm is an innovator and the value 0 otherwise. Thus, we can write

$$(2) \quad \begin{aligned} I_i &= 1 && \text{if } r_i^* > 0 \\ I_i &= 0 && \text{otherwise.} \end{aligned}$$

The formal reasoning concerning the use of an appropriability strategy is similar. When we observe that a firm has used a set of IPR instruments, we can conclude that it is because the firm expected that they would have a positive effect on its profitability. In this case,

$$(3) \quad \begin{aligned} IPR_i &= 1 && \text{if } r_i^* > 0 \\ IPR_i &= 0 && \text{otherwise.} \end{aligned}$$

Thus, we have two sets of relationships, one for the innovation I_i and the second for the use of IPR_i .

$$(4) \quad E(r_i^* | x_i) \text{ gives us } Prob(I_i = 1) = F(b'x_i)$$

$$(5) \quad E(r_i^* | z_i) \text{ gives us } Prob(IPR_i = 1) = G(c'z_i),$$

where F and G are the cumulative distributions of a logistic variable.

According to economic theory, the profitability of an innovation is a function of the size of the firm, its activities and strategies, as well as the competitive environment, technological opportunities and demand conditions it faces. Most of these variables are also expected to influence the choice of an appropriation strategy, i.e. the use of IPRs and other means to protect the firm's IP.

DEPENDENT VARIABLES

Innovation Variables

INNOVATION IS MEASURED IN THREE different ways for the purpose of this analysis. First, the incidence of innovation is captured by a dichotomous variable that measures whether a firm has introduced an innovation of any type in the three years prior to the survey date of 1999. The binary variable takes the value 1 for innovative firms and the value 0 for non-innovative firms. Second, a set of binary variables is constructed to capture novelty effects — world-first innovators versus all other innovating and non-innovating firms; Canada-first innovators versus other innovating and non-innovating firms; and firm-first innovators versus non-innovators and other innovators. The novelty of an innovation is likely to affect the use of IP.

Third, the type of innovation introduced by a firm is captured by a set of three binary variables. The first variable identifies cases where a firm develops only product innovations. It takes the value 1 in this case, and the value 0 otherwise. The second binary variable identifies process-only innovators, while the third contrasts firms that introduced both product and process innovations against the rest.

Appropriability and IPRs

To protect their innovations from being copied by competitors, innovators use IPRs and other strategies.

A set of binary variables have been constructed to estimate the determinants of use of IPRs and their effects on innovation. The variables are based on whether a firm uses patents, trade secrets or any other IPR (trade-marks, copyright or confidentiality agreements) to protect its innovations. Each variable takes the value 1 if the property right is used and the value 0 if it is not.

The IPR variables appear among explanatory variables in the innovation equation and innovation variables are among explanatory variables in the IPR equations.

EXPLANATORY VARIABLES

INNOVATION IS HIGHLY FIRM-SPECIFIC. Some of the differences in innovative capabilities will be related to differences in industry environment. But within industries, there are considerable differences in the innovative tendencies of firms. Therefore, innovation is assumed to be a function of both firm-specific and industry-specific variables. Firm-specific variables include characteristics of the firm such as firm size and country of ownership (unfortunately, no information on firm ownership is available in the 1999 survey); firm activity variables

such as R&D and use of IPRs; and firm perceptions with regard to the competitive environment and success factors (strategies). Industry-specific variables include proxies for technological opportunity and industry dummy variables.

FIRM CHARACTERISTICS

Firm Size

THE CONTINGENCY TABLES IN THE FIRST PART of the study show a clear relationship between innovation and firm size on the one hand, and firm size and the propensity to use various IPR instruments on the other. A measure of firm size is included to test whether there are inherent advantages associated with size that are independent of other variables. A large size will matter if the Schumpeterian hypothesis that large firms have inherent scale advantages is true. It is often argued that large firms tend to be more innovative than their smaller counterparts. Reasons for this include the scale advantages of large firms, a greater likelihood to engage in risky projects, and economies of scope (Cohen and Klepper, 1996). Larger firms have easier access to financing, can spread the fixed costs of innovation over a larger volume of sales and may benefit from economies of scope and complementary relations between R&D and other manufacturing activities. However, other views exist to suggest that as firms grow, their R&D becomes less efficient. Levin and Reiss (1984) reviewed the empirical evidence on the relationship between innovation and firm size and found it inconclusive.²⁵ Economies of scale and scope may exist, but they may be exhausted only in medium-size firms.

Size is measured by the total number of employees in the firm. Firms are classified in one of four categories: 20 to 49 employees, 50 to 99 employees, 100 to 499 employees, and 500 employees or more. Based on this, four binary variables have been constructed to capture size effects.

FIRM PERCEPTIONS

Competitive Conditions

IN CONTRAST TO EARLIER STUDIES, which considered the market structure of an industry as one of the major exogenous determinants of innovation, more recent theoretical (Dasgupta and Stiglitz, 1980) and empirical work (Levin and Reiss, 1984, 1988; and Cohen and Levinthal, 1989) suggest that it is more likely to be an endogenous outcome of the dynamic growth of innovating firms.

The concept we want to measure is the degree of competition faced by a firm. The firm's representatives were asked to score their agreement with several statements describing the degree of competition faced by the firm. The competition variables take the value 1 when the respondent agrees or strongly

agrees with the statements identifying a high level of competition (variable COMPET)²⁶ as being important or very important.²⁷ Another proxy variable for the competitive challenge is identified as a threat of rapidly changing production or office technology, TECHCH. Otherwise, the variable takes the value 0. Firms in rapidly evolving fields often have difficulties hiring and retaining qualified staff. The variable STAFF takes the value 1 when a firm indicates that this problem is important or very important, and the value 0 otherwise.

Competitive Strategies and Success Factors

In response to questions on success factors, firm representatives revealed what they considered to be successful competitive strategies. Responses to questions related to the firm's success were used to construct three variables. The first, NEWMT, captures responses that give a high score to the importance of new markets and new products to the success of the firm.²⁸ The next, EXPMT, identifies firms that draw their success from export markets. A more general strategy is promotion of the firm or the reputation of the product. This variable, REPUT, identifies firms adopting a strategy that may be associated with the use of trade-marks.

FIRM ACTIVITIES

Research and Development

EVEN THOUGH FIRMS NOT INVOLVED IN R&D activities introduced 32 percent of innovations, every study of innovation confirms that R&D is the primary input to innovative activity. Firms that have an effective R&D program are more likely to innovate for several reasons. First, R&D directly produces new products and processes. Second, firms that perform R&D are also more receptive to technological advances made by others and able to absorb and adapt spillovers to their advantage (Cohen and Levinthal, 1989). A binary variable takes the value 1 if the firm carries out R&D and the value 0 otherwise.

The way firms organize their R&D activities — establishing a separate R&D unit and/or contracting out R&D — is likely to influence their innovation performance and need for protecting IP. The presence or absence of a particular organizational form is, again, identified by a set of binary variables.

Government Support Programs

Government programs in support of innovation and R&D activities subsidize their cost, either directly through subsidies, or indirectly through tax credits. Other government assistance programs such as information and Internet services are also designed to enhance private innovation activities. We create a

series of binary variables that identify cases where a firm uses a particular government assistance program by the value 1; otherwise, the variable takes the value 0.

Industry Effects

Technological opportunities differ across industries when the scientific environment provides more fertile ground for advances in some industries than others.²⁹ Progress in science reduces the cost of technological advance generated per unit of R&D expenditures. The classification of a firm in one of the three technology sectors (*core*, *secondary* and *other*) provides a proxy for technological opportunity.

Industry-specific Effects

Industries vary widely not only with respect to technological opportunity and their position in the technology life cycle, but also with respect to the degree of exposure to external competition, the availability and cost of factors such as specialized labour, natural resources, etc. Thus, relying on a simple three technology typology (*core*, *secondary* and *other*) may not capture other industry-specific conditions that may have a bearing on innovation and the use of IP protection. A set of industry dummy variables identifies the 24 major manufacturing industry groups.

Province-specific Effects

Innovation is a social activity. As such, it depends not only on incentives, motivations, resources and a thriving private sector, but also on the institutional environment in which firms operate. Recognition of the importance of the complex relationships between the private sector and its institutional environment led to the concepts of national and regional systems of innovation.³⁰ Many aspects of education and science, technology, industrial and fiscal policies come under provincial jurisdiction and are likely to affect the innovation performance of resident firms. For example, owing to provincial R&D tax credit programs, the real cost of conducting R&D varies from one province to another (Warda, 1997). To see whether the province of residence of a firm affects its innovation performance and its use of IP protection, a set of dummy variables identifies the province of residence of the firm. The list of variables is presented in Table 10.

TABLE 10		
SUMMARY OF DEPENDENT AND EXPLANATORY VARIABLES		
VARIABLES	EXPLANATION	VALUES
DEPENDENT VARIABLES		
INNO	Firm introduced successfully an innovation	Yes=1, No=0
W-FIRST, C-FIRST AND F-FIRST	World-first, Canada-first and firm-first innovation	Yes=1, No=0
PRODUCT, PROCESS AND BOTH	Product, process or both	
Use of IPRs		
PATENT	Firm used patents	Yes=1, No=0
TRADEMARK	Firm used trade-marks	Yes=1, No=0
COPYRIGHT	Firm used copyright	Yes=1, No=0
TRADE SECRET	Firm used trade secrets	Yes=1, No=0
CONFIDENTIALITY	Firm used confidentiality agreements	Yes=1, No=0
EXPLANATORY VARIABLES		
1. FIRM CHARACTERISTICS		
Size		
SIZE-A	Employment Size – 20 to 49 employees	Yes=1, No=0
SIZE-B	– 50 to 99 employees	Yes=1, No=0
SIZE-C	– 100 to 499 employees	Yes=1, No=0
SIZE-D	– More than 500 employees	Yes=1, No=0
2. FIRM PERCEPTIONS OF COMPETITIVE CONDITIONS		
COMPET	High competition in the product market	Yes=1, No=0
TECHCH	Production and office technology change rapidly	Yes=1, No=0
STAFF	Difficult to hire and/or retain qualified staff	Yes=1, No=0
3. SUCCESS STRATEGIES		
NEWMT	Seeking new and/or developing special. markets	Yes=1, No=0
EXPMT	Developing export markets	Yes=1, No=0
REPUT	Promoting firm or product reputation	Yes=1, No=0
4. FIRM ACTIVITIES		
R&D Activity		
PERFORMS R&D	Performs R&D activity	Yes=1, No=0
SEPARATE UNIT	Performs R&D in a separate R&D unit	Yes=1, No=0
CONTRACTS OUT	Contracts out R&D	Yes=1, No=0
5. GOVERNMENT SUPPORT		
R&D-SUBSIDY	Uses government R&D subsidies	Yes=1, No=0
R&D-TAX CREDIT	Uses government R&D tax credits	Yes=1, No=0
GVMNT-INTERNET	Uses govt. information and Internet services	Yes=1, No=0
6. INDUSTRY CHARACTERISTICS		
Technology Sector		
CORE	Firm belongs to 'Core' sector	Yes=1, No=0
SECONDARY	Firm belongs to 'Secondary' sector	Yes=1, No=0
OTHER	Firm belongs to 'Other' sector	Yes=1, No=0
7. PROVINCE		
ALBERTA	Firm located in Alberta	Yes=1, No=0
ONTARIO	Firm located in Ontario	Yes=1, No=0
QUEBEC	Firm located in Quebec	Yes=1, No=0

ECONOMETRIC ISSUES

1. In order to be representative of the “provincial enterprise” — the statistical unit selected by Statistics Canada for the 1999 Survey of Innovation — the regressions are weighted by the gross business income of each firm.
2. All explanatory variables are binary, taking the value 1 or 0. When a variable classifies firms into several subcategories (e.g. firms are classified in one of several size categories), one of the dummy variables is left out and serves as the default category. The estimated regression coefficients (after an appropriate transformation) show the marginal effect of a given explanatory variable on the probability of the event with respect to the reference case given by the default category.
3. Regression equations in all tables usually exclude explanatory variables that were not statistically significant in previous runs.
4. As is often the case, the results of logit and probit regression model estimates are practically identical. Since there are no theoretical nor econometric reasons to prefer one method over the other and logit results are easier to interpret, we opted for logit regressions.
5. According to economic theory, a firm’s decision to innovate depends on its ability to appropriate the benefits from its innovation. Thus, a priori, it is likely that the decision to use a particular IPR and the decision to innovate are not mutually independent. In this case, estimating, say, the patent function and the innovation function separately by a single-equation approach would lead to a simultaneous equation bias. The remedy is to formulate a system of simultaneous equations and estimate it by the two-stage estimation method (Maddala, 1983). The information on the use of IPRs is, however, rather general. It is not specific to a firm’s innovation activity, and even less to its most important innovation. Thus, it is not sure that both decisions are really interdependent and the two-stage approach is called for. To be on the safe side, in addition to single-equation models, we estimate also a simultaneous two-equation model using a two-stage logit procedure.
6. Since neither the SAS nor STATA softwares at our disposal provide an integrated two-stage logit procedure, we estimated the second stage equations of the simultaneous model by using as instruments the predicted value (linear) of each endogenous variable (patent and innovation, respectively). These were obtained by regressing the interdependent endogenous variables in the first-stage equation on all

independent variables. The drawback of this procedure is that the covariances estimated as in a single-equation procedure are likely to underestimate the correct asymptotic covariances. To compensate for this possible underestimation, the standard errors are computed by the *robust* procedure that gives more conservative estimates of standard errors than the normal method.

INTERPRETATION OF THE RESULTS

Models Predicting the Use of IPRs

THE ESTIMATED REGRESSION COEFFICIENTS of five logit models predicting the probability that a firm will use a particular IPR are presented in Table 11. The signs of the regression coefficients show whether the answer “yes” to a particular question (the variable takes the value 1) increases (+) or decreases (–) the probability that a firm will use the IPR. The probabilities are estimated for a firm with 100-499 employees operating in the secondary sector that introduced a firm-first process innovation.³¹

The first important result is that the models confirm in the multivariate context the finding from tabulations regarding the positive association between firm size and the probability that the firm uses most IPRs to protect its knowledge assets. Small firms are less likely, and the largest firms more likely, to use any or all IPR instruments than medium-size firms. The relationship is statistically significant for the use of all IPRs except trade secret and it is most notable for patents. In contrast, small firms do not use trade secret less frequently than medium-size firms. This finding seems to corroborate the hypothesis that, for small- and medium-size firms, cost considerations may discourage the use of IPRs other than trade secret.

Firms carrying out R&D, especially those who conduct it in a separate unit and/or who contract out their R&D, are also more likely to use any or all IPRs than firms not involved in R&D. Innovating firms, especially those that introduced original world-first innovations, and to a slightly lesser extent those that introduced new technology for the first time in Canada, are likely users of IPRs. However, world-first innovators rely less on trade secret and more on patents, copyright and confidentiality agreements. The probability that a firm uses IPRs increases notably when the firm introduces product innovations or both product and process innovations rather than process innovations only. Again, these characteristics of innovations are more closely linked to the use of patents than of other IPRs.

TABLE 11

USE OF IPRs – RESULTS OF LOGIT REGRESSIONS

DEPENDENT VARIABLE	PATENT	TRADE-MARK	COPYRIGHT	TRADE SECRET	CONFIDENTIALITY
Intercept	-2.661 (0.197)a	-2.273 (0.159)a	-3.208 (0.242)a	-2.470 (0.195)a	-1.237 (0.158)
1. FIRM CHARACTERISTICS					
Firm Size					
SIZE-A	-0.390 (0.111)a	-0.391 (0.092)b	-0.267 (0.140)c	0.063 (0.105)	-0.391 (0.097)a
SIZE-B	-0.262 (0.098)a	-0.334 (0.084)a	-0.235 (0.124)c	0.005 (0.094)	-0.376 (0.086)a
SIZE-C	Left out	Left out	Left out	Left out	Left out
SIZE-D	0.418 (0.135)a	0.152 (0.127)	0.409 (0.159)a	0.311 (0.136)b	0.270 (0.138)b
2. FIRM PERCEPTIONS					
Competitive Conditions					
COMPET	0.103 (0.084)	0.247 (0.071)a	0.167 (0.102)c	0.059 (0.082)	-0.097 (0.074)
STAFF	-0.343 (0.093)a	-0.178 (0.078)	-0.098 (0.111)	0.100 (0.084)	-0.002 (0.081)
Success Factors					
NEWMT	0.011 (0.128)	0.221 (0.111)b	0.055 (0.153)	0.297 (0.138)b	0.297 (0.116)a
EXPMT	0.130 (0.086)	0.115 (0.075)	-0.025 (0.109)	-0.130 (0.084)	-0.102 (0.077)
REPUT	0.163 (0.114)	0.206 (0.093)b	0.048 (0.137)	-0.004 (0.105)	0.105 (0.093)
3. FIRM ACTIVITIES					
R&D Activity					
PERFORMS R&D	0.454 (0.120)a	0.229 (0.097)b	0.293 (0.158)c	0.589 (0.116)a	0.426 (0.098)a
-SEPARATE UNIT	0.463 (0.092)a	0.342 (0.084)a	0.319 (0.112)a	0.547 (0.089)a	0.491 (0.089)a
-CONTRACTS OUT	0.362 (0.100)a	0.239 (0.092)a	0.456 (0.114)a	0.213 (0.096)b	0.415 (0.099)a
USE OF IPRs					
PATENT					
TRADEMARK					
TRADE SECRET					
4. GOVERNMENT SUPPORT					
R&D-SUBSIDY	0.471 (0.123)a	0.245 (0.116)b	0.091 (0.145)	0.090 (0.114)	0.609 (0.121)a
R&D-TAX CREDIT	0.206 (0.094)b	0.088 (0.084)	-0.108 (0.113)	-0.036 (0.090)	0.246 (0.863)a
GVMNT-INTERNET				0.406 (0.078)a	0.695 (0.081)a
5. INDUSTRY CHARACTERISTICS					
CORE Sector	0.343 (0.103)a	0.397 (0.097)a	0.364 (0.129)a	0.057 (0.102)	0.298 (0.101)a
SECONDARY Sector	Left out	Left out	Left out	Left out	Left out
OTHER Sector	-0.566 (0.096)a	0.504 (0.085)a	0.217 (0.125) c	-0.102 (0.093)	-0.298 (0.084)

TABLE 11 (CONT'D)

USE OF IPRs – RESULTS OF LOGIT REGRESSIONS

DEPENDENT VARIABLE	PATENT	TRADE-MARK	COPYRIGHT	TRADE SECRET	CONFIDENTIALITY
6. PROVINCE					
ALBERTA	0.444 (0.147)a	0.177 (0.131)	0.410 (0.182)b	0.234 (0.145)c	0.212 (0.133)
ONTARIO	0.624 (0.111)a	0.190 (0.096)b	0.341 (0.128)a	0.157 (0.108)	0.356 (0.099)a
QUEBEC	0.056 (0.107)	0.327 (0.089)a	-0.559 (0.138)a	-0.269 (0.100)a	-0.326 (0.089)a
OTHERS	Left out	Left out	Left out	Left out	Left out
7. INNOVATION					
W-FIRST	0.691 (0.147)a	0.216 (0.133)	0.326 (0.160)b	0.183 (0.134)	0.339 (0.148)b
C-FIRST	0.496 (0.105)a	0.418 (0.094)	0.391 (0.128)a	0.391 (0.100)a	0.373 (0.099)a
F-FIRST	Left out	Left out	Left out	Left out	Left out
PRODUCT	0.959 (0.141)a	0.820 (0.114)a	0.688 (0.175)a	0.294 (0.132)	0.322 (0.115)a
BOTH	0.709 (0.116)a	0.619 (0.167)a	0.604 (0.148)a	0.611 (0.108)	0.441 (0.091)a
PROCESS	Left out	Left out	Left out	Left out	Left out
Summary Statistics					
Number of obs. (weighted)	8,509	8,509	8,509	8,509	8,059
Log. likelihood	-2,396	-3,102	-1,730	-2,646	3,060
Pseudo R ²	0.200	0.088	0.098	0.097	0.145
% concordant*	78.51	66.8	87.6	75.2	69.1
% of firms using IPRs	25.9	36.2	12.0	24.9	43.9
Notes: Weighted regressions. All regressions have probability > chi2=0.0000. Level of statistical significance of robust standard errors in parentheses: c=10%, b=5%, a=1%. * Percentage of correctly classified observations based on non-weighted results.					

Firms that base their competitive strategy on the development of new markets are likely to protect their IP using trade-marks, trade secrets and confidentiality agreements. Curiously, they are unlikely to use patents for this purpose. Equally surprising is the absence of statistical association between the export strategy and the use of any IPR. As expected, the regression results confirm that trade-marks are a means to enhance a firm's reputation.

Firms that reported receiving government subsidies for their R&D projects are more likely to use patents, trade-marks and/or confidentiality agreements than firms benefiting from the more generally available R&D tax credit. Both groups are likely to use those IPRs more frequently than firms that did not receive government assistance. Paradoxically, firms that reported using government

information services through the Internet or otherwise are more likely than other firms to use trade secret, copyright and confidentiality agreements.

The results suggest that there are some notable differences associated with the province where a firm operates. Firms located in Ontario and Alberta are more likely to use most IPRs than firms located in other provinces. Firms based in Quebec are more likely than those of other provinces to protect their products by trade-marks, but less likely to use copyright, trade secret and confidentiality agreements. One hypothetical explanation could be that the use of French or the loyalty of employees to the firm may provide an efficient protection against imitation and make it unnecessary to use these IPRs. An alternate explanation could be that the pattern of IPR use in Quebec is determined by its industrial mix.

Firms in the core sector are more likely to use all IPRs except trade secret than firms in the secondary sector. Patents are used less frequently in the *other* sector than in both upstream core and secondary sectors. In keeping with their consumer product orientation, firms in the *other* sector are more likely than those in the secondary sector to use trade-marks and copyright.

Industry dummy variables identifying major manufacturing industry groups were found to be redundant (F-test) and excluded from the regressions.

One way to judge how well our probability models perform is to let them predict which firms are expected to use a particular IPR and compare this prediction with the observed use of IPRs. The second last row in Table 11, denoted “% concordant,” shows the percentage of firms in the sample that were correctly classified by the logit regression function as users or non-users of a particular IPR. It ranges from a low of 66.8 percent for the use of trade-marks and a high of 87.6 percent for the use of copyright.

As for the use of IPRs, the results suggest that there are two groups of firms: (1) firms for which the use of patents and trade-marks seems to be an integral part of a successful innovation strategy — regularly performing R&D financed in part by government subsidies and leading to the introduction of world-first innovations. The larger the firm, the more likely it will use patents. The probability of using patents for firms operating in the high-tech *core* sector is about twice that of firms in the low-tech *other* sector. Firms based in Quebec are less likely to use patents than those based in Ontario and Alberta.

The second group of firms is likely to rely primarily on trade secret. It consists of firms that introduce mainly Canadian-first innovations and that are less oriented toward product innovations than firms that belong to the first group. Even though they are as likely to perform R&D as the latter, they rely less on government financing of R&D but more on government information services. Firms in this group belong to all firm-size categories but those in the largest one are somewhat more likely to use trade secret than medium-size and small firms. They are found in all three sectors and in all provinces outside Quebec. Firms from Quebec are less likely to use trade secret than those in the rest of Canada.

The Innovation Models

PROTECTION OF NEW PRODUCTS AND PROCESSES from imitation is believed to be one of the principal incentives for innovation. Firm's decisions to innovate depend on a host of other variables, some related to its characteristics, activities and strategies, others determined by competitive pressures, technological opportunities and government policies. All or some of these factors might also determine which type of innovation a firm is likely to introduce.

Four logit regressions are presented. The first predicts the probability that a firm is an innovator, i.e. that it introduced an innovation during the 1997-99 period. The next three models predict, respectively, the probability of introduction of a world-first, Canada-first or firm-first innovation.

The first model predicts the occurrence of a successful innovation ($I=1$) as opposed to cases where a firm did not complete an innovation during the 1997-99 period or was not involved in an innovative process ($I=0$). The probabilities are estimated for a firm belonging to the secondary sector.

The preliminary results (not presented here) suggested that the probability of a successful innovation is not correlated with firm size. The size of the firm is, however, the principal determinant of a firm's decision to conduct R&D and how it will be organized. Therefore, firm size influences the innovation activity indirectly through R&D and its organizational modalities. The innovation function thus includes two R&D variables, the first taking the value 1 when the firm performs R&D, the second identifying firms that conduct their R&D in a separate unit. Since none of the firm-size variables was statistically significant in the presence of R&D variables, they were excluded from the final model presented in the first column of Table 12. Several variables reflecting a firm's perceptions of its competitive environment and its success factors or strategies were excluded for the same reason.

The results suggest that firms operating in the core sector (and to a much lesser degree those operating in the *other* sector) are more likely to innovate than firms operating in the secondary sector. The probability that a firm is an innovator greatly increases when it carries on R&D activities. It matters little, however, that R&D activities are conducted in a separate division or in other departments of the firm. Nor does it matter whether R&D is contracted out. The latter variable was thus excluded. Firms receiving assistance from government programs, especially R&D subsidies and, to a lesser degree, R&D tax credits, are more likely to innovate than those that do not use them. The positive correlation between the use of government support programs and innovation is not necessarily an indication of a beneficial effect of these programs. It may simply show that innovating firms are better aware of and organized to solicit successfully governmental aid.

TABLE 12**DETERMINANTS OF INNOVATION – LOGIT REGRESSIONS**

DEPENDENT VARIABLE	INNOVATOR	WORLD-FIRST	CANADA-FIRST	FIRM-FIRST
Intercept	–1.125 (0.157)a	–4.664 (0.224)a	–2.894 (0.129)a	–0.963 (0.129)a
1. FIRM CHARACTERISTICS	Left out	Left out	Left out	Left out
2. FIRM PERCEPTIONS				
Competitive Conditions				
COMPET				
TECHCH	0.644 (0.112)a			0.291 (0.079)a
STAFF	0.219 (0.105)b			
Success Factors				
NEWMT	0.632 (0.127)a			0.392 (0.109)a
EXPMT	0.282 (0.093)a	0.373 (0.126)a	0.289 (0.084)a	0.103 (0.074)
REPUT	0.250 (0.111)b			
3. FIRM ACTIVITIES				
R&D Activity				
PERFORMS R&D	1.432 (0.115)a	1.308 (0.227)a	0.975 (0.120)a	1.182 (0.089)a
–SEPARATE UNIT	0.049 (0.156)		0.158 (0.091)c	–0.182 (0.094)b
–CONTRACTS OUT				
USE of IPRs				
PATENT	0.453 (0.145)a	1.129 (0.128)a	0.777 (0.093)a	0.234 (0.092)b
TRADEMARK	0.192 (0.107)	0.127 (0.123)	0.227 (0.087)a	0.237 (0.078)
TRADE SECRET	0.705 (0.132)a	0.499 (0.118)a	0.503 (0.087a	0.001 (0.086)a
4. GOVERNMENT SUPPORT				
R&D-SUBSIDY	0.904 (0.280)a		0.216 (0.117)c	
R&D-TAX CREDIT	0.238 (0.129)c	0.623 (0.126)a	0.544 (0.095)a	0.337 (0.084)a
GVMNT-INTERNET				
5. INDUSTRY CHARACTERISTICS				
CORE Sector	0.243 (0.142)c	0.212 (0.117)c	0.026 (0.105)	–0.067 (0.099)
SECONDARY Sector	Left out	Left out	Left out	Left out
OTHER Sector	0.199 (0.105)b		–0.075 (0.99)	0.044 (0.084)

TABLE 12 (CONT'D)				
DETERMINANTS OF INNOVATION - LOGIT REGRESSIONS				
DEPENDENT VARIABLE	INNOVATOR	WORLD-FIRST	CANADA-FIRST	FIRM-FIRST
6. PROVINCE				
ALBERTA	0.422 (0.115)a	Left out	Left out	Left out
ONTARIO	0.462 (0.119)a	-0.154 (0.161)	-0.107 (0.101)a	0.471 (0.092)a
QUEBEC	0.409 (0.102)a	0.161 (0.142)	0.347 (0.0.096)	-0.083 (0.080)
OTHERS	Left out	Left out	Left out	Left out
Summary Statistics				
Number of obs. (weighted)	8,509	8,509	8,509	8,509
Log. likelihood	1,677.4	-1,299	-2,417	-3,111
Pseudo R ²	0.199	0.169	0.156	0.102
% concordant*	82.4	90.5	76.7	68.7
% of manufacturing firms	81.3	8.5	14.6	36.3
Notes: Weighted regressions. All regressions have probability > chi2=0.0000. Level of statistical significance of robust standard errors: c=10%; b=5%; a=1%. * Percentage of correctly classified observations based on non-weighted results.				

Firms that are developing new markets for their products both in Canada and abroad are more likely to innovate than others. These firms share the same concern over the rapid change of production and office technologies and they experience problems hiring and retaining qualified staff.

Last, but not least, as predicted by the economic theory of innovation, firms that are protecting their IP with patents, trade-marks and most notably with trade secret are more likely to innovate than other firms. In this respect, using trade secret increases the probability of innovation more than using patents. Other estimations results not presented here show also a statistically significant positive link between the use of *any* statutory instrument of IPR and the probability of introducing an innovation.

When the program compares the predicted probability that a firm be an innovator with the observed result, the outcome is correct for 82.4 percent of firms.

Originality of Innovation

The next three models predict the probability that a firm will introduce a world-first, Canada-first or firm-first innovation. Each of these three models is formulated to estimate the probability that a firm will introduce a particular type of innovation against all other possible outcomes.³²

The results of the three regressions estimating the probability of a world-first, Canada-first and firm-first innovation are presented in columns 2 to 5 of Table 12. Again, most variables that were not statistically significant are excluded. We concentrate our interpretation on the three IPR variables included in each regression.

To be patentable, an invention must make an original contribution to the state of technology.³³ Therefore, it can be expected that the use of patents is a better predictor of the probability that the firm introduced a world-first innovation than a Canada-first or firm-first innovation. This is what that data show.

Firms using trade secret are more likely to introduce a world-first or Canada-first innovation than those already existing elsewhere in Canada (firm-first). The latter is associated to a similar degree with the use of patents and trade-marks but not with trade secret. Firms introducing new technology to Canada are also using trade-marks.

Simultaneous Model Estimated by a Two-stage Method

As mentioned earlier, the decision to innovate and to protect the IP in an innovation may well not be independent. In this case, the single-equation estimation method used so far may lead to a simultaneous equation bias. To obtain consistent estimates of regression coefficients, we used a two-stage estimation method (Maddala, 1983). The results of one such model including two equations — one predicting the probability that a firm uses patents and the other that it introduces an innovation — are presented in Table 13.³⁴ For the sake of comparison, we present along each estimated structural equation (patent and innovation) the corresponding single-equation estimate.

After obtaining predicted values for each interdependent endogenous variable (PR-INNOVATOR and PR-PATENT) in the first stage by regressing each variable on all explanatory variables, these predicted values are included in the second-stage structural equations.

The comparison of regression coefficients of each structural equation with its single-equation equivalent in Table 13 shows that most regression coefficients estimated by the two-stage method are not very different from those obtained by a single-equation approach. In the patent equation, the regression coefficient of the predicted value of innovation is almost identical to the single-equation coefficient. The most important difference between the single and the two-stage versions of the patent equation appears in the variables representing government support programs. The large and statistically significant regression coefficient of R&D-SUBSIDY obtained in the single equation all but disappears and becomes statistically insignificant in the two-stage estimation. The regression coefficient of R&D-TAX CREDIT is also smaller and statistically less significant in the two-stage estimation.

TABLE 13				
RESULTS OF 2-STAGE LOGIT VS. SINGLE-EQUATION LOGIT ESTIMATES				
DEPENDENT VARIABLE	PATENT 2ND-STAGE LOGIT	PATENT SINGLE EQUATION	INNOVATION 2ND-STAGE LOGIT	INNOVATION SINGLE EQUATION
Intercept	−2.126 (0.553)a	−2.695 (0.210)a	−0.445 (0.199)b	−1.066 (0.107)a
ENDOGENOUS VARIABLES				
PR-INNOVATOR	0.477 (0.257)c			
INNOVATOR		0.622 (0.096)a		
PR-PATENT			0.213 (0.051)a	
PATENT				0.591 (0.0946)a
EXOGENOUS VARIABLES				
1. FIRM CHARACTERISTICS				
Firm Size				
SIZE-A	−0.244 (0.342)	−0.309 (0.076)a		
SIZE-B	−0.176 (0.291)	−0.202 (0.073)a		
SIZE-C				
SIZE-D	0.454 (0.261)c	0.418 (0.121)a		
2. FIRM PERCEPTIONS				
Competitive Conditions				
COMPET	−0.046 (0.244)	−0.003 (0.061)	0.056 (0.085)	0.061 (0.066)
TECHCH	−0.181 (0.323)	0.108 (0.064)c	0.623 (0.096)a	0.641 (0.075)a
STAFF	−0.382 (0.304)	−0.272 (0.067)a	0.273 (0.094)a	0.222 (0.072)a
Success factors				
NEWMT	−0.279 (0.457)	0.015 (0.098)	0.636 (0.111)a	0.654 (0.081)a
EXPMT	0.023 (0.262)	0.165 (0.064)	0.236 (0.0841)a	0.275 (0.065)a
REPUT	−0.0008 (0.349)	0.111 (0.083)	0.219 (0.100)b	0.252 (0.764)a
3. FIRM ACTIVITIES				
R&D Activity				
PERFORMS R&D	**	0.639 (0.118)a	1.363 (0.117)a	1.509 (0.084)a
−SEPARATE UNIT	0.386 (0.257)d	0.455 (0.096)a	0.058 (0.148)	0.118 (0.113)
USE of IPRs				
TRADEMARK	1.567 (0.289)a	1.734 (0.087)a	Left out	Left out

TABLE 13 (CONT'D)

RESULTS OF 2-STAGE LOGIT VS. SINGLE-EQUATION LOGIT ESTIMATES

DEPENDENT VARIABLE	PATENT	PATENT	INNOVATION	INNOVATION
	2 ND -STAGE LOGIT	SINGLE EQUATION	2 ND -STAGE LOGIT	SINGLE EQUATION
4. GOVERNMENT SUPPORT				
R&D-SUBSIDY	0.064 (0.376)	0.522 (0.091)a	0.851 (0.251)a	0.960 (0.195)a
R&D-TAX CREDIT	0.173 (0.275)	0.444 (0.067)a	0.199 (0.120)c	0.251 (0.093)a
GVMNT-INTERNET				
5. INDUSTRY CHARACTERISTICS				
CORE Sector	0.162 (0.248)	0.284 (0.077)a	0.207 (0.125)c	0.251 (0.098)a
SECONDARY Sector	Left out	Left out	Left out	Left out
OTHER Sector	-0.928 (0.336)a	-0.883 (0.071)a	0.334 (0.097)a	0.217 (0.069)a
6. PROVINCE				
ONTARIO	0.306 (0.329)	0.499 (0.075)a	0.375 (0.105)a	0.473 (0.076)a
QUEBEC	-0.383 (0.319)	-0.252 (0.079)b	0.411 (0.097)a	0.395 (0.075)a
OTHERS	Left out	Left out	Left out	Left out
Summary Statistics				
Number of obs. (weighted)	8,509	8,509	8,509	8,509
Pseudo R ²	0.251	0.369	0.190	0.263
% concordant*	78.37	82.40	73.10	79.70
Notes: Global null hypothesis: Beta=0 rejected for all regressions with probability $pr < 0.0000$; $pr > \chi^2_2$. Asymptotically correct standard errors computed according to Murphy and Topel (1985). The level of statistical significance is denoted as follows: c=10%, b=5%, a=1%. * Percentage of correctly classified observations based on non-weighted results. ** The variable PERFORMS RD is excluded by the program because of multicollinearity ($r=0.82$) with the "predicted INNO" variable.				

The two methods of estimation of the innovation equation show that the regression coefficient of PR-PATENT obtained in the two-stage structural equation is significantly smaller than that of the single-equation estimation. In contrast with the patent equation, the regression coefficients of R&D-SUBSIDY and R&D-TAX CREDIT estimated by the two-stage method in the innovation equation are not significantly different from those obtained by the single-equation method.

Thus, when the possible interdependence of the decisions to innovate and to use patents is taken into consideration, the positive correlation with the probability that an innovating firm will use patents remains unchanged. On the other hand, the use of patents has less effect on the firm's decision to innovate than would suggest the single-equation estimates. This outcome points in the

same direction as the findings of Baldwin, Hanel and Sabourin (2000). Analyzing data from the 1993 Survey of Innovation, they concluded that the relationship is much stronger going from innovation to the decision to use patents than from the use of patents to innovation.

Even though the two-stage estimation of the innovation function suggests that patents may not be as strong an incentive for innovation as economic theory claims, world-first innovators are likely to use patents more frequently than trade secret. Given the sceptical attitude of firms toward patents' effectiveness as a means of appropriating innovation benefits (Baldwin, 1997), firms introducing more original innovations may use patents for multiple other reasons.

The Geographical Pattern of Patenting

IN THIS SECTION, WE SEEK TO DETERMINE which firm and industry characteristics are likely to be associated with a particular geographical pattern of patenting. The three models estimate respectively the probability that a firm applies for a patent in Canada only, in the United States only and in both countries. We started with the full set of explanatory variables used in the previous models and excluded variables that were not statistically significant in any of the three models. The results suggest that firms that introduced a Canada-first innovation tend to apply for patents exclusively in Canada (Table 14, column 1). The probability of applying for a patent in Canada only is further enhanced when the firm belongs to the largest category and is conducting R&D. On the other hand, the probability that a firm patents only in Canada is the same for all three sectors.

The probability that a firm will apply for a patent in the United States only is higher for world-first and Canada-first innovators that conduct R&D and do so in a separate unit. These could be mostly U.S.-owned firms. Unfortunately, the information on the ownership of firms is not known. When a firm operates in Ontario, it is more likely that it will file for a patent in the United States only. Again, the sector in which the firm operates does not affect the probability that it seeks patents only in the United States.

A more important group of firms patented both in Canada and in the United States. Their distinctive features are that they are medium- and large-size firms, successfully pursuing an export strategy and conducting R&D by contracting it out. The likelihood of filing patents in both countries increases when the firm belongs to the core sector, is located in Ontario or Alberta and receives R&D subsidies and tax credits. Firms operating in the *other* sector are less likely than others to apply for patents in both countries.

TABLE 14**COUNTRY OF PATENT APPLICATION – LOGIT REGRESSIONS**

DEPENDENT VARIABLE	CANADA ONLY	UNITED STATES ONLY	CANADA AND UNITED STATES
Intercept	-4.400 (0.187)a	-4.941 (0.321)a	-3.696 (0.145)a
1. FIRM CHARACTERISTICS			
Firm Size			
SIZE-A			-0.486 (0.102)a
SIZE-B			-0.202 (0.090)b
SIZE-C	Left out	Left out	Left out
SIZE-D	0.556 (0.189)a	-0.571 (0.355)c	0.156 (0.138)
2. FIRM PERCEPTIONS			
Competitive Conditions			
COMPET	0.191 (0.118)c		
TECHCH	-0.116 (0.127)	0.214 (0.177)	
STAFF	-0.200 (0.131)	-0.541 (0.215)b	
Success Factors			
NEWMT			
EXPMT	0.166 (0.125)		0.511 (0.084)a
3. R&D ACTIVITY			
PERFORMS R&D	0.999 (0.174)a	0.465 (0.293)d	0.851 (0.119)a
-SEPARATE UNIT	0.169 (0.128)	0.887 (0.200)a	
-CONTRACTS OUT			0.427 (0.084)a
4. GOVERNMENT SUPPORT			
R&D-SUBSIDY			0.428 (0.101)a
R&D-TAX CREDIT		0.359 (0.192)c	0.634 (0.087)a
GVMNT-INTERNET			0.126 (0.103)
5. INDUSTRY CHARACTERISTICS			
Technology Sector			
CORE	0.164 (0.152)		0.219 (0.090)b
SECONDARY	Left out	Left out	Left out
OTHER	-0.002 (0.139)		-0.562 (0.092)a
6. INNOVATION			
W-FIRST	-0.119 (0.182)	0.632 (0.228)a	0.643 (0.111)a
C-FIRST	0.657 (0.138)a	0.591 (0.215)a	0.579 (0.092)a

TABLE 14 (CONT'D)			
COUNTRY OF PATENT APPLICATION – LOGIT REGRESSIONS			
DEPENDENT VARIABLE	CANADA ONLY	UNITED STATES ONLY	CANADA AND UNITED STATES
7. PROVINCE			
ONTARIO		0.538 (0.237) ^b	0.634 (0.081) ^a
QUEBEC		–0.48 (0.282) ^c	
ALBERTA		0.462 (0.334)	0.312 (0.150) ^b
OTHERS		Left out	Left out
Summary Statistics			
Number of yes=1 (weighted)	321	154	1,006
Number of observations (weighted)	8,609	8,509	8,509
Likelihood ratio: chi2	147	188	1,206
% concordant	67	75	80.9
% of all manufacturing firms	3.9	1.8	11.8
Notes: Weighted regressions. Level of statistical significance of standard errors: d=15%, c=10%, b=5%, a=1%. All regressions have probability > chi2=0.0000.			

CONCLUSION

WHILE INDUSTRY EXPERTS DO NOT HAVE a high opinion of the effectiveness of IP protection, two thirds of manufacturing firms in Canada use at least one of many IPRs. Firms using specific IP protection instruments find them generally more effective than firms not familiar with them. Firms using various instruments of IP protection innovated more frequently than those that tried but did not succeed, and the latter use these instruments more than non-innovators.

The proportion of firms (innovating and non-innovating alike) that use IPRs is increasing with firm size. Firms operating in the core sector that feeds innovations to the secondary and *other* sectors and to the rest of economy protect their IP more frequently than firms operating in the secondary sector. Firms operating in the low-tech *other* sector use IPRs the least. The close association between the use of IPRs and firm size is also observed within each technology sector. It suggests that the cost of learning and using effectively the means of protecting IP discourages small- and medium-size firms from using it as frequently as larger firms.

One of the main purposes of IPRs is to encourage innovation and creation by protecting the exclusive character of new products, processes, works of art, software, etc. It is thus not surprising that most world-first innovators use all IP

protection instruments more frequently than firms that introduced less original Canada-first and imitative firm-first innovations.

Even though carrying out R&D is not a precondition for successful innovation — about one in three successful innovators did not conduct R&D — firms that perform R&D are significantly more likely to innovate than others. Firms conducting R&D are also more likely to innovate in a more original way, and thus protect their IP more frequently than firms that do not carry out R&D. Firms conducting R&D use IPRs more and differently than firms not performing R&D. The most notable differences between the two groups of firms is observed in the use of patents. Non-performers of R&D are much less likely to introduce original innovations that rely on IPRs more than imitative innovations. R&D-performing firms use patents significantly more often.

Firms using IPRs are more likely to introduce innovations. The largest effect in this respect is associated with trade secret, patents and trade-marks. The results of our econometric analysis suggest that patents and trade secret are often used by different firms in different situations.

Using patents and trade-marks seems to be an integral part of a successful innovation strategy, which consists of regularly performing R&D financed in part by government subsidies, introducing world-first product innovations and exporting. The probability of using patents for firms operating in the high-tech core sector is about twice that of firms in the low-tech *other* sector. In contrast, trade-marks are used as much by core sector firms and firms in the *other* sector. Firms in Quebec are less likely to patent than those located in other provinces.

Firms that introduced mainly Canada-first innovations seem to rely somewhat less on patents but almost equally on trade secret as those of the first group. Like the latter, they also export. They are less successful at getting R&D subsidies and rely more on R&D tax credits than firms in the first group. Firms from all sectors introduce Canada-first innovations. Quebec firms are more likely to introduce Canada-first innovations than those of other provinces.

The majority of innovations consist in the introduction of less original firm-first new or improved products and processes already used elsewhere in Canada. These innovations are often made in response to changes in production and office technologies and as part of a strategy to seek new markets. These innovations are more likely to be made by firms using patents (probably allowing them to use existing patented technology) and trade-marks. The probability of introducing this type of innovation is not specific to any sector. The likelihood of this type of innovation is greater for Ontario firms than those of other provinces and it increases when firms use patents and trade-marks.

As for patenting, most firms apply for patents in Canada, but many apply also in the United States. Two thirds of firms applying for a patent do so in both countries. Less than 10 percent of firms applying for a patent do so exclusively in the United States. About 20 percent apply only in Canada and some

5 percent apply elsewhere. The tendency to apply for a patent in the United States increases with the extent of patenting and firm size. Firms applying for more than 10 patents tend to patent more in the United States than in Canada.

Results of the two-stage estimation of a simultaneous two-equation model of the decisions to patent and to innovate as mutually interdependent provide additional evidence that owning patents may not be as strong an incentive to innovate as the results of the single-equation model suggest. These results also cast doubt on the single-equation estimate of a statistically significant positive relationship between the use of patents and receiving R&D subsidies.

Overall, the evidence indicates that even though IPRs may not be perfect means of appropriating the benefits from innovation, firms that protect their IP succeed in maintaining their profit margins or increasing their profitability more often than other firms.

The results of the present study suggest several policy measures. The pervasive evidence shows that small- and medium-size firms use any or all IPRs less frequently than large firms. This suggests that the cost of obtaining, maintaining and enforcing IPRs by litigation imposes a heavier burden on small- and medium-size firms. This calls for improved information and training for small- and medium-size firms on how to use IPRs effectively. Another step in the right direction would be to consider making the cost of applying for, and of renewing, statutory IP instruments (first of all patents) eligible for tax credits or subsidies for small- and medium-size firms. A further study should determine whether these firms would likely benefit from the introduction of a specialized court for hearing IP-related cases.

To conclude, even though IP protection is far from being a perfect means for appropriating the benefits from innovation and new technology, its importance, especially for the most original innovations, is well documented. To innovate successfully, firms must not only learn how to conduct R&D to absorb, create and adapt new knowledge, how to find and process market information, and how to collaborate. They must also learn to use IPRs effectively and combine them with other appropriation strategies. Further research is needed to evaluate the use and efficiency of these other strategies and compare them with statutory IPRs.

APPENDIX A

TABLE A-1

CONVERSION FROM THE NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM (NAICS) TO ROBSON, TOWNSEND AND PAVITT'S TECHNOLOGY SECTORS

OTHER SECTOR	CORE SECTOR	SECONDARY SECTOR
311 Food	324 Refined Petroleum	326 Plastics-Rubber
312 Beverages-Tobacco	3251 Chemicals	327 Non-metallic
313 Primary Textiles	3252 Chemicals	331 Primary Metals
314 Textiles	3253 Chemicals	332 Fabricated Metals
315 Clothing	3254 Chemicals	3335 Fabricated Metals
316 Leather	3255 Chemicals	3361 Transportation
3211 Wood	3256 Chemicals	3362 Transportation
3212 Wood	3259 Chemicals	3363 Transportation
3219 Wood	3331 Machinery	3364 Transportation
322 Paper	3332 Machinery	3365 Transportation
323 Printing	3333 Electrical	3366 Transportation
337 Furniture	3334 Machinery	3369 Transportation
339 Other Manufacturing	3339 Machinery	
3346 Other Manufacturing	3341 Electrical	
	3342 Electrical	
	3343 Electrical	
	3344 Electrical	
	3345 Scientific Instruments	
	335 Electrical	

Source: Author's conversion.

APPENDIX B

TABLE B-1					
USE OF IPRs BY INNOVATION STATUS AND BY FIRM EMPLOYMENT SIZE (PERCENTAGE OF FIRMS)					
SHARE OF TOTAL (%)	NUMBER OF EMPLOYEES				ALL
	20-49	50-99	100-499	500+	
Innovators	75.2	80.6	84.9	87.1	
Unsuccessful	7.9	7.0	6.6	7.4	
Not Involved	16.9	12.5	8.5	5.5	
Total	100.0	100.0	100.0	100.0	
All	30.2	31.9	32.4	5.5	100
IPRs/INNOVATION STATUS					
Patent					
Innovators	21.2	25.7	36.8	50.6	29.6
Unsuccessful	11.0	12.9	17.2	22.9	14.1
Not Involved	8.0	8.8	8.4	4.0	8.3
All	18.2	22.7	33.1	46.0	25.9
Trade-mark					
Innovators	32.8	35.5	47.8	52.4	39.8
Unsuccessful	24.8	23.4	24.5	43.6	25.3
Not Involved	17.8	14.6	28.7	16.6	19.1
All	29.6	32.0	44.4	49.8	36.3
Copyright					
Innovators	9.9	11.4	17.1	24.2	13.7
Unsuccessful	2.9	5.5	7.7	25.6	6.4
Not Involved	5.8	2.0	5.6	4.0	4.5
All	8.6	9.9	15.5	23.2	12.0
Trade Secret					
Innovators	25.2	26.5	31.2	39.8	28.2
Unsuccessful	12.0	16.5	11.1	34.2	14.4
Not Involved	9.0	5.0	8.5	3.9	7.5
All	21.4	23.1	27.9	37.4	24.9
Confidentiality					
Innovators	39.5	44.3	58.3	67.0	49.0
Unsuccessful	30.6	27.8	32.8	69.6	32.6
Not Involved	17.8	12.5	22.8	7.9	16.9
All	35.1	39.2	53.6	64.0	43.9
Other					
Innovators	2.5	3.1	2.4	4.1	2.8
Unsuccessful	2.5	2.0	1.2	0.0	1.8
Not Involved	2.7	1.5	2.9	0.0	2.3
All	2.5	2.8	2.3	3.6	2.6
At Least One					
Innovators	65.2	69.2	80.4	87.3	72.9
Unsuccessful	48.7	43.2	53.2	74.0	49.7
Not Involved	34.2	31.3	47.1	24.6	35.9
All	58.7	62.7	75.7	82.9	66.8
Source: Statistics Canada 1999 Survey of Innovation.					

TABLE B-2**USE OF IPRs BY INNOVATION STATUS AND BY SECTOR
(PERCENTAGE OF MANUFACTURING FIRMS)**

SHARE OF TOTAL (%)	SECTOR			
	CORE	SECONDARY	OTHER	ALL
Innovators	88.2	78.2	79.1	
Unsuccessful	5.0	8.0	7.6	
Not Involved	6.8	14.0	13.3	
Total	100.0	100.0	100.0	
All	21.0	31.3	47.7	100.0
IPRs/INNOVATION STATUS				
Patent				
Innovators	47.0	32.6	19.2	29.6
Unsuccessful	29.2	13.9	9.9	14.1
Not Involved	13.6	9.6	6.1	8.3
All	43.9	27.9	16.8	25.9
Trade-mark				
Innovators	47.0	32.1	41.3	39.8
Unsuccessful	30.0	19.1	28.3	25.3
Not Involved	15.8	14.9	22.8	19.1
All	44.1	28.6	37.8	36.3
Copyright				
Innovators	18.6	11.7	12.5	13.7
Unsuccessful	14.9	4.3	5.4	6.4
Not Involved	2.9	5.1	4.5	4.5
All	17.3	10.2	10.9	12.0
Trade Secret				
Innovators	34.5	29.2	25.1	28.2
Unsuccessful	26.6	12.6	12.0	14.4
Not Involved	7.8	9.8	5.8	7.5
All	32.3	25.1	21.5	24.9
Confidentiality				
Innovators	63.9	52.4	40.2	49.0
Unsuccessful	44.4	33.0	28.9	32.6
Not Involved	28.4	19.4	12.5	16.9
All	60.5	45.4	35.7	43.9
Other				
Innovators	2.7	3.5	2.3	2.8
Unsuccessful	6.9	1.5	0.6	1.8
Not Involved	3.0	2.2	2.3	2.3
All	2.9	3.1	2.1	2.6
At Least One				
Innovators	83.8	74.5	66.6	72.9
Unsuccessful	68.3	46.2	46.8	49.7
Not Involved	43.4	33.7	35.8	35.9
All	80.3	66.5	61.0	66.8

Source: Author's tabulation based on Statistics Canada 1999 Survey of Innovation.

TABLE B-3

**USE OF IPRs BY ORIGINALITY OF INNOVATION AND BY FIRM EMPLOYMENT SIZE
(PERCENTAGE OF FIRMS THAT INTRODUCED A WORLD-FIRST, CANADA-FIRST OR
FIRM-FIRST INNOVATION IN A GIVEN SIZE CATEGORY)**

SHARE OF INNOVATING FIRMS (%)	NUMBER OF EMPLOYEES			
	20-49	50-99	100-499	500+
World-first	7.7	10.0	13.1	19.7
Canada-first	14.1	17.5	21.5	22.9
Firm-first	45.9	45.32	41.3	34.8
Not Reported	32.3	27.1	24.2	22.6
Total	100.0	100.0	100.0	100.0
All	30.2	31.9	32.4	5.5
IPRs/ORIGINALITY OF INNOVATION				
Patent				
World-first	54.9	54.5	67.3	81.5
Canada-first	33.9	38.2	44.8	47.8
Firm-first	14.7	18.1	26.2	43.3
Trade-mark				
World-first	52.8	55.5	60.0	65.6
Canada-first	43.8	43.8	54.8	54.6
Firm-first	26.6	29.7	40.4	45.2
Copyright				
World-first	24.5	25.8	24.4	42.7
Canada-first	18.7	15.6	19.8	25.1
Firm-first	6.3	8.5	13.0	16.9
Trade Secret				
World-first	29.3	49.2	46.8	48.9
Canada-first	38.6	37.1	35.8	45.8
Firm-first	25.1	19.7	24.5	30.2
Confidentiality				
World-first	49.3	77.1	74.9	88.6
Canada-first	51.9	56.6	66.3	64.1
Firm-first	35.3	38.8	51.8	57.5
At Least One				
World-first	85.1	94.1	95.0	100.0
Canada-first	81.7	79.8	87.2	89.7
Firm-first	60.1	63.9	74.1	82.6
Source: Author's tabulation based on Statistics Canada 1999 Survey of Innovation.				

TABLE B-4

METHODS USED TO PROTECT INTELLECTUAL PROPERTY, BY INDUSTRY, 1997-99
(PERCENTAGE OF INNOVATING FIRMS)

INDUSTRIES	FIRMS THAT PROTECTED INTELLECTUAL PROPERTY (%)	OF THESE, PERCENTAGE THAT USED					
		PATENT	TRADE- MARK	COPYRIGHT	CONFIDENT. AGREEMENT	TRADE SECRET	OTHER
Total, Manufacturing Industries	72.9	40.3	54.8	18.8	66.7	39.1	3.7
Food Manufacturing	78.4	21.7	73.3	17.7	69.6	45.6	2.7
Beverages and Tobacco Products Manufacturing	87.8	36.3	86.3	35.2	77.3	55.8	3.4
Textile Mills and Textile Products Mills	68.4	35.0	65.3	21.6	52.4	40.5	2.3
Clothing Manufacturing	71.7	12.1	83.2	10.4	35.6	27.2	1.3
Leather and Allied Products Manufacturing	81.4	24.0	64.6	10.3	21.8	39.5	0.0
Sawmills and Wood Preservation; Veneer, Plywood and Engineered Wood Products Manufacturing; and Other Wood Products Manufacturing	46.2	22.9	43.8	6.2	55.0	32.6	6.1
Paper Manufacturing	67.4	35.1	42.9	12.4	76.1	34.1	2.1
Printing and Related Support Activities	60.6	21.5	39.2	28.6	70.0	33.4	4.4
Petroleum and Coal Products Manufacturing	92.7	31.6	57.9	13.2	71.1	57.9	5.3
Chemicals Manufacturing (excluding 3254)	87.1	47.9	67.4	18.9	80.9	55.0	2.4
Pharmaceuticals and Medicines Manufacturing (3254)	94.2	59.4	74.9	29.5	96.0	55.7	0.0
Plastics and Rubber Products Manufacturing	82.1	51.4	51.8	13.9	67.7	41.5	3.9
Non-metallic Mineral Products Manufacturing	68.7	48.5	51.3	17.3	58.0	45.3	8.9
Primary Metals Manufacturing	66.3	33.7	23.8	13.6	74.6	54.1	0.9
Fabricated Metal Products Manufacturing	70.9	37.4	41.3	13.6	68.0	32.9	4.4

METHODS USED TO PROTECT INTELLECTUAL PROPERTY, BY INDUSTRY, 1997-99
(PERCENTAGE OF INNOVATING FIRMS)

Source: Preliminary results of the Statistics Canada 1999 Survey of Innovation.

TABLE B-5

USE OF IPRs BY ORIGINALITY OF INNOVATION AND BY SECTOR
(PERCENTAGE OF FIRMS THAT INTRODUCED A WORLD-FIRST, CANADA-FIRST OR FIRM-FIRST INNOVATION
IN A GIVEN SECTOR)

IPRs/ORIGINALITY OF INNOVATION	SECTOR		
	CORE	SECONDARY	OTHER
Patent			
World-first	73.2	61.7	51.6
Canada-first	54.9	43.7	29.4
Firm-first	37.9	23.8	12.4
Trade-mark			
World-first	58.9	50.3	63.7
Canada-first	58.6	35.7	53.6
Firm-first	38.9	26.2	34.7
Copyright			
World-first	29.2	25.9	24.6
Canada-first	23.9	14.0	19.0
Firm-first	11.7	7.6	10.1
Trade Secret			
World-first	48.1	45.3	39.2
Canada-first	43.4	36.9	34.4
Firm-first	26.7	24.5	21.2
Confidentiality			
World-first	75.9	72.8	67.0
Canada-first	73.6	60.0	51.7
Firm-first	57.0	46.2	35.2
At Least One			
World-first	94.1	97.8	88.5
Canada-first	90.1	83.7	80.2
Firm-first	78.3	69.3	60.9
Source: Author's tabulation based on Statistics Canada 1999 Survey of Innovation.			

TABLE B-6							
PATENT APPLICATIONS IN CANADA AND THE UNITED STATES, 1997-99, INNOVATIVE MANUFACTURING FIRMS							
	APPLIED FOR AT LEAST ONE PATENT	OF THESE, PERCENTAGE THAT APPLIED FOR PATENT IN:					
		CANADA	UNITED STATES	BOTH CANADA AND UNITED STATES	CANADA ONLY	UNITED STATES ONLY	NEITHER CANADA NOR UNITED STATES
				(%)			
Total, Manufacturing Industries	22.4	85.2	75.4	65.8	19.5	9.6	5.1
Food Manufacturing	10.5	80.9	63.6	50.5	30.4	13.2	6.0
Beverages and Tobacco Products Manufacturing	23.8	100.0	41.9	41.9	58.1	0.0	0.0
Textile Mills and Textile Products Mills	20.7	91.8	79.9	71.7	20.2	8.2	0.0
Clothing Manufacturing	3.9	100.0	67.9	67.9	32.1	0.0	0.0
Leather and Allied Products Manufacturing	16.2	88.9	77.8	66.7	22.2	11.1	0.0
Sawmills and Wood Preservation; Veneer, Plywood and Engineered Wood Products Manufacturing; and Other Wood Products Manufacturing	6.8	91.9	67.3	61.8	30.1	5.5	2.6
Paper Manufacturing; Printing and Related Support Activities; Petroleum and Coal Products Manufacturing	19.2	76.4	64.8	55.1	21.4	9.7	13.8
Chemicals Manufacturing (excluding 3254)	29.4	77.3	71.1	62.0	15.3	9.0	13.6
Pharmaceuticals and Medicines Manufacturing (3254)	30.0	93.8	67.2	61.0	32.8	6.2	0.0
Plastics and Rubber Products Manufacturing	30.6	86.4	81.1	73.5	12.8	7.5	6.1
Non-metallic Mineral Products Manufacturing	20.8	80.0	78.7	67.9	12.1	10.8	9.2
Primary Metals Manufacturing	17.3	100.0	74.9	74.9	25.1	0.0	0.0
Fabricated Metal Products Manufacturing	20.8	80.0	72.6	57.3	22.7	15.3	4.7
Agricultural, Construction, Mining, and Industrial Machinery Manufacturing (3331 and 3332)	54.1	94.1	81.3	75.4	18.7	5.9	0.0

TABLE B-6 (CONT'D)

PATENT APPLICATIONS IN CANADA AND THE UNITED STATES, 1997-99, INNOVATIVE MANUFACTURING FIRMS

	APPLIED FOR AT LEAST ONE PATENT	OF THESE, PERCENTAGE THAT APPLIED FOR PATENT IN:					
		CANADA	UNITED STATES	BOTH CANADA AND UNITED STATES	CANADA ONLY	UNITED STATES ONLY	NEITHER CANADA NOR UNITED STATES
				%			
Machinery Manufacturing (excluding 3331 and 3332)	33.8	82.8	84.6	73.0	9.8	11.6	5.6
Computer and Peripheral Equipment Manufacturing	36.2	67.9	65.2	46.0	21.9	19.3	12.8
Communications Equipment Manufacturing	48.2	96.6	81.7	78.3	18.3	3.4	0.0
Audio and Video Equipment Manufacturing	40.0	100.0	100.0	100.0	0.0	0.0	0.0
Semiconductor and Other Electronic Equipment Manufacturing	40.9	89.5	88.8	78.3	11.2	10.5	0.0
Navigational, Measuring, Medical and Control Instruments Manufacturing, and Magnetic and Optical Media Manufacturing and Reproducing	39.3	75.6	88.6	68.8	6.8	19.8	4.6
Electrical Equipment, Appliances and Components Manufacturing	40.6	91.4	73.3	68.6	22.8	4.7	3.9
Motor Vehicles Manufacturing, Motor Vehicle Body and Trailer Manufacturing, and Motor Vehicle Parts Manufacturing	34.5	84.4	77.9	70.2	14.3	7.7	7.8
Aerospace Products and Parts Manufacturing	20.1	73.6	82.0	64.0	9.6	18.0	8.4
Railroad Rolling Stock Manufacturing, Ship and Boat Building, and Other Transportation Equipment	20.8		80.4		19.6		0.0
Furniture and Related Products Manufacturing	20.7	84.9	52.7	44.1	40.8	8.6	6.5
Miscellaneous Manufacturing	28.4	95.7	80.2	75.9	19.8	4.3	0.0

Source: Preliminary results of the Statistics Canada 1999 Survey of Innovation, question 26.2.

TABLE B-7a						
RELATIONSHIP BETWEEN THE USE OF IPRs AND PROFITABILITY DUE TO INNOVATION (QUESTION 13b)						
SECTOR						
	CORE	SECONDARY	OTHER		ALL	
IPRs	Chi2	Chi2	Chi2	Chi2	Phi	z
Patent	6.13a	13.73a	0.82	22.27a	0.069	-4.72a
Trade-mark	20.93a	9.49a	5.19b	28.21a	0.077	-5.31a
Copyright	3.15	21.80a	0.01	12.56a	0.052	-3.54a
Trade Secret	0.13	0.73	11.45a	7.79a	0.041	-2.79a
Confidentiality	4.15c	17.50a	13.21a	19.04a	0.065	-4.36a
TABLE B-7b						
RELATIONSHIP BETWEEN THE USE OF IPRs AND THE MAINTENANCE OF THE PROFIT MARGIN DUE TO INNOVATION (QUESTION 13g)						
SECTOR						
	CORE	SECONDARY	OTHER		ALL	
IPRs	Chi2	Chi2	Chi2	Chi2	Phi	z
Patent	26.51a	10.01a	4.78c	41.61a	0.094	-6.45a
Trade-mark	9.40a	21.52a	6.58b	32.97a	0.084	-5.74a
Copyright	1.23	12.09a	0.29	9.99a	0.044	-3.16a
Trade Secret	3.62	8.11a	16.50a	21.81a	0.063	-4.67a
Confidentiality	2.16	8.61a	4.28c	17.83a	0.061	-4.22a
Significance Levels	1%	5%	10%			
Symbol	a	b	c			
Critical Values						
Chi2 (one degree of freedom)	6.63	5.02	3.84			
z (1 tail)	2.60	1.95	1.60			
Note: Wherever significant, the chi-square tests rejected the hypothesis of independence between the use of a particular IPR and an innovation's contribution to a firm's profitability. Due to the layout of underlying contingency tables, the negative value for z indicates the α rejection region according to the alternative hypothesis that the use of IPRs is associated positively with the contribution of innovation to the maintenance or increase in the firm's profitability.						

ENDNOTES

- 1 See *Oslo Manual* (OECD, 1989). For a review of a series of 12 European studies of innovation policy and practice, see European Commission, 2001.
- 2 The report surveyed a sample of 900 firms, broken down into four groups: Top R&D performers (100); High-technology firms (300); Medium- and low-technology firms (400); and Major copyright users (100).

- 3 Smaller firms with sales of less than \$5 million used IPRs less than larger firms and were less satisfied with Canadian IPRs.
- 4 These responses have to be considered in a proper perspective. Amendments to the *Copyright Act* introduced in June 1988 extended copyright protection to computer programs, strengthened the right of artists to control who uses their works, and improved the systems used to collect copyright fees. The new Act also increased penalties for infringement of copyright up to a maximum of \$1 million, with prison terms ranging from six months to five years. The Canadian *Patent Act* also underwent significant changes in 1989 (for details, see the study by Gallini, Putnam and Tepperman in this series). Thus, the dissatisfaction and criticism that Canadian IPRs did not provide sufficient protection and had not kept pace with technological developments may not be valid anymore.
- 5 Baldwin's study is based on the Statistics Canada 1993 Survey of Innovation and Advanced Technology, which surveyed both small and large manufacturing firms. One of the particularities of the survey is that, in the case of larger firms, different sections of the questionnaire were addressed to persons in the firm most likely to be intimately involved with the subject at hand. Thus, questions about IPRs were answered by the person in charge of IP protection in the firm. These and other methodological differences make it difficult to compare the results of this survey with the most recent Statistics Canada Survey of Innovation (1999). For more details regarding the differences between the two surveys, see the methodological discussion at the beginning of the section dealing with the results of Statistics Canada's innovation surveys.
- 6 See the classification of industries into three technology sectors — core, secondary and other — in Appendix A.
- 7 Note that firms may not have confidence in the effectiveness of patents (or other IPRs) to protect their inventions from imitation and use them anyway for other strategic reasons (Cohen, Nelson and Walsh, 2000), such as to signal their technological prowess on the stock market (Hall, 1998) or on the labour market in order to attract highly qualified manpower, etc.).
- 8 The questionnaire did not include such statutory IPRs as industrial designs, integrated circuit designs and plant breeder's rights. Widely used strategies other than statutory IPRs, such as being first on the market or the complexity of product design, were not available options in the questionnaire either.
- 9 Firms that innovated successfully are called "innovators" according to the Oslo definition (OECD, 1989). Note that firms that did not complete their innovation in the 1997-99 period but might have completed it successfully later are classified as unsuccessful innovators in the 1999 survey. The survey does not allow to distinguish cases of incomplete innovations from those that failed for technical or commercial reasons (Therrien, 2000).
- 10 For example, the definition used in the Statistics Canada 1999 Survey of Innovation was:

(1) A new product (good or service) is a product which is new to your firm whose characteristics or intended uses differ significantly from those of your firm previously produced products. A significantly improved product (good or service) is an existing product whose performance has been significantly enhanced or upgraded. A complex

product which consists of a number of components or integrated subsystems may be improved by partial changes to one of the components or subsystems. Changes to your firm's existing products which are purely aesthetic or which involve minor modifications are not to be included.

During the last three years, 1997 to 1999, did your firm offer new or significantly improved products (goods and services) to your clients?

(2) New production/manufacturing processes are processes which are new to your firm. They involve the introduction into your firm of new production/manufacturing methods, procedures, systems, machinery or equipment which differ significantly from your firm's previous production/manufacturing processes. Significantly improved production/manufacturing processes involve significant changes to your existing processes which may be intended to produce new or significantly improved products (goods or services) or production/manufacturing processes. Minor or routine changes to processes are not to be included.

During the last three years, 1997 to 1999, did your firm introduce new or significantly improved production/manufacturing processes?

- 11 Owing to methodological differences, a strict comparison of the results of the 1999 and 1993 surveys is not possible. In the 1999 survey, the sample unit was the provincial enterprise. The latter was defined as being the accumulation of all establishments having the same industry and province codes. Thus, if a business operated in the same industry in three provinces, it received three questionnaires. Only firms with at least 20 employees and a gross business income over \$250,000 were selected. The questionnaire was sent to and filled by the CEO or a person designated by the CEO as the respondent. The survey was applied to a sample of 5,220 manufacturing firms and included special sections for firms producing building and construction products and selected natural resource products. The response rate exceeded 90 percent.

There are reasons to believe that the survey might have overestimated the percentage of firms that perform R&D and the percentage of firms that innovate. According to an article by Hamdani (2000), the choice of the reporting unit, the questionnaire design and the lack of definition of R&D in the 1999 survey explain a significant overestimation of the percentage of firms performing R&D. Even though the article does not explicitly deal with the possible overestimation of the percentage of firms that innovate, the choice of the reporting unit is most likely also responsible for an upward bias in the estimation of the percentage of firms that innovated.

In contrast, the 1993 survey was sampled (sample size of 5,729) so as to be representative of manufacturing firms of all sizes. It contained a sample of small firms not included in the Business Register as well as larger firms (sample of 1,595 head offices) included in the Business Register. The majority of small firms employed less than 20 persons. Small firms were separated into two sample groups, each received the general section and one of the two separate parts of the short version of the questionnaire. The group of interest to our purpose here (sample of 1,088 small firms) answered section (1) general; (3) innovation; and (4) intellectual property. Before sending the long version of the complete questionnaire to the head office of the sampled large firms, these firms were contacted to determine

who was best qualified to reply to each section of the questionnaire. The IP protection section of the questionnaire was addressed to the division or individual responsible for IP protection, the R&D and innovation section was sent to the R&D manager or product manager, and the general section was sent to the head office. The sample is representative of Canadian manufacturing firms. The overall response rate was 85.5 percent.

To summarize, the principal difference between the two surveys is that the 1999 survey represents large manufacturing "provincial enterprises," while the 1993 survey represents both small and large manufacturing firms.

- 12 Patents are often used by competitors to obtain valuable technical information. For example, 38 percent of top R&D performers reported to use patents "quite a bit" to obtain information (Industry, Science and Technology Canada, 1989).
- 13 Note that the wording of the question relative to the use of IPRs does not necessarily imply that the firm used a particular IPR to protect its most important innovation classified in one of the three "originality" classes. The likelihood that the response concerns that particular innovation is, however, very strong for the world-first innovations. In the case of a Canada-first or even more so a firm-first innovation, the interpretation of the response that a firm used patents to protect its IP may be less directly related to its most important innovation.
- 14 See the description of the taxonomy in the Introduction and the classification of industries by technological sector in Appendix A.
- 15 This is one of several limitations on the effectiveness of patent protection listed in Levin et al. (1987) which seems particularly relevant to this particular industry.
- 16 Patents in the computer industry were considered effective for 41 percent of product innovations and 33 percent of process innovations, compared to respectively 61 percent and 40 percent of innovations that considered *lead time* as providing effective protection.
- 17 Note that firms can carry out R&D themselves in a separate R&D department or in other departments and they can also contract it out to other firms.
- 18 The chi-square tests reject the hypothesis of independence between R&D collaboration with universities and use of all IPRs beyond the 0.001 level of significance. Firms that collaborate to R&D with universities are almost twice as likely to use patents as those that do not collaborate.
The relationship is strongest for the use of patents. This is true for firms of all sizes and all three technology sectors. The contingency tables are not presented here but they are available on request.
- 19 R&D is only one of the innovation inputs and the cost of R&D represents less than half of the total innovation cost in Canada. Basic and applied research accounted for only 17 percent and development expenditures (defined more liberally than in official R&D statistics) for 30 percent of total innovation cost in the 1989-91 period. Recent statistics on the share of officially defined R&D costs in Canada are not available. If European Union data may serve as a reference, the officially defined R&D expenditures in that region range from 25 percent of total innovation expenditures for electrical products to just 10 percent for the pulp and paper industry, according to the European Commission (2001).

- 20 The number of respondents that have indicated that they applied for a patent in the 1997-99 period was smaller than the number of respondents that indicated in their answer to the previous question that they used patents to protect their IP during the same period. The correlation of the two responses was not particularly strong ($r=0.76$). It suggests that the respondents gave an approximate answer to the more general first question that asked them to enumerate the various means used by their firm to protect its IP. The response could, in the case of patents, include patents licensed from suppliers of technology. In this case the firm did not apply for the patent and would respond “no” to the second question asking specifically whether the firm applied for a patent in Canada, in the United States or elsewhere in the 1997-99 period. This explains at least part of the difference between the response rates to the two questions, their loose wording being probably responsible for the rest.
- 21 The lack of information on the country of ownership makes it impossible to determine to what extent firms that patented in the United States only were affiliates of U.S. companies.
- 22 On an industry-by-industry basis the percentages in the five columns vary, even though they are closely correlated ($r=0.98$). Since variations tend to almost cancel out for the total manufacturing sector, the figures shown in the two lines are remarkably similar.
- 23 The z test shows that the positive relationship between the use of IPRs and increased profitability is significant well beyond the 1 percent level. Values of the ϕ statistic range between 4 and 9 percent (ϕ can be interpreted as a correlation coefficient ($\phi=0$: no relationship; $\phi=1$: perfect correlation)).
- 24 Introduction of an innovation involves various activities including often, but not always, R&D. Therefore, the variable of interest here is the return on investment in innovation activity rather than the return on investment in R&D.
- 25 The recent research as reviewed by Cohen and Levinthal (1989) tends to regard the failure of the empirical literature to obtain robust results on how innovation is related to firm size and market structure as an indication that these relationships are more complex than previously believed. More elaborate modelling of technological change (Levin and Reiss, 1984; Levin and Reiss, 1988) suggests that innovation, firm size and market structure are mutually dependent variables.
- 26 Agree or strongly agree with the statement:
Q1b: My clients can easily substitute my products (goods and services) for the products of my competitors.
Q1d: The arrival of new competitors is a constant threat.
Q1e: The arrival of competing products (goods and services) is a constant threat.
Q1i: My products (goods and services) quickly become obsolete.
- 27 We tried to reduce the scores on 11 competitive environment related questions to a smaller number of factors by a principal component analysis. Since the results of this more complex approach are less transparent and statistically not better than the ones reported above, we abandoned the principal component approach.
- 28 Respondents rated the importance of Q2a: “Seeking new markets;” and Q2c: “Developing niche or specialized markets”.

- 29 The concept of technological opportunity goes back at least to Scherer (1965). Levin et al. (1987) measure the extent to which an industry relies on science-based research. Baldwin, Hanel and Sabourin (2000) measure technological opportunity for an industry by the percentage of R&D performers within the industry that have collaborative agreements with universities, colleges or external R&D institutions. This variable proved to be a statistically significant determinant of innovation.
- 30 See Lundvall (1992), Nelson (1993), Niosi (2000), and De la Mothe and Paquet (1998).
- 31 The variables labelled “left out” in Table 11.
- 32 Thus, in the case of the introduction of a world-first innovation, $I_{w-1st} = 1$ and all other outcomes that include less original innovations (Canada-first and firm-first), unsuccessful innovation and not being involved in innovation obtain $I_{w-1st} = 0$.
- 33 The question on the use of IPRs was quite general. It did not ask respondents to report IPRs used to protect their most important innovation. Information solicited on the most important innovation included questions regarding the novelty and the type of innovation.
- 34 An attempt to estimate a more complex model involving three or more equations with three or more interdependent endogenous variables did not work. Obviously, we have to heed Griliches’ warning of moderation of our demands on data — our desires have to be kept within the bounds of our means.

ACKNOWLEDGMENTS

SINCERE THANKS FOR ACCESS to and help with the data are expressed to: F. Gault, F. Anderson, S. Schaan and B. Nemes, of Statistics Canada, and P. Therrien of Industry Canada. My students M. St-Pierre and C. Trudeau helped me with the computer work. I also acknowledge receiving helpful comments from the editor of this project, J. Putnam. I am solely responsible for the opinions and remaining errors.

BIBLIOGRAPHY

- Baldwin, John. 1997. *Innovation and Intellectual Property*. Ottawa: Statistics Canada, Cat. No. 88-515-XPE.
- Baldwin, John, Petr Hanel and David Sabourin. 2000. *Determinants of Innovative Activity in Canadian Manufacturing Firms*. Ottawa: Statistics Canada, Cat. No. 11F0019MIF 2000122.

- Baldwin, John, and Petr Hanel. 2003. *Innovation and Knowledge Creation in an Open Economy: Canadian Industry and International Implications*, Cambridge (MA): Cambridge University Press.
- Cohen, Wesley M., and Daniel A. Levinthal. 1989. "Innovation and Learning: Two Faces of R&D." *The Economic Journal* 99: 569-596.
- Cohen, Wesley M., and Steven Klepper. 1996. "A Reprise of Size and R&D." *The Economic Journal* 106: 925-951.
- Cohen, Wesley M., Richard R. Nelson and John P. Walsh. 2000. *Protecting their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)*. NBER Working Paper No. 7552 (February).
- Dasgupta, Partha, and Josef Stiglitz. 1980. "Industrial Structure and the Nature of Innovative Activity." *The Economic Journal* 90 (June): 266-293.
- De la Mothe, John, and Gilles Paquet. 1998. *Local and Regional Systems of Innovation*, Boston: Kluwer Academic Publishers.
- De Melto, Denis P., Kathryn E. McMullen and Robert M. Wills. 1980. *Preliminary Report: Innovation and Technological Change in Five Canadian Industries*. Discussion Paper No. 176. Ottawa: Economic Council of Canada.
- European Commission. 2001. *Building an Innovative Economy in Europe: A Review of 12 Studies of Innovation Policy and Practice in Today's Europe*. Luxembourg: European Commission.
- Friedman, David D., William M. Landes and Richard A. Posner. 1991. "Some Economics of Trade Secret Law." *Journal of Economic Perspectives* 5, 1.
- Hall, Bronwyn H. 1998. *Innovation and Market Value*. Paper prepared for the NIESR Conference on Productivity and Competitiveness, London.
- Hamdani, Daood. 2000. "Why do the Surveys on Innovation and R&D Diverge." *Statistics Canada Innovation Analysis Bulletin* 2, 3 (September).
- Industry, Science and Technology Canada. 1989. *Appendices for the Survey of Intellectual Property Rights in Canada, Final Report*. Ottawa: Industry, Science and Technology Canada.
- Levin, Richard C., Alvin K. Klevorick, Richard R. Nelson and Sidney G. Winter. 1987. "Appropriating the Returns from Industrial Research and Development." *Brookings Papers on Economic Activity* 3: 783-831.
- Levin, Richard C., and Petr C. Reiss. 1984. "Tests of a Schumpeterian Model of R&D and Market Structure." In *R&D, Patents and Productivity*. Svi Griliches (ed.). Chicago: The University of Chicago Press.
- . 1988. "Cost-reducing and Demand Creating R&D Spillovers." *RAND Journal of Economics* 19, 4: 538-556.
- . 1989. *Cost-reducing and Demand Creating R&D with Spillovers*. NBER Working Paper No. 2876.
- Lundvall, Bengt A. (ed.). 1992. *National Systems of Innovation*. London: Pinter.
- Maddala, G.S. 1983. *Limited-dependent and Qualitative Variables in Econometrics*, Cambridge, London (N.Y.): Cambridge University Press.
- Murphy, Kevin M., and Robert H. Topel. 1985. "Estimation and Inference in Two-Step Econometric Models." *Journal of Business and Economic Statistics* 3, 4 (October): 370-379.

- Nelson, Richard. R. (ed.). 1993. *National Innovation Systems: A Comparative Analysis*, New York : Oxford University Press.
- Niosi, Jorge. 2000. *Canada's National System of Innovation*, Montreal: McGill-Queen's University Press.
- OECD. 1989. *Proposed Guidelines for Collecting and Interpreting Technological Innovation Data, Oslo Manual*. Paris: Organisation for Economic Co-operation and Development / GD, 92, 26.
- Rafiqzaman, Mohammed, and Lori Whewell. 1998. *Recent Jump in Patenting Activities: Comparative Innovative Performance of Major Industrial Countries, Patterns and Explanations*. Working Paper No. 27. Ottawa: Industry Canada, Micro-Economic Policy Analysis Branch.
- Robson, M., J. Townsend and K. Pavitt. 1988. "Sectoral Patterns of Production and Use of Innovations in the UK: 1945-83." *Research Policy* 17: 1-14.
- Scherer, Frederic M. 1965. "Corporative Inventive Output, Profits, and Growth." *Journal of Political Economy*, 290-297.
- Therrien, Pierre. 2000. "What Distinguishes Innovative Firms from Other Firms: Results from the 1999 Innovation Survey." Ottawa: Industry Canada, Market Place Innovation. Mimeo.
- Trajtenberg, Manuel. 2000. *Is Canada Missing the Technological Boat? Evidence from the Patent Data*. Discussion Paper No. 9. Ottawa: Industry Canada.
- Warda, Jacek. 1997. *R&D Tax Treatment in Canada: A Provincial Comparison*. Ottawa: Conference Board of Canada.

OTHER REFERENCES

- Amesse, Fernand, Claude Desranleau, Hamid Etemad, Yves Fortier and Louise Seguin-Dulude. 1991. "The Individual Inventor and the Role of Entrepreneurship: A Survey of the Canadian Evidence." *Research Policy* 20, 1: 13-27.
- Pazderka, Bohumir. 1999. "Patent Protection and Pharmaceutical R&D Spending in Canada." *Policy Options* 25, 1: 29-46.
- Rafiqzaman, Mohammed. 1999. "The Importance of the Intellectual Property Rights System to Economic Performance: A Study of the Canadian Experience." Ottawa, Industry Canada, Micro-economic Policy Analysis Branch. Mimeo.



Patent Policy and the Diffusion of Pharmaceutical Innovation

INTRODUCTION

THE OBJECTIVE STIPULATED FOR THIS STUDY is to examine how Canada's intellectual property system encourages the diffusion of innovation. It was made clear that our analysis should have a practical policy orientation, in the sense of focusing on selected aspects of the intellectual property system. One criterion for the selection of these aspects is whether Canada has the ability to exercise discretion within its international obligations, and another is whether the issue is currently on the policy agenda. We were also asked to review various measures of innovation diffusion and their effectiveness. To make the discussion more specific, we agreed to focus on the pharmaceutical industry.

We paid close attention to the terms of reference for the other studies to be presented at the conference and made a conscious effort to avoid unnecessary duplication. This constraint, together with space limitations, makes our discussion of some topics necessarily brief.

The study is organized as follows: The second section, entitled *Diffusion of Innovation*, provides definitions, gives a brief background on the various theories of innovation diffusion, and reviews the evidence on diffusion of innovation in the international pharmaceutical industry.

In the third section, entitled *Measures of Diffusion*, we discuss three ways of measuring diffusion: Measures of adoption of innovative products and processes; measures of flows of technological information; and other indicators of diffusion.

The fourth section, entitled *Government Policies Affecting Diffusion*, gives an overview of a variety of government policies affecting innovation diffusion. The topics discussed include the role of regulatory standards for drug approval,

the impact of price control schemes, and changes in the drug distribution networks. Special attention is paid to the contribution of publicly funded research, and the role of patents in the diffusion process.

The fifth section, entitled *Implications of Patent Theory for Canada's Patent and Diffusion Policy* adopts and develops a theoretical framework distinguishing four economic functions of patents. This framework is then applied to a critical analysis of selected aspects of the current Canadian patent system and its impact on the diffusion of pharmaceutical innovation in Canada.

In the sixth section, entitled *Possible Changes in Patent Policy and their Impact on the Diffusion of Innovation*, we consider a number of possible changes in Canadian patent law, and attempt to assess their potential impact on the diffusion of innovation. Among such changes are earlier and fuller disclosure of patent applications, reducing the length of the deferment period, new provisions for pre- and post-grant opposition, as well as patent term restoration.

The last section contains a summary and brief conclusions.

DIFFUSION OF INNOVATION

DEFINITIONS

INNOVATION IN A DICTIONARY DEFINITION is the act of introducing something new; innovation in an economic sense is "the first commercial transaction involving the new product, process, system, or device" (Freeman, 1982, p. 7). Innovation is distinguished from invention, which is a new product, process, system, or device as yet untested in the marketplace. Diffusion of innovation is conventionally defined as the way in which innovations spread throughout an economy. According to a *strict* definition found in the literature (Lissoni and Metcalfe, 1994, pp. 106-107), the diffusion of process innovation occurs when new technology embodied in a specific capital good is adopted by other firms. The diffusion of product innovation is defined analogously, except that the potential buyers are households. Diffusion occurs whether buyers acquire the new technology or products from the original innovator, from licensees, or from other producers who copy the innovation. The pattern and speed of innovation diffusion depends, among other things, on intellectual property arrangements.

Lissoni and Metcalfe consider the strict definition of diffusion, which focuses on the act of buying, unduly restrictive and propose a wider definition "related to systems of different machines, inputs, and organizational procedures ... production design and manufacturing techniques ... and the contemporaneous diffusion of products, processes, infrastructures, and manpower education" (*ibid*, p. 108). In this study, we follow their guidance and define the diffusion of pharmaceutical innovations broadly. Our definition includes not

only products, processes and scientific instrumentation, but also knowledge¹ diffused from universities and government laboratories, or made available through the scientific and trade literature, patent disclosure, inter-firm collaborative agreements, word-of-mouth (especially in geographic clusters of biopharmaceutical firms), and through other vehicles.

Pharmaceuticals are commonly described as a “science-based” industry. Considerable components of the diffusion of innovation are, therefore, flows of knowledge from university and government laboratories to pharmaceutical companies. We discuss this process in the sub-section entitled *Policies for Publicly Funded Research and Education*, with emphasis on the special role played by new biotechnology firms. Within the industry, the main sources of innovation are firms performing *pioneering* R&D, which results in new products representing significant therapeutic advances. The recipients of this flow of innovations are both consumers (patients and hospitals), and firms which perform *imitative* R&D, focusing on the investigation of known products with a view to developing marginal advances. The diffusion of innovation also occurs within the groups of pioneering and imitative firms, and between these groups (Grabowski and Vernon, 1987; Orsenigo, Pammoli and Riccaboni, 2001). Consumption of new pharmaceuticals by consumers (patients) results in a shift in their utility function. The absorption of information by producers allows them to generate new products, and thus shifts their production possibility frontier. The “generic” firms in the industry engage in a strategy of producing and marketing, at a lower price, known compounds for which patents have expired.

The patterns of diffusion are affected both by the demand side and the supply side of the market. On the demand side, the attractiveness of adopting an innovation is largely determined by its profitability, and the risk and uncertainty surrounding its performance characteristics. These are, of course, affected by intellectual property rights, as discussed in detail in the sub-section entitled *The Induce Commercialization Function*. The risk associated with performance characteristics can be reduced by promulgating technical standards. In some industries (for example, electronics), standards facilitate entry by promoting compatibility between equipment parts produced by competing manufacturers. Some authors regard technical standards as a “central component of diffusion-oriented technology policies” (Mowery, 1995, p. 537). In the pharmaceutical industry, the standard-setting function is performed by the government drug approval process. On the supply side, the diffusion of innovation is affected by the amount of information provided by the innovator (Karshenas and Stoneman, 1995, p. 273). The pharmaceutical industry’s advertising and promotional policies have been the subject of debate for some time; we briefly touch on these controversies in the sub-section entitled *Diffusion of Innovation in the Pharmaceutical Industry*.

Diffusion occurs with two time lags. One takes place between the time an innovation appears and the time it is adopted by the first group of users. The other lag is the period during which the innovation is adopted by all relevant agents. The combination of these lags typically generates an “S-shaped” diffusion path.² Earlier studies of diffusion focused on psychological and sociological factors influencing the probability of adoption and speed of diffusion, such as the efficiency of communication networks, and the degree of homogeneity of the entrepreneurial population. Economists introduced the profitability of adoption as the key factor.

THEORIES OF INNOVATION DIFFUSION

GEROSKI (2000) PRESENTS four leading theoretical representations of the innovation diffusion process: the epidemic model; the probit model; the process of legitimization and competition; and information cascades. These are not mutually exclusive, but each focuses on a different set of agents (such as consumers, or competitors) and on different levels of aggregation (individual consumers, vs. market penetration).

The *epidemic model* postulates, alternatively, that information is transferred (1) from some common central source; or (2) gradually, by word-of-mouth, from person to person; or (3) by some combination of (1) and (2). The *common source* hypothesis seems to fit the pattern of pharmaceutical innovation diffusion — the common source in this case is the innovative firm whose product was approved by regulatory authorities. This information is relatively easily codified and transferred, much like the *hardware* aspects of new technology can be communicated through user manuals.

The *probit models* of diffusion focus on the characteristics of agents (individuals and firms) to determine the probability that a particular agent will adopt the innovation. The challenge is to identify the relevant characteristics. Firm size is frequently considered, on the assumption that large firms are more capable, that they may be able to use innovations on a larger scale, that they may be freer from financial constraints, etc. Empirical evidence seems to suggest that large firms tend to be quicker imitators than small firms (Geroski, 2000, p. 612). As mentioned above, the risk and uncertainty surrounding the performance characteristics of the innovation, as well as its profitability, are important determinants of the adoption decision. In the case of prescription drugs, profitability considerations are largely replaced by considerations related to the therapeutic efficacy of the drug, professional ethics of the prescribing physician, and policies of health care financing agencies.³

Suppliers and their pricing and servicing policies affect the cost of technology adoption, as do learning and search costs, and the costs of switching from old to new technology. The prescribing behaviour of physicians is characterized by

considerable inertia; marketing efforts appear to be an important instrument in overcoming this inertia, but marketing represents a significant switching cost. The other instrument for undermining this inertia is drug substitution laws. For example, Gorecki (1986) concludes in his study of the Canadian prescription drug market that physicians write, by and large, prescriptions for the pioneering brand, unless an element of price competition is introduced at the pharmacist's level. Coscelli (2000), who analyzed a unique data set for Italian physicians as well as patients over a three-year period, also found that in those therapeutic submarkets where regulations prohibit price competition, habit persistence translates into *sticky* market shares. However, the prescribing inertia is not absolute, since a given physician has a different probability of prescribing a certain drug to different patients.

Geroski (2000, p. 614) suggests that diffusion is slower when there are sunk costs (for example, in the form of specialized equipment which cannot be sold when the firm switches to another product). In the pharmaceutical industry, the most important sunk cost is likely to be the advertising goodwill.⁴

DIFFUSION OF INNOVATION IN THE PHARMACEUTICAL INDUSTRY

DURING THE LAST DECADE, the international pharmaceutical industry has undergone a major structural change that significantly affects the pattern of innovation diffusion. This structural change has several components (Jacobzone, 2000, pp. 21-26).

First, the proliferation of generic drugs has been facilitated in the United States by the *Drug Price Competition and Patent Term Restoration Act* of 1984 (the *Hatch-Waxman Act*), complemented by drug product substitution laws enacted by state legislatures. In Canada, similar legislation was adopted in connection with the compulsory licensing of prescription drugs after 1969. Other countries followed suit and introduced similar measures designed to speed up diffusion in the form of generic drugs. Generics represented 43 percent of all prescriptions in the United States in 1998, 40 percent in Canada (in 1996-97), about half of all prescriptions in Denmark and Finland, 40 percent in Germany and the Netherlands, and as much as 69 percent in the United Kingdom. Their share is still low in France (just over 3 percent), Belgium and Switzerland.

Second, a change has occurred in the drug distribution system. In the United States, the key new feature is the development of pharmaceutical benefit management companies. They establish drug formularies, negotiate rebates on these formularies with manufacturers, and provide an integrated delivery service and payment system to their customers, such as health plans and health maintenance organizations, who share some of the cost savings. Mail order pharmacies have grown in the United States, Australia and New Zealand, but are still rare in Europe.

Third, a wave of horizontal mergers, pursuing mainly the objective of wider R&D portfolios and sharing of discovery risks, as well as vertical mergers, aimed at ensuring better control over the distribution system. Some innovative drug companies have also established generic subsidiaries and compete in both the brand-name and generic segments of the market.

Fourth, the proliferation of formal and informal inter-firm networks and collaborative research arrangements. One of the causal factors here was the advent of molecular biology, which enabled the development of research technologies that have a broad range of applications. Orsenigo, Pammoli and Riccaboni (2001) studied a data set covering almost 4,000 collaborative R&D agreements among 1,700 international bio-pharmaceutical firms and related research and health-care institutions over the period 1978-87.⁵ They characterize these agreements as organizational devices through which research hypotheses and techniques are combined. Established members of the industry network, called “developers,” benefit from new research technologies introduced by new entrants, called “originators.” Many of the established *developer* firms entered into agreements not only with originators, but also with other developers.⁶

An important vehicle of innovation diffusion is the adoption of scientific instruments. Surveys have shown that firms consider instrumentation as one of the most important outputs of public research. For example, 84 percent of responding U.S. pharmaceutical firms rated specialized knowledge as an important output of public research, 76 percent rated general knowledge from basic research as important, and 49 percent rated instrumentation as important (Salter and Martin, 2001, pp. 522-523).

Industry representatives consider the goal of strengthening a firm’s R&D potential as a key justification for most pharmaceutical company mergers. Nevertheless, innovation in the drug industry — more so than in most other industries — depends heavily on the diffusion of knowledge from universities and government laboratories (see, for example, Narin and Olivastro, 1992; Klevorick, Levin, Nelson and Winter, 1995). The relative importance of interaction with users and suppliers is much lower. Laursen (1996, p. 1135) claims that downstream users “cannot be said to have played any significant part in inducing innovation in pharmaceuticals.” He contrasts this with biotechnology, where products are often developed jointly with the user. Nevertheless, while users may have a role, for example, in an incremental adaptation of a specific enzyme, major breakthroughs in biochemicals were not influenced by users.

A case study of the Danish insulin producer Novo Nordisk A/S (Laursen, 1996) illustrates that the breakthrough product and process innovations were pioneered in the firm’s research laboratories and production engineering departments, augmented by the flow of knowledge from university research.

While suppliers provided sophisticated fermentation and electronic control equipment, its adaptation was under the control of Novo Nordisk.

The most important source of innovation has been efforts to combine research conducted by the manufacturer with knowledge disseminated from universities. Even though Danish scientists were awarded Nobel prizes in physics, chemistry, and medicine or physiology, the major scientific breakthroughs relevant to Novo were almost always made at foreign universities. Laursen emphasizes, however, that the assimilation and commercialization of inventions made abroad was only possible because of the research skills developed at Danish universities.⁷ More generally, *nation matters* — the development of a domestic industry was made possible by the availability of raw material (fine chemicals) and the presence of high quality domestic science (Laursen, 1996, p. 1136).

Pharmaceutical companies consider it essential to *develop the market* for an innovative product by providing information to prescribing doctors by journal advertising, detailing (visits to doctors by company representatives) and direct mail advertising.⁸ The total expenditures on all forms of promotion often amount to 20-30 percent of sales revenues (Rizzo, 1999, p. 90). Empirical studies of prescription drug advertising yielded contradictory results; some reported a positive relationship between promotional expenditures and new product entry, suggesting that advertising indeed facilitates the diffusion of innovation. However, other studies have concluded that promotion helped incumbents to protect their market shares against potential entrants, and thus slowed down diffusion. For example, a study of the U.S. anti-ulcer drug market (cited in Coscelli, 2000, p. 368) concludes that the second entrant has to advertise heavily in order to gain market share over the first entrant. Specifically, the ratio of personal selling (detailing) expenditures to sales were the lowest for the pioneering brand (Tagamet), higher for the second entrant (Zantac), higher yet for the third entrant (Pepcid), and the highest for the fourth entrant (Axiid).

Rizzo (1999) provides a brief review of several published studies and reports the results of his own analysis of the U.S. market for anti-hypertensive drugs. They show that physician prescribing behaviour is significantly affected by promotion; in particular, promotion reinforces the brand image and substantially reduces the prescribers' sensitivity to price. Rizzo is especially critical of detailing, questions its educational value, and advocates strict regulation of marketing practices in the industry.

MEASURES OF DIFFUSION

THE LITERATURE DISCUSSES A NUMBER OF MEASURES. Some of them deal with the diffusion of innovation in the form of products and processes, while others address the diffusion of knowledge in the form of patents, literature citations, and other means. The discussion below reviews the measures

found in the literature and attempts to assess their applicability to pharmaceutical innovations.

DIFFUSION OF INNOVATIVE PRODUCTS AND PROCESSES

THE THREE MOST FREQUENTLY STUDIED MEASURES of product and process diffusion are based, respectively, on the number of potential adopters, the value of industry output, and the stock of production technology. Additional measures include counts of *significant* innovations or counts of new products variously defined.

Ratio of the Number of Adopters to the Number of Potential Adopters

This measure is sometimes called the “rate of imitation” (Lissoni and Metcalfe, 1994, p. 108); one of its weaknesses is that the degree of commitment of the adopters and the risk that they may subsequently reverse their adoption decision are not taken into account. In the case of prescription drugs, the relevant ratio would be either the number of doctors prescribing a particular innovative product to the total number of doctors, or, analogously, the number of patients treated with a particular innovative product divided by the total patient population afflicted with the condition for which the product is indicated.

Share of Output of the New Product or Technology in Total Output

This measure is sometimes called the “overall rate of diffusion” (Lissoni and Metcalfe, 1994, p. 109). One approach may be asking marketing managers what percentages of sales of their firms are (i) products radically changed or newly introduced; (ii) products incrementally improved; and (iii) products essentially unchanged. Alternatively, innovative products can be divided into those “new to the firm, but already known to the industry”, and those “new to the industry” (Santarelli and Piergiovanni, 1996, p. 692).

In the pharmaceutical industry, this is equivalent to calculating the market share of an innovative product in its therapeutic class. Two versions of market share are usually reported: one based on the number of prescriptions, another based on the dollar value of sales.⁹ (The two versions frequently yield dramatically diverging results, since a brand-name drug often sells at a price which is a multiple of the price of a generic equivalent).

Proportion of a Firm’s Output Produced with the New Technology

This is a measure of diffusion employed in studies of the length of innovation lags. It applies to process innovation, and may be measured as the proportion of a firm’s capital stock consisting of the innovative technology (Karshenas and Stoneman, 1995, p. 267).

Count of Significant Innovations

The development of this type of measures requires the cooperation of experts and industry insiders, who are asked to identify the most important innovations in an industry over a period of time (usually several decades). While this approach is highly subjective, it has the advantage of capturing both patented and non-patented innovations. One of the best known databases of this kind was developed at the University of Sussex (Pavitt, Robson and Townsend, 1987).¹⁰

There are numerous lists of *significant pharmaceutical innovations*; their most frequent use is to establish a ranking of countries according to the innovativeness of their pharmaceutical industry. Typically, only *new chemical entities* (NCEs) are listed; thus, the count does not include combinations of existing chemical entities. The challenge is to distinguish *breakthrough* drugs from *me-too* drugs. The subjective nature of this approach is mitigated to some extent when the ranking is determined by a combination of technological advance and economic importance (measured by product sales during a given period after introduction).

FLOWS OF TECHNOLOGICAL INFORMATION

THE MOST FREQUENTLY EMPLOYED MEASURES are patent counts, patent citations, and literature citations in patents. Geroski (2000, p. 607) finds that most patents receive the majority of their citations shortly after they are issued, but some (notably in pharmaceuticals) are sometimes cited for as long as 15-20 years. This suggests that technology diffusion through patents follows an asymmetric S-shaped curve.

Patent Counts

Patents are widely used in studies of innovation diffusion. Their popularity derives from a number of strengths; but their use as a measure of innovation does have a number of weaknesses. The literature identifies the following (Jacobsson, Oskarsson and Philipson, 1996; Santarelli and Piergiovanni, 1996; Meyer, 2000):

Strengths

- Patents cover almost every area of technology (computer software is the main exception).
- In the pharmaceutical industry, more so than in most other industries, patents are critically important.

- Patents provide detailed information about the amount, direction and composition of innovative activity, the year of invention, the assignee, and citations.
- Patent information is easily available and rapidly disseminated.

Weaknesses

- Patents are only one of several instruments¹¹ for protecting an innovation against imitation, and there is considerable variance among industries in the choice of a preferred instrument. Patenting requires the disclosure of the innovation's technical features to potential competitors; consequently, not all innovations are patented.
- A simple patent count does not reflect the economic value of the embodied knowledge; some patents are very valuable while others may be worthless. In some industries, incumbent firms employ other methods for protecting intellectual property in preference to patents. Conversely, some patented inventions are never developed. As a result, not all patents become innovations.¹²
- There is variation among firms (and firm sizes), industries and countries in the propensity to patent.¹³
- The patent systems of different countries adjust to the advent of new technologies with different lags.
- Some patents contain a single claim, others contain several claims, each of which could be filed as a separate patent; the propensity to bundle claims varies across countries.
- When measuring innovation in a particular field of technology or an industry through patent counts, the researcher has to determine which items (classes) in the international patent classification (or a similar system) are relevant. This can lead to two types of errors: If too many classes are selected, the patent count may include innovations which have no relationship to the technology under study. If too few classes are selected, some relevant innovations may be missed (Lanjouw and Mody, 1996, p. 554).

Patent Citations of Other Patents

Patent law requires that patent examiners verify the novelty of the patented invention (in addition to its usefulness and non-obviousness). A fundamental part of this verification focuses on two types of citations: (i) references to

other patents; and (ii) “non-patent references”, i.e. citations of other sources (Narin, Hamilton and Olivastro, 1997, p. 318). Patent citations are discussed in this section; non-patent references are discussed in the sub-section entitled *Patent Citations of Scientific Literature*.

The frequency with which a patent is cited in subsequent patents is a somewhat limited measure of innovation diffusion since it does not provide information about innovations that are marketed without a patent. As for patented inventions, the frequency with which the corresponding patents are cited in other patents can be interpreted as a measure of the impact the knowledge embodied in prior inventions has in stimulating new inventions (Harhoff, Narin, Scherer and Vopel, 1999, p. 511).

In studies using the frequency of patent citations, the implicit assumption is that patents of relatively high economic value are cited more frequently than low-value patents. While there is some indirect evidence in support of this assumption,¹⁴ Harhoff, Narin, Scherer and Vopel (1999) tested its validity (and thus the effectiveness of the frequency of citation measures) with two patent databases — one from Germany and the other from the United States.¹⁵ Regression analysis supported the existence of a positive relationship between the frequency of citations and the reported economic value, but the statistical fit (measured by R^2) was weak.

Patent Citations of Scientific Literature

Non-patent references appearing on the front page of U.S. patents identify scientific journal papers, meetings, books, as well as non-scientific sources, such as industrial standards, technical disclosures, engineering manuals, etc. (Narin, Hamilton and Olivastro, 1997). Patent citations of scientific papers have the following advantages and disadvantages:

- Only a minority of patents contain non-patent references. Moreover, citations of science material in patents do not work the same way as in the scientific literature, since they are not written by scientists, but by patent departments or specialized patent lawyers (Meyer, 2000, p. 412 and 421).
- Citations of scientific material give the addresses of authors of scientific papers, and make it possible to identify the agencies supporting these papers.
- Most published studies restrict their analysis to citations appearing on the front page of patents. This is convenient, and may be justified on the grounds that the most important citations would be on the front page, rather than in the body of the text. However, the procedure may underestimate the contribution of science.

- Citations measure only codified knowledge and understate the contribution of public science through the training of researchers. More generally, they do not reflect knowledge related to the design, development, production, marketing and use of a particular product model or a specific product line (Meyer, 2000, p. 425).

Narin, Hamilton and Olivastro (1997, p. 320) show that U.S. drug and medicine patents from almost all countries cite almost exclusively papers in scientific fields of clinical medicine and biomedical research.

Volume of R&D Contracted Out

The empirical evidence reviewed in the sub-section entitled *Diffusion of Innovation* above shows that a crucial part of the process of creation and diffusion of innovation is linkages between in-house R&D conducted by the innovator and external sources of knowledge. One of the sources of external knowledge is research consortia and other forms of co-operation. A possible measure of the extent of inter-firm diffusion of innovation is the size of the firm's contracting-out budget. It could be further subdivided by type of partnership, for example according to whether the co-operating firms are related (Veugelers, 1997).

Interaction Between Users and Suppliers

The long-standing "linear model" of innovation postulates a sequence running from basic research (science) to applied research and, eventually, product development and marketing. However, for most industries, the modern understanding of the generation and diffusion of product innovation emphasizes the importance of continuing interaction (initiated at the beginning of the innovation process) between the innovator and the potential users of the product. For process innovation, the interaction between the innovator and the suppliers of production technology is equally important (see, for example, Cohen and Levinthal, 1989).

The pharmaceutical industry is described as "science-based"; its strong dependence on university research and scientific literature is discussed in the second section. Some of the industry's interaction with users occurs during clinical testing, which is thus an integral part of product innovation. The post-marketing surveillance and monitoring of drug safety is only indirectly related to innovation diffusion as traditionally understood, and is not discussed here. The industry's interaction with suppliers is rather limited and firm- or innovation-specific, as explained above in the section entitled *Diffusion of Innovation in the Pharmaceutical Industry*. Neither the interaction with users nor the interaction with suppliers appears to be easily amenable to statistical measurement.

OTHER INDICATORS OF DIFFUSION

Public and Private Expenditures on the Technology

DEMAND FOR INNOVATION STIMULATES its diffusion; a broadly defined measure of demand includes not only spending on new products and technologies, but also spending on their approval process, monitoring and control. For some purposes, including the study of trends in innovation diffusion and international comparisons, total public and private spending on drugs, or on health care, may be an appropriate indicator. Trends in medical practice influence the substitution between drug therapy and other modes of therapy, and thus affect the diffusion of pharmaceutical innovations. However, these changes are not easily measurable.

Resources Devoted to R&D

R&D is a source of much innovation, but also an indicator of its diffusion. First, part of the R&D activity is explicitly directed at the development and commercialization of the innovation. Second, the “absorptive capacity” of the recipient of innovation diffusion is enhanced if it engages in R&D (Cohen and Levinthal, 1989).

However, measured R&D expenditures reflect only the spending reported by formal R&D departments. Diversified firms are classified by their main economic activity, and R&D in various product areas is not always reported separately.¹⁶ Informal and occasional innovative activities are not captured; the underreporting is particularly severe for small firms. The same reservations apply to the other important measure of resources devoted to R&D, namely the numbers of scientific personnel (often the number of scientists and engineers) employed by a firm, an industry or a country.

GOVERNMENT POLICIES AFFECTING DIFFUSION

INDUSTRIAL POLICIES AND REGULATION

GOVERNMENT POLICIES AFFECTING DIFFUSION are developed and implemented as part of a country’s industrial and social policies. Metcalfe (1995, pp. 462-463) defines a “national system of innovation” as a set of institutions that contribute to the development and diffusion of new technologies and provide a framework within which governments form and implement policies to influence the innovation process.

Mowery (1995, pp. 531-539) observes that the national economic returns to “diffusion-oriented” (or “adoption-oriented”) policies may be considerable, but cautions that they may conflict with policies designed to support the creation

of new technologies (for example, by encouraging excessive disclosure). He discusses five classes of adoption-oriented policies: (1) subsidies for adopting new technologies; (2) information provision, including industrial and agricultural extension services and industry co-operative research organizations; (3) government procurement; (4) technical standards; and (5) government mandated technology transfers. He adds that another important source of influence on both technology adoption and creation are (6) policies on intellectual property protection.

Subsidizing the adoption of new pharmaceutical technologies and innovations is, to some extent, accomplished through government financing of health care expenditures. (Mowery's "government procurement" policy is part of the same process).

Publicly funded institutions also promote the diffusion of information or subsidize the inherent externalities in such a process. Additional efforts might include identifying and motivating key actors (in the case of pharmaceuticals, presumably, health care professionals), and building up the necessary human capital. Governments also influence prescribing physicians by means of prescribing guidelines, sometimes backed by financial incentives, such as budgeting constraints and reference pricing. The success of other methods used to influence the prescribing behaviour (education and information diffusion) has been limited and depends on the type of feedback and supporting evidence.

Government standard-setting legitimizes innovative products and thus facilitates their diffusion. In the drug industry, the tightening of the U.S. regulatory process for approval of new drugs, following the enactment of the *Kefauver Harris Act* in 1962, was responsible for extending the total time required for a successful drug to reach the market: The process took 6.7 years in the 1970s, it rose to 8.5 years in the 1980s, and then to 9.1 years in the mid-1990s (Jacobzone, 2000, p. 18). However, it is less clear to what extent the diffusion of truly significant innovations was hampered. Dranove and Meltzer (quoted in Jacobzone, p. 18) show that the more important drugs reached the market sooner and had lower development costs than drugs representing less significant therapeutic advances.

Anecdotal evidence from cross-national comparisons suggests that tighter regulatory standards may actually improve the quality of innovation. For example, Jacobzone (2000, p. 18) cites studies by Thomas and Barral which show that that high regulatory standards force innovating firms to target their R&D on drugs of superior efficacy. This has been the case in the United Kingdom and Germany, which followed the U.S. regulatory model. In contrast, the French regulatory standards were strengthened only at the end of the 1970s. This could explain why the French pharmaceutical industry lost some of its comparative advantage.

A significant contribution to facilitating the diffusion of pharmaceutical innovations is provided by international harmonization of the drug approval process. In Europe, a Council Directive adopted in 1989 improved the transparency of measures regulating the pricing of drugs and their inclusion in national health insurance plans. The extension of patent protection throughout the European Union (EU) was approved in 1992, and the European Medicines Evaluation Agency was established in 1993. Starting in 1998, drug companies had two options. One is to apply for a national licence valid in one EU member country and wait for five years before applying for a licence in another country. The other option is to apply for a pan-European licence. The European Court of Justice has ruled that patients can import cheaper over-the-counter (OTC) drugs for their own use from another member country, provided the product is approved in the home country. It has also ruled in favour of parallel imports among member countries. These initiatives facilitate diffusion. The European Commission is working on provisions to establish a common market for pharmaceuticals. Implementation of the common currency is expected to increase transparency in pricing and enhance price competition (Jacobzone, 2000, p. 26). Canada may see advantages in joining a regional drug approval process.

Government controls over the prices of prescription drugs have the predictable consequence of reducing the profitability of the industry, and thus have a negative impact on R&D funding. A recent survey conducted by the OECD illustrates the pervasiveness of such controls: The results show that 20 member countries operated some form of price controls (in five of them, price controls were combined with profit controls); in addition, the United Kingdom had a system of profit controls (Jacobzone, 2000, Tables 13 and 14, pp. 77-78).

According to Jacobzone (2000, p. 37), price controls in France have created incentives for drug companies to channel their R&D towards the development of *me too* drugs. The reason is the cost of R&D; *me too* drugs cost less to develop, and thus can more easily satisfy the price control limits than *break-through* drugs. In addition, Danzon and Chao (2000, p. 314-319) note that the impact of generic competition is weakened by strict price or reimbursement regulations for the same reason: If the regulatory regime drives down the price of innovative drugs, competing products are introduced as minor modifications of known molecules. This enables producers to come under the regulatory price ceiling. Since these brand-name drugs representing minor therapeutic advances sell at a lower price, the competitive advantage of generics is reduced. Danzon and Chao mention France, Italy and Japan as countries where local manufacturers have an incentive to introduce a stream of new products representing minor innovations in order to obtain a higher price. This, in turn, undermines the competitiveness of these countries in innovative R&D. By contrast, in

countries with free pricing or moderate regulatory regimes, additional products are introduced as generics, which must compete on price.

Grabowski and Vernon's (1987) computer simulation model shows that generic competition reduces the rate of innovation, while the extension of patent life enhances profitability, and thus the rate of innovation.

The U.S. Congressional Budget Office (CBO, 1998, p. 13) discusses in detail the economic impact of four types of competition: Between brand-name drugs in the same therapeutic class; between brand-name drugs and their generic counterparts; between generic drugs in the same therapeutic class; and between prescription drugs and other forms of medical treatment.

Several empirical studies (reviewed in CBO, 1998, p. 30) analyze the impact of generic entry on the relevant therapeutic market. The typical result is that the demand curve for brand-name products shift to the left, as expected, but also becomes less elastic. Brand-name prices typically remain constant, or even rise after the generic entry. In other words, there is a market segmentation where price-sensitive buyers switch to the cheaper generics, while price-insensitive buyers keep purchasing brand-name products, sometimes at higher prices. The net effect on the profitability of brand-name (innovative) firms may actually be positive,¹⁷ hence the rate of innovation and its subsequent diffusion may actually increase. Government policies mandating generic drug substitution may, of course, reduce or eliminate the profit-enhancing effect.

POLICIES FOR PUBLICLY FUNDED RESEARCH AND EDUCATION

FREE ACCESS TO KNOWLEDGE GENERATED by public research raises the productivity of private research by enabling more focused exploration. Private firms are induced to produce a superior innovation and their output increases. In addition, as non-innovating firms exit the market, the surviving innovative firms are induced to spend more on R&D, because they have a larger share of a bigger market (Metcalf, 1995, p. 444).

Empirical analysis of data on 1,719 U.S. manufacturing firms by Cohen and Levinthal (1989) revealed that R&D intensity is positively related to variables measuring the importance of basic and applied sciences to research conducted by these firms, with basic sciences having a stronger effect. Knowledge generated by universities and government laboratories was equally valuable. Making use of knowledge produced outside the firm is not costless; the cost of transmission and absorption by the firm is, however, lower for R&D-performing firms. Metcalfe (1995, pp. 457-458) argues that even knowledge codified in journal and book publications has some uncodifiable (tacit) components only accessible to individual scientists. Furthermore, even in science-based industries, such as pharmaceuticals, knowledge is frequently accumulated through an experimental research program, and many pharmaceutical innovations are

generated on the basis of a very limited scientific understanding of their operating mechanism. The standard measures of diffusion discussed in the third section thus underestimate the amount of knowledge transferred.

Mansfield (1998) reports updated findings of his previous interview-based inquiry on the importance of academic research. For a sample of 77 major firms in seven industries over the period 1986-94, he found that, on average, 15 percent of product innovations would not have been developed (without substantial delay) in the absence of recent academic research. This compares to 13 percent for the period 1975-85. The *drugs and medical products* industry reported the highest percentage (31 percent for the period 1986-94, up from 27 percent for the earlier period).

Another stream of the literature on technology diffusion focuses on the importance of *bridging* institutions, such as university-industry research parks, or government institutes, such as the U.S. National Institute of Standards and Technology. Martin and Scott (2000, pp. 443-445) cite the examples of extension services operating in the United States since 1862 as a repository of technical information available to private farmers. Other illustrations include the German Fraunhofer Gesellschaften, which conduct applied research for industry on a contract basis, using the facilities and personnel of regional universities. A study of the development of beta blockers by Swedish pharmaceutical companies concluded that success depended on the ability of these firms to "link up their clinical and chemical competence into a coherent whole by relying on basic biological and pharmacological knowledge" (Martin and Scott, 2000, p. 444). This, of course, required close formal and informal connections between firms and university researchers.

The methods of interaction of business firms with government laboratories include contract research, cooperative research, research consortia, science parks, workshops, licensing, sponsored research, technical consultation, employee exchanges, the use of laboratory facilities, laboratory visits, and formal dissemination of information through publications. Studies of technology transfer reveal that contract research is by far the most important, followed by cooperative research (Bozeman, 2000, p. 641).

Giesecke (2000) describes a scenario where biotechnology start-up firms initially serve as technology transfer mechanisms for bringing the results of academic research to market.¹⁸ At a later stage, pharmaceutical companies become interested in forming strategic alliances and undertaking product development. Biotechnology companies, in turn, are interested in such alliances either to obtain financing or to gain access to distribution networks. The crucial role of biotechnology companies in transferring knowledge from university laboratories to the market is confirmed by other research as well (McMillan, Narin and Deeds, 2000).

Several studies have demonstrated that geographic proximity is an advantage in communicating tacit knowledge. For example, one-third of public U.S. biotechnology companies are located in either the San Francisco Bay area or New England (McMillan, Narin and Deeds, 2000, p. 2). A similar finding emerges from a survey of executives of 70 major U.S. firms. It suggests that firms located in the country and area where academic research occurs are significantly more likely than distant firms to be amongst the first to apply the findings of this research (Salter and Martin, 2001, p. 518).

Jensen and Thursby (2001) address the optimal structure of licensing contracts between universities (and/or university inventors) and industrial licensees. Based on the results of a survey of 62 U.S. universities,¹⁹ they observe that, at the time they are licensed, most university inventions are little more than a “proof of concept” with unknown commercial potential, and technically so embryonic that additional effort by the inventor is required. However, the inventor is subject to moral hazard in that his/her effort cannot be effectively monitored or enforced. The contract must therefore be written in such a way as to induce effort from the inventor.²⁰ Jensen and Thursby employ a range of game theory models to demonstrate that an optimal licence contract cannot rely solely on lump-sum payments, such as fixed fees, but must also include output-based payments, such as royalties. (The details vary, depending on whether the licensing arrangement includes funding of sponsored research, royalty payments or equity participation.)

The dominance of public science in the diffusion of innovation in general and pharmaceutical innovation in particular is evident from the patent citation data: Narin, Hamilton and Olivastro (1997, p. 318) analyzed over 430 000 non-patent references on the front pages of almost 398 000 U.S. patents issued in 1987-88 and 1993-94. Of the 430 000 references, some 242 000 were citations of scientific journal papers, scientific meetings, and other scientific publications. As for drugs and medicine patents, some 50 percent of scientific references were to U.S. public science, and 33 percent to foreign science, most of which is also public. Only 17 percent of scientific references were to U.S. drug industry papers.²¹

The patent-to-science linkage has a strong national component, i.e. citations in U.S.-invented patents favour U.S.-authored papers. This may not be surprising for the United States, since U.S. research dominates in many fields, but the same pattern applied to all five countries in the Narin, Hamilton and Olivastro study (Canada was not among them). In their U.S. patents, each country’s inventors cited papers published in their own country two to four times more often than would dictate the size of the country’s scientific publication rate. Narin, Hamilton and Olivastro (1997, pp. 320-322) infer from this observation that there are strong national ties between scientists and inventors in a country. They conclude that a strong domestic scientific base is necessary

for a strong national technology base in science-dependent industries, such as pharmaceuticals and biotechnology.

THE ROLE OF PATENTS IN THE DIFFUSION PROCESS

MUCH OF THE LITERATURE on the link between patents and innovation diffusion deals with the empirical evidence and policies of large economies. In this section, we briefly review some of this literature. In two sections below (*Implications of Patent Theory for Canada's Patent and Diffusion Policy*, and *Possible Changes in Patent Policy and their Impact on the Diffusion of Innovation*), we indicate how the conventional wisdom has to be modified to reflect the special characteristics of small economies, such as Canada, and draw conclusions for a small country's patent policy.

A consistent theme in the literature is that patents and the protection of intellectual property are only one of many influences on inventive activity, the commercialization of inventions and the diffusion of innovation. For example, Grandstrand (2000, p. 1067), concludes that "there is, as there always has been, a mixed verdict over whether the intellectual property system promotes technological innovation and diffusion."

The literature is replete with observations about the unique role patents play in the pharmaceutical industry. Jacobzone (2000, p. 17), among others, observes that "the whole pharmaceutical industry may be viewed as a product of the patent system." Kingston (2001, p. 405) elucidates the basis for this claim: The initial cost of developing a pharmaceutical invention is very high. However, once the patented formula is known, copying is possible at a very low cost (more so than in other high-tech industries), and as a result of free-rider behaviour, the amount of investment in pharmaceutical R&D could be less than socially optimal.

In general, the strength of patent protection has contradictory influences on diffusion (Jaffe, 2000, pp. 533-534): Weak patent protection makes inventions widely available, but strong patent protection increases the incentives for private firms to develop and commercialize inventions.

With respect to the results of R&D financed by public funds, Mowery, Nelson, Sampat and Ziedonis (2001) argue that the related patenting is:

- unnecessary, because the incentive to encourage research activity, which is the usual justification for patent grant, is not required in this case; and
- counterproductive, because the patent may slow down technology transfer by creating barriers to entry.

Arundel and Kabla (1998, p. 133) report the results of a study of the propensity to patent (defined as the percentage of inventions for which the firm submitted a patent application) based on questionnaire data for a sample of European firms. The pharmaceutical industry had the highest sales-weighted propensity to patent product innovations among the 20 industries in the sample (79.2 percent against the sample average of 35.9 percent), and the second highest propensity to patent process innovations (45.6 percent against the sample average of 24.8 percent).

Grabowski and Vernon (1987) developed a computer simulation model to explore the impact on innovative firms of changes in the length of patent life, the length of the regulatory review process, and the degree of sales loss to generics after patent expiration. Under reasonable assumptions, the negative effect of generic competition on returns to R&D becomes relatively insignificant for a patent life approaching 17 years. Pioneering innovators (firms that develop breakthrough drugs) are affected by generic competition to a greater extent than imitators (firms that develop *me too* drugs). The reason is that pioneering innovators require a longer R&D time, hence have a shorter effective patent life.

Extension of patent life beyond the traditional length does enhance the returns on R&D, but less so than a reduction in the time required for regulatory approval. The reason for this difference is the timing of the cash flow increase. A shorter regulatory approval process increases the cash flow at the beginning of the product cycle. The present value of the cash flow is therefore significantly increased, and, in addition, firms have resources available to engage in new R&D projects earlier. In contrast, an extension of patent life adds cash flow at the end of the product cycle, when its present value is low. In addition, new R&D projects then start later than would be the case if the approval process were faster.

According to a recent study by the CBO (1998, p. xv), some representatives of the U.S. pharmaceutical industry called for amendments to the *Hatch-Waxman* Act of 1984 to further lengthen patent term. The CBO employed the Grabowski and Vernon methodology and arrived at the following result (CBO, 1998, p.18): Extending patent life on a prescription drug by one year would increase the net present value of returns to R&D by \$12 million (in 1990 dollars) on average. In contrast, accelerating the FDA approval process by one year would increase the net present value of the drug's returns by \$22 million. The CBO therefore does not endorse any further extension of the length of U.S. drug patents.

Lichtenberg and Philipson (2001) attempted to quantify the two types of losses drug innovators incur as a result of competition. One of them occurs as a result of generic competition (imitation) after the patent has expired. The other type occurs as a result of entry of new and superior patented products,

both during and after the patent life of the original innovator's drug. A priori, the loss due to imitation should be relatively small, partly because only a minority of drugs face generic entry after the patent expires, and partly because if such entry occurs, it is late in the product cycle, and the net present value of the loss of income is small.

Based on FDA data for a panel of 298 drugs approved between 1950 and 1993, the subsequent entry of new drugs within the same therapeutic class reduces the net present value of the innovator's sales by 23 percent relative to what it would have been in the absence of competition. Assuming that generics eventually capture 50 percent of the market, generic imitation after patent expiry also reduces the net present value of the innovator's sales by 23 percent. If the generic market share is assumed to be a more realistic 25 percent, the net present value of the loss to imitation is only 11 percent. In other words, the effect of an extension of the patent term would not represent a major stimulus to innovation since it would have no impact on the intensity of the more important form of competition (from new and superior products).

Berndt, Ling and Kyle (2003) analyzed the U.S. market for anti-ulcer and heartburn drugs with a view to determining whether the negative impact of patent expiry is mitigated by a switch of the drug status from prescription to OTC. In principle, such a switch has two offsetting influences. On the one hand, when a drug is marketed both as an OTC and a prescription product, consumer awareness of its existence rises and its total sales are likely to increase. On the other hand, the OTC sales may cannibalize some of the original prescription sales. Under plausible assumptions about pricing and marketing strategies, the results are mixed. For a drug that suffered from rapid sales erosion after patent expiry (cimetidine, sold under the brand-name Tagamet), the switch to OTC status offered a reprieve, but only temporarily, since the drug was being superseded by superior products. Cannibalization was minimal, since prescription sales were already low. In contrast, for ranitidine (sold under the brand name Zantac), the OTC version raised total sales somewhat, but cannibalization of prescription sales was substantial.

Scherer and Harhoff (2000) report the results of their study of the value of German and U.S. patents (in all fields of technology). Their estimates of the value of patents come from three sources: Questionnaire survey of management; data on royalty payments; and estimates of rents on new drug products, developed by Grabowski and Vernon. Scherer and Harhoff conclude that most innovations generate only modest returns. The "lion's share" of the private returns to innovation comes from roughly 10 percent of the technically successful patents (p. 561). They cite two studies by Grabowski and Vernon showing that the returns to pharmaceutical patents are similarly skewed. Consequently, they warn that "heavy-handed price controls" (if they affect one or more of the top 10-percent inventions) may make the appropriation of private returns impossible,

and thus may seriously undermine the potential for future innovation. This analysis, like much of the literature, applies to a large country; the special aspects of the incentive to invent in a small country are discussed in the remainder of this study.

IMPLICATIONS OF PATENT THEORY FOR CANADA'S PATENT AND DIFFUSION POLICY

FOUR FUNCTIONS OF PATENTS

OUR TASK IN THIS SECTION AND THE NEXT is to examine how changes in Canada's patent policy could affect the diffusion of technology at the margin. To approach this task systematically, we start by reviewing the implications of patent theory or *patent models* presented in the recent literature. In a survey of this literature, Mazzoleni and Nelson (1998) emphasize that patents serve a range of functions; the various models they discuss focus on different functions or aspects of the rationale that is thought to guide public policy in granting the exclusive rights associated with patents under existing laws:

- The prospect of patent protection provides a motivation for useful invention; this model is called the *invention motivation* theory.
- Patent protection for inventions may be needed to induce the investment required to develop and commercialize them; this model is called the *induce commercialization* theory.
- Patents are awarded to induce inventors to disclose their inventions; this model is referred to as the *information disclosure* theory.
- Patents may be needed to permit the orderly exploration of a broad prospect of inventions; this is called the *exploration control* theory.

Of course, more than one of these theories could apply to any given patent. We discuss each of the four functions of patents separately in order to derive implications for Canada's patent policy, giving special consideration to the pharmaceutical industry.

THE INVENTION MOTIVATION FUNCTION

IT IS GENERALLY RECOGNIZED THAT INVENTORS need an incentive to invest in the research effort to make an invention. It is also generally recognized and supported by empirical studies that the pharmaceutical industry is most dependent on patent protection in order to appropriate the revenues required to cover the cost of inventing new medicines. Indeed, Mazzoleni and Nelson

(1998, pp. 274-276) refer to pharmaceuticals and fine chemicals as an exception because, in many other industries, patents are not a crucially important part of the incentives to invest in R&D activities. In a survey of a wide range of industries, including high-tech industries, respondents rated a head start in establishing effective production, sales and service facilities, and rapid movement down the learning curve, as much more effective than patents in enabling them to profit from their R&D. By contrast, the pharmaceutical industry depends on patent protection because it would be relatively easy for competent imitators to quickly copy new products by way of reverse engineering and to enter production by using commercially available ingredients. But even for the development of new pharmaceutical products and processes, firms rely heavily on other, more open, channels of knowledge and technology transfer, such as access to publicly funded research (Gambardella, 1995; Mowery, Nelson, Sampat and Ziedonis, 2001, p. 118).

Where patents are needed solely as an incentive to invent, as assumed in the *invention motivation* theory, they almost by definition and deliberately delay the adoption of (access to) new technology, because the patent grant raises its price. The patent may also slow down the creation and improvement of related technologies if the potential inventors are deterred by fear of infringement actions. Patent policy, at least conceptually, has the task of implementing the optimal trade-off between strong patent protection to encourage technological progress on the one hand, and ready access to new knowledge to permit its rapid diffusion and use, on the other hand (Scherer and Ross, 1990, pp. 621-626). In the case of Canada's patent policy, at least two special features must be considered. One is the fact that patent protection in a small market can have only a very marginal effect on the amount of inventive activity worldwide. Scherer (1985, p. 85; and 1998, p.104) approvingly quotes the Canada Court of Exchequer which, in a 1971 decision over a patented medicines case, observed that it would "be unrealistic to think the returns from the Canadian market have any important bearing on whether research on an international scale will go on." (*Merck & Co. Inc. v. Sherman & Ulster Ltd.*, 65 C.P.R. 1, 24).

Thus, for Canada there exists no trade-off between the creation of new knowledge and its rapid adoption by producers other than the inventor. If Canada were unconstrained by international obligations, a patent policy focused on the national interest would disregard the invention motivation function of patents and would foster technological progress by promoting rapid diffusion of (access to) new technology. This would apply to new technology created in Canada as much as to new knowledge or technology created abroad, provided that Canadian inventors remained motivated to invent by obtaining patents in large foreign jurisdictions. The second important fact is the existence of international obligations requiring Canada to apply certain standards of patent protection and enforcement (see the section entitled *Canada Needs to Toe*

the Line on TRIPs and NAFTA). As it were, Canada has been made to pay its *dues*, but it must be understood that, from a national policy perspective, the invention motivation function of patents is not the reason for such payment. It follows that, as far as this function is concerned, there is no reason for paying more than is required under international obligations. This will be referred to as the *dues-paid* approach to patent policy in a small market. (The dues-paid approach to patent policy implies that there can be no suggestion that Canada could be a free rider on the international R&D system).

COUNTER ARGUMENTS TO A DUES-PAID APPROACH

WE HAVE HEARD THE OPINION THAT CANADA would consign itself to the status of a minor player in the world of pharmaceutical innovations if it provided patent protection *only* as strong as required by its international obligations, and less strong than provided by major players such as the United States and many European countries. We fail to see the logic of this opinion. Stronger patent protection is supposed to encourage inventive effort by raising the revenues expected from an invention. This cannot work in the case of Canada because inventors with a global market perspective expect to derive only a very small percentage of their total sales revenues from the Canadian market. The Eastman Report (1985, p. 347) estimates that Canadian consumption of pharmaceutical products accounts for less than 2 percent of world consumption. If a hypothetical enhancement of Canada's patent protection beyond the standard of international obligations raised the domestic share of a Canadian inventor's expected world revenues from, say, 1.9 percent to 2.2 percent, this would not likely have a noticeable impact on the domestic (or any other) inventive activity, and certainly could not make the difference in determining whether Canada would remain a minor player as a locus of pharmaceutical innovation.

Canadian inventors typically file for patents in foreign jurisdictions, especially in the United States, before filing in Canada. In many instances, they do not seem to file in Canada at all. Maskus (2005, Table 1) reports that, in certain years of the 1990s, Canadian residents applied as much as 50 percent more for U.S. patents than they applied for Canadian patents. The strength of patent protection in major foreign jurisdictions matters a great deal more to Canadian inventors than protection in the Canadian market. If the government wishes to encourage inventive activity in Canada, it must rely on other policy tools, such as support for graduate education, publicly funded research, R&D tax incentives, and support for regional clusters of research that have a critical mass. About 94 percent of patent applications in Canada are filed by foreign residents (*ibid*, Table 4). It stands to reason that stronger protection for these patents would more likely hinder than promote inventive activity in Canada.

Some Canadian inventors may expect to derive much more than 2 percent of their revenues from domestic sales; their inventive effort would then be guided by a domestic, rather than global, perspective. If such cases exist, they are likely to account for a small fraction of the six percent of all Canadian patent applications filed by Canadian residents. The existing standard of patent protection may provide insufficient incentives for some of these inventions, where making them would be in the public interest. The sensible policy would then be to support such research selectively, rather than enhance patent protection and concomitant rents for the other 99.9 percent. An example of such selective support is the U.S. *Orphan Drug Act* of 1982.

Occasionally, it is suggested that Canada ought to follow the example of Switzerland, because it is a small country with a highly successful world-scale, research-based pharmaceutical industry. Switzerland is a key proponent of strong patent protection for pharmaceuticals globally and at home. The suggestion is that the strength of the Swiss national patent system is behind the success of the Swiss pharmaceutical companies. Historically, however, Swiss industrialization progressed rapidly in the second half of the 19th century when Switzerland had no patent law of practical significance (Schiff, 1971, pp. 83-106). During this period, many leading Swiss inventions emerged and could be patented in other industrial countries — but not at home — while Swiss industry could freely use inventions patented abroad (*ibid*, pp. 107-112). Switzerland's patent law of 1907 was adopted largely as a result of pressures from foreign (mostly German) competitors of the emerging Swiss chemical enterprises (*ibid*, pp. 93-94). And still, under the 1907 law, only chemical processes were patentable, while patent protection was denied to chemical substances (*ibid*, p. 95). Switzerland has allowed patents for chemical substances only since 1977 (Lanjouw and Cockburn, 2001). By that time, of course, the Swiss pharmaceutical companies had acquired a leading position in the world. It seems plausible that Switzerland's current posture as a principal proponent of strong patent protection is a result of the strength of its research-based pharmaceutical industry, rather than the reverse. The Swiss experience suggests that Jacobzone (2000, p. 17) may not be completely correct when he claims that in the past, countries without a strong patent system "have been unable to develop a significant innovative pharmaceutical industry."

So far, we have not found a valid argument suggesting why Canada should not follow a *dues-paid* approach in its national patent policy. One reason remains: the possibility that multinational pharmaceutical companies collectively use their ability to shift investment away from Canada to exert pressure on the government and make it accede to industry demands for stronger patent protection. This has happened before (Campbell and Pal, 1989, p. 83). Canada may be a *strategic* market for multinationals in the sense that it is one of the countries where patent protection needs to be enhanced beyond the standards

of current international obligations before the industry can hope to have new higher standards *globalized* in the next round of multilateral trade negotiations. Such strategic behaviour is more likely to succeed when pharmaceutical investment is regionally concentrated, as it is in Canada, and politicians are conscious of regional interests. On the other hand, it is not a foregone conclusion that all pharmaceutical companies will adhere to this strategy or will be able to make credible threats. Canadian pharmaceutical research facilities are of a high calibre and costs are low compared to U.S. and European levels. Competitive behaviour could prevail because all players know that it is advantageous for each individual firm to hold on to these resources, or to take them over should competitors decide to move their investment to other locations.

THE INDUCE COMMERCIALIZATION FUNCTION

THE *INDUCE COMMERCIALIZATION THEORY* suggests that an important function of patents is to induce investors to commit resources to the development of commercial applications of inventions when these applications are still uncertain. Obtaining a patent may be a prerequisite for access to financing at the development stage. Similarly, a patent could be a prerequisite for selling or licensing the technology. An exclusive licence could then encourage others to invest in the development of the technology. Commercialization is an important aspect or stage in the diffusion of new knowledge, and the induce commercialization function of patents could be especially important for pharmaceutical inventions where costs at the development stage (notably, for clinical testing and regulatory approval) can be very high.

As Mazzoleni and Nelson (1998, pp. 275, 277) point out, the induce commercialization theory may apply independently of the invention motivation theory; or, in certain cases, both could apply simultaneously. Thus, for Canada, the induce commercialization function could be an important reason to offer patent protection, while the invention motivation function, as has been argued above, is not. An effective diffusion policy would then include patents as instruments to encourage the commercial development of new knowledge and technology in Canada. On the other hand, not all inventions need to be patented to ensure or facilitate their development (*ibid*, pp. 277-278). It must also be remembered that for most inventions patented in Canada, patents were previously granted in other jurisdictions, and commercial development would be already under way in the larger and more lucrative markets. If Canadian patent policy could be formulated without regard for international obligations, it would aim to grant patents only where they are needed for the specific purpose of commercial development in Canada. However, such a policy is ruled out under Canada's international obligations. The granting of patents cannot be restricted to cases where they serve to induce commercialization and diffusion,

let alone domestic diffusion. In accordance with international rules, patents meeting certain standards must be granted regardless of their purpose, if applied for. A dues-paid patent policy may be doing more than enough with regard to the induce commercialization function of patents, but this is an empirical issue on which little evidence exists.

The induce commercialization theory has been used to justify the patenting of inventions that result from publicly funded research in government laboratories or universities. The invention motivation function of patents cannot apply to such research because its cost is covered with public funds. Inventing would go on in any case because obtaining patents is not the publicly funded researcher's motivation (one assumes). In the United States, the adoption of the *Bayh-Dole Act* in 1980, according to Eisenberg (1996) and others, was based on the presumption that firms have weak incentives to invest in the development work required for the commercialization of new knowledge "unless an exclusive licence on a university patent provides assurance that the returns from such investment can be appropriated" (Mazzoleni and Nelson, 1998, p. 277). Often, patents cannot be taken out on further *inventing* involved in development work. "Thus a controlling patent on the original invention is seen as the only way to prevent competition from sharing the returns through imitation" (*ibid*).

Patent policy for publicly funded research in Canada is not part of our mandate and is covered by a different study in this series (Callan and Cervantes, 2005). However, it should be noted that patent policy for publicly funded research is not constrained by international obligations to the same extent as the granting of patents to individuals and private firms. Essentially, the funding agency or the government department can set the rules or write the terms of contracts to determine under what conditions patents may be applied for in situations where inventions result from research that is (fully or partially) funded by the public. The same applies to licensing policy if publicly funded inventions are patented. Thus, in this area, Canada could try to set rules that restrict patenting to inventions that would not otherwise be developed commercially, or it could impose generous licensing provisions for technologies that should be used widely, either for ethical reasons or as *research tools* to stimulate further inventing. However, one should not underestimate the difficulties inherent in making such rules operational.

In the United States, university patenting has increased considerably since the adoption of the *Bayh-Dole Act*, though not necessarily because of it (Jaffe, 2000). Yet, it is still unclear whether the increased propensity of universities to patent and license research output has had the effect of accelerating its commercial use, compared to the situation where research results were simply placed in the public domain (Mowery, Nelson, Sampat and Arvids, 2001, pp.101, 117-118). One must assume that universities use patenting and exclusive

licensing primarily as a means of opening up new sources of funds. Therefore, they will tend to patent anything that has commercial potential. From a public policy point of view, one has to be concerned that widespread patenting and exclusive licensing of fundamental research results or of tools whose principal use is in further research could hinder not only commercial application, but also the advance of science. Whatever the impact of the *Bayh-Dole Act* on university patenting, allowing universities to “collect revenues from patenting and licensing research tools that, in an earlier era, likely would have simply been placed in the public domain ... does not spur technology transfer” or commercial development (*ibid.*, p. 118).²²

THE INFORMATION DISCLOSURE FUNCTION

UNDER THE *INFORMATION DISCLOSURE THEORY*, “patents encourage and provide a vehicle for disclosure and, more generally, generate quick and wide diffusion of the technical information underlying new inventions” (Mazzoleni and Nelson, 1998, p. 278). Disclosure may stimulate further inventive activities and applications using the new knowledge without infringing on the patent holder’s rights; it may also reduce wasteful duplication of inventive effort, thus freeing scarce resources for more productive research. The information disclosure theory has been part of the conventional wisdom of patent policy discussions for a long time (Machlup, 1958), and it is still popular today.

The basic idea is that without a patent an inventor might appropriate sufficient returns from a new process or product by using or producing it while keeping secret the information that imitators would need to have. The possibility of patenting and obtaining additional rents from exclusive rights during the term of the patent serves to *lure* the inventor into making the relevant information public. Thus, the patent grant gives society the relevant information on the new technology in exchange for the right of the patentee to exclude others from its use for the duration of the patent. In the opinion of Mazzoleni and Nelson (1998, p. 278), the information disclosure theory becomes more interesting when it is assumed that the inventor cannot exploit all possible uses of the invention. “Then, to the extent that the publication of a patent attracts the attention of parties who can make use of the invention, patenting can increase use.” Indeed, as Ordovery (1991, p. 50) has pointed out: “When secrecy is the main means of protection, the sale of information through licensing may become quite difficult, if not impossible.” Legally secured disclosure with a patent thus may permit diffusion of new knowledge that could not occur if the information was kept secret without a patent.

The information disclosure theory of patents is well regarded in the Canadian patent policy community. An article entitled “The Canadian Patent System: An Appropriate Balance between the Rights of the Public and the Patentee” by Garland and Want (1999, p. 43) begins as follows:

It is well understood that in Canada the grant of a patent is akin to a contract or bargain between the patentee on the one hand and the government of Canada (representing the interests of the general public) on the other. The patentee receives the grant of an exclusive right to use the patented invention in Canada for a specific period of time in return for fully disclosing the invention to the public by way of the patent specification.

This statement is bolstered with a quotation from Mr. Justice Dickson in a 1981 Supreme Court of Canada decision. But one wonders whether in Canada a patent grant really is such an exchange. There must be very few Canadian patents that, in fact, trigger the disclosure of new knowledge. The same knowledge would have been disclosed in other countries’ patents, or the relevant knowledge in some cases could not have been kept secret for long. It is hard to imagine that an invention would not be patented and disclosed anywhere else just because it could not be patented in Canada. The rationale of the information disclosure theory seems particularly weak with regard to patents for pharmaceutical products. As stated above, the pharmaceutical industry depends on patenting much more than others exactly because it is practically impossible to keep the relevant information secret once the product becomes available on the market. Thus, one can hardly argue that information disclosure is one side of a bargain between the patentee and the public. The reason why Canada grants strong patents for pharmaceutical products is not information disclosure, but its international obligations. Canada is paying its dues and there is no reason to grant stronger patent protection than required by these obligations for the purpose of obtaining more disclosure of new knowledge.

THE EXPLORATION CONTROL FUNCTION

THE *EXPLORATION CONTROL* THEORY applies when an initial discovery or invention is seen as opening up a prospect of follow-on discoveries or inventions. According to this theory, a broad patent on a prospect-opening invention is needed to permit the development of a full range of possibilities to proceed in an orderly fashion (Kitch, 1977). The contention is that, without such a controlling patent, many researchers simultaneously will see the same opportunities implied in a scientific breakthrough and will race to exploit them. “Thus a broad patent on the initial invention is necessary if ‘wasteful mining of the prospect’ or ‘overfishing of the pool’ is to be avoided” (Mazzoleni and Nelson,

1998, p. 279). This contention, however, has been disputed by authors who are concerned about the implications of recent trends towards exceedingly broad and strong patents, even on *embryonic* inventions far removed from any specific practical use (Merges and Nelson, 1990; Mazzoleni and Nelson, 1998, pp. 279-282; Jaffe, 2000, pp. 540-552). An example of such patenting, which has attracted attention in high places as well as in the media, is patents for the human genetic code or segments of it.

Whereas the exploration control function of patenting was intended to prevent a *tragedy of the commons*, some authors are now more concerned about a tragedy of the *anticommons*. A proliferation of fragmented intellectual property rights, along with high transaction costs of bargaining, could deter inventive activity at the frontier of biomedical research (Heller and Eisenberg, 1998).

This is not the place to discuss the complex economics of the optimal scope of patents; the debate has not yet yielded answers that would fit all cases. As concerns Canada's patent policy, it is worth noting that international obligations do not prescribe specific rules for determining the scope of patents. According to Ordover (1991, p.48), the Japanese system of granting relatively narrow patents evolved to meet the needs of an economy depending largely on domestic diffusion of imported technologies and research results. However, more than patent scope was involved. "The Japanese experience illustrates how a patent system that offers a narrow scope and weak novelty requirements can induce licensing, especially if it also creates institutional obstacles for obtaining a patent by means of an expensive and possibly protracted pre-grant opposition process" (*ibid*, p. 49). Thus a combination of institutional factors, a specific historical mix, was behind Japan's successful diffusion policy. One should keep this in mind as we now turn to examining possible changes for some of these factors in the context of Canadian patent policy.

POSSIBLE CHANGES IN PATENT POLICY AND THEIR IMPACT ON THE DIFFUSION OF INNOVATION

CANADA NEEDS TO TOE THE LINE ON TRIPS AND NAFTA

THE TERM POSSIBLE CHANGES IN PATENT POLICY used in this study has two aspects. First, it must be possible for Canada to implement any such changes without violating its international obligations. Second, these changes should be possible or relevant in the sense of being currently on the policy agenda. International constraints on Canada's patent policy stem mostly from the NAFTA (more specifically, chapter 17 of the Agreement) and the TRIPs Agreement. Canada must also comply with the Paris Convention (Paris Convention for the Protection of Industrial Property, Stockholm Text of 1967)

repeatedly referred to and reinforced by the TRIPs Agreement and others governed by the World Intellectual Property Organization (WIPO), such as the Patent Cooperation Treaty of 1970. Here we will concentrate on the TRIPs Agreement, but no attempt can be made to cover Canada's obligations under it comprehensively.²³

The TRIPs Agreement sets minimum standards that all WTO members must adhere to regarding the availability, scope and use of intellectual property rights for seven types of intellectual property, and it imposes enforcement and due process requirements. The Agreement's section on patents defines patentable subject matter, the rights conferred by a patent grant, and the extent of disclosure required from patent applicants (Art. 27-29). The section on patents also includes a vague provision on limited exceptions to the rights conferred by a patent (Art. 30), and a detailed list of conditions that must be met if a member permits other uses without the authorization of the right holder (Art. 31), which is TRIPs vernacular for compulsory licensing. Furthermore, the section on patents stipulates that the term of protection shall be no less than 20 years counted from the filing date (Art. 33), and it ends with the so-called reverse onus provision (Art. 34) stipulating that the burden of proof can be shifted to the defendant in an infringement proceeding if the subject matter of the patent is a process for obtaining a product.

The TRIPs Agreement also imposes standards for the protection of trademarks (Art. 15-21) and for the protection of undisclosed information, often referred to as "trade secrets" (Art. 39). Of particular interest for the pharmaceutical industry is paragraph 39:3, which says that WTO members shall protect and not divulge undisclosed test or other data when these are required as a condition of approving the marketing of pharmaceutical or agricultural chemical products incorporating new chemical entities (subject to narrow exceptions and apparently without time limits). This type of intellectual property in data sets and the protection of trade-marks are important for research-based and brand-name pharmaceutical firms and can provide some protection for the market share of their products beyond the expiry of patent rights (Maskus, 2000, p. 23).

Another type of constraints imposed by the TRIPs Agreement on Canada's policies with respect to the protection and diffusion of intellectual property derives from its anti-discrimination provisions. These are: (1) the National Treatment provision requiring each WTO member to "accord to the nationals of other Members treatment no less favourable than that it accords to its own nationals with regard to the protection of intellectual property" (Art. 3:1); (2) the Most-Favoured Nation Treatment (MFN) provision, requiring each member to grant immediately and unconditionally to the nationals of all other Members any advantage, favour or privilege it is granting to the nationals of any other Member (Art. 4:1); and (3) the provision stating that "patents shall

be available and patent rights enjoyable without discrimination as to the place of invention, the field of technology and whether products are imported or locally produced" (Art. 27:1). Given these constraints, it would not be possible for Canada to apply differentiated rules to the intellectual property of nationals of different countries, though it may be feasible to favour Canadian nationals or firms for the purposes of diffusion policy with measures not covered by the TRIPs Agreement, such as funding or tax policies for R&D. The most important implication of item (3) is that patent owners must enjoy the same rights with respect to imported products as for products manufactured in Canada. Local working requirements for foreign-owned or any other patents are not permitted, except to prevent narrowly defined abuse of patent rights (Gervais, 1998, pp. 148, 162). In accordance with the cited provision from paragraph 27:1, importation is sufficient to meet local working requirements that would still be consistent with the Paris Convention (*ibid*, p. 167). Of course, local working requirements have not been a significant part of Canada's patent policy for many years, not even as a sanction for narrowly defined abuse of patent rights (Vaver, 1997, pp. 168-170; and McFetridge, 1998, pp. 78-81).

The history of the TRIPs Agreement shows that its patent provisions were shaped largely through lobbying by major research-based U.S. and multinational pharmaceutical producers (Ryan, 1998; Gervais, 1998; and Sell, 1998). The most important achievements of this lobbying (mostly resisted by the developing countries) were: mandatory availability of product patents in addition to process patents, equal protection with respect to imported products, severe restrictions on compulsory licensing, and stringent obligations for all members to enforce intellectual property rights in their jurisdiction and at their border. Moreover, the integration of the TRIPs Agreement into the WTO system enables members to avail themselves of the WTO dispute settlement mechanism if other members violate the TRIPs obligations (Stegemann, 2000, pp. 1252-1263). In practical terms, the pharmaceutical producers and their trade associations are largely responsible for the vigilant enforcement of TRIPs provisions. These interests monitor foreign intellectual property policies for violations and routinely petition their home governments to make certain that other countries comply with their obligations. The dominant WTO members represent their domestic intellectual property interests by means of more or less subtle diplomatic pressures and invoke the formal WTO dispute settlement procedures only occasionally (Ryan, 1998; and Braithwaite and Drahos, 2000). Still, a significant percentage of formal disputes brought since the WTO was established on January 1, 1995 concerns the TRIPs Agreement, and a large percentage of these is based on complaints by pharmaceutical producers about violations of the Agreement's patent provisions (WTO, 1999, pp. 72-73, 75-79). Two of those disputes involved Canada (Howse, 2000).

The image of *toeing the line* in the heading of this subsection has two applications. One is that Canada has no choice but to accept the obligations stemming from the TRIPs Agreement and the intellectual property provisions of the NAFTA Agreement. In cases where the limits of these obligations are ambiguous or not fully tested, Canada may still wish to be cautious. Developing countries are more likely to persuade a WTO panel of the merits of their diffusion policies, if a dispute is adjudicated under the WTO dispute settlement procedures. Certainly, the United States and the EU would not let Canada get away with a violation of its TRIPs obligations, or even a generous and possibly precedent-setting interpretation of the exceptions provisions. Since more than 80 percent of Canadian exports are destined for the U.S. market, Canada is especially vulnerable to diplomatic pressure from the United States; and there are always sensitive issues like exports of softwood lumber or wheat on the bilateral agenda to exert diplomatic leverage.

The second application of *toeing the line* is that Canada should not amend its patent laws or otherwise change its patent policy in ways that strengthen the protection of intellectual property beyond the TRIPs and NAFTA obligations, unless it can be demonstrated that such changes are in Canada's national interest, which includes rapid domestic diffusion of new technologies. By the same token, if the protection of intellectual property could be reduced without violating clearly understood international obligations, and if it can be demonstrated that such changes could increase or speed up the domestic diffusion of technology, Canadian law and policy should be amended accordingly. This is just another way of stating the dues-paid approach discussed in the section entitled *Implications of Patent Theory for Canada's Patent and Diffusion Policy*.

EARLIER AND FULLER DISCLOSURE OF PATENT APPLICATIONS

FOR NEW KNOWLEDGE OR TECHNOLOGY to be diffused (applied widely), potential users other than the inventor must be able to learn it. Disclosure of an invention in the patenting process is one of the vehicles for disseminating new knowledge. Changing the rules to speed up disclosure or to increase the amount of information disclosed may thus raise the speed of diffusion. On the other hand, changing the rules in Canada may not do much, if the relevant information is available at the same time or earlier from other sources, or if the disclosed information cannot be used until some later date, such as after the expiry of the patent term, in any event. With the proviso that both *ifs* may apply in the case of pharmaceutical product patents, let us now consider the existing rules for disclosure and potential changes thereof.

As concerns the quantity and quality of information, Canadian law (*Patent Act*, s. 34(1)(b)-(c)) conforms with what is prescribed in the TRIPs Agreement (Art. 29:1):

Members shall require that an applicant for a patent shall disclose the invention in a manner sufficiently clear and complete for the invention to be carried out by a person skilled in the art and may require the applicant to indicate the best mode for carrying out the invention known to the inventor at the filing date or, where priority is claimed, at the priority date of the application.

Patent applications must be written to satisfy the criteria for patenting (usefulness, novelty and non-obviousness), and the claims that determine the scope of protection must be as broad as is justifiable to discourage infringement or to increase the prospect of winning an infringement dispute. For these reasons, patent applications are likely to disclose more than the bare minimum of information needed to satisfy disclosure requirements even if a patentee wishes to reveal as little as possible to competitors (Vaver, 1997, pp. 138-143).

The TRIPs Agreement is silent on the deadline for disclosure. But publication of patent applications 18 months from the earliest of the filing date or the priority date is now the international standard, including Canada, since 1989.²⁴ The filing date of a patent application in any particular country is important for several purposes. In particular, it constitutes the date from which the term of a national patent is calculated. When the applicant wishes to obtain a patent for the same invention in more than one country (which is usually the case), the filing date of the first application determines the priority date of subsequent applications for the same patent. For certain important purposes, such as the evaluation of novelty and non-obviousness, the later applications will be treated as if they had been filed on the same day as the earliest application. This substitution of dates is valid only for subsequent filings occurring within 12 months of the filing for priority.

The right of priority can be obtained in several ways. It can be based on a national application, for example by first filing an application in the United States, and then obtaining priority under the Paris Convention for subsequent applications elsewhere. The same can be done by first filing a regional application, such as through the European Patent Office (EPO). The third way is filing an international application under the provisions of the Patent Cooperation Treaty before filing national or regional applications for the same patent. In each case, the contents of the patent application are disclosed 18 months after the priority date, which coincides with the date of the first filing. If priority is established through an international filing under the Patent Cooperation Treaty, disclosure takes the form of an *international publication*, meaning that the application is published in several major languages, at least saving the

applicant, relevant national patent offices and some interested third parties the cost of translation (WIPO, 1998, pp. 274-279).

Publication of a patent application discloses the invention and gives notice of the scope of protection which may be obtained if a patent is granted. This disclosure is important both for the applicant and for potential users of the claimed invention. The applicant may wish to advertise the invention to potential licensees. The date of disclosure is relevant in infringement actions, since the patent owner can prove an infringement only if the prohibited act was done after the publication of the patent application (Garland and Want, 2005, p. 6, note 30).²⁵ As for the potential users of the claimed invention, some need to learn the disclosed information because they are potential licensees, others as rivals who may wish to invent around the pending patent or to challenge its validity, others still as innocent users who have to discontinue an infringing application. It is conceivable that any of these groups would welcome earlier publication of patent applications pending in Canada.

For the purposes of diffusion policy, it should be recalled that most countries moved from a system of post-grant publication to the present 18-month-from-filing rule because they wanted to enhance domestic industrial development through earlier disclosure of new technologies (Ragusa, 1992, pp. 144-145, 160-163). The question is whether disclosure earlier than 18 months from the date of filing is feasible and whether it would matter much for purposes of the diffusion policy.

A certain amount of time is needed to examine applications for formal requirements and to allow applicants to correct any defects discovered before publication can occur. In most cases, this examination takes place first at the international or regional stage of the process and then at the national stage. Most patent applications in Canada are not first filings. Since an applicant preserves priority rights by filing in Canada within 12 months of the priority date, it would not seem feasible to reduce the lag between the first filing and the publication of patent applications in Canada to less than 12 months from the priority date. In limiting cases, this would imply that publication would occur immediately after the application is filed in Canada, and this would be possible only if the results of earlier examinations at other patent offices were deemed to satisfy the requirements of Canadian law.²⁶

Would it matter much for the purposes of diffusion policy that patent applications were published six months earlier than is presently the case? In many cases, this would be inconsequential; reducing the lag between the first filing and disclosure by six months may simply increase the lag between disclosure and potential diffusion (wider use of a new technology) by the same number of months. This clearly would be the case when potential diffusion becomes possible only after the patent expires, as is the case for the production of generic substitutes of patented drugs. Similarly, diffusion by licensing may not be accelerated

at all by disclosing the contents of patent applications six months earlier, where licensing has to wait until a patent is granted. On the other hand, certain procedural steps aimed at reducing uncertainty about the validity of an applicant's claims, such as pre-grant opposition, could be taken sooner if disclosure occurred earlier. Whether and how this would affect the diffusion of new technology will be examined in the subsection below entitled *Additional Grounds for Pre-grant and Post-grant Opposition*.

THE LENGTH OF THE DEFERMENT PERIOD AND THE DIFFUSION OF INNOVATION

UNDER CURRENT CANADIAN LAW (s. 96(1) of the Patent Rules), an applicant can defer the examination of a pending patent for five years from the filing date. Prior to October 1996, the deferment period was seven years; the reduction from seven to five years was made in 1993 for *operational* reasons. Deferring the request for an examination is likely to be useful to an applicant who is uncertain about the market prospects of the invention and/or expects resistance from the Patent Office. Deferment does not extend the term of a patent, if granted, nor can it be used to keep an invention secret. The term of a patent runs from the filing date, and an application becomes public 18 months from filing, regardless. If no request for examination is made within the specified period, the application lapses. The question to be examined here is how a change in the length of the deferment period might affect the diffusion of new technologies.

Heller (1995, p. 244) reports data provided by the CIPO; in the case of biotechnology inventions, the average time between the date of filing (or the priority date) of an application for a patent and the date of the request for examination was 12.57 months for the 6,604 applications filed between October 1, 1989 and September 24, 1993. The average lag from the request for examination to the date of issuance of the first Patent Office action on the merits of the application was 19 months. Thus, it appears that the actual deferment period was not all that long on average; it seems short compared to the subsequent delay at the Patent Office. However, this information is a snapshot of applications filed during a four-year span. Over that period, only 17.42 percent of biotechnology applicants and 30.81 percent of non-biotechnology applicants requested examination. It would be interesting to learn what the average term of deferment was for applicants who eventually requested examination, and what percentage used the full deferment period allowed under Canadian law. Were the constraints binding for some applicants? Are there distinct patterns of deferment time used by type of technology, size of firm, national origin of inventions, or breadth of patent claims?

Heller (*ibid.*, pp. 257, 263) points out that members of the Canadian biotechnology industry consider the deferment of examination as an important option in their patent strategies, and this option is closely related to another element of their strategies: seeking broad blocking patents, or at least making broad blocking patent applications. Patent applicants may have one or several of the following reasons when invoking the right to defer examination for up to five years: (1) the applicants can establish a priority date for an invention without immediately committing themselves to the full process of patenting, which is an advantage especially when the outcome is uncertain; (2) they may wish to wait for other patent offices to determine the patentable scope of claims before requesting examination in Canada (Wainwright, 1997, p. 67); (3) pending applications, especially those containing broad claims, may prevent competitors from manufacturing, using or selling products covered by the claims or from using processes covered; for competitors, the outcome may be more uncertain than for the applicant; (4) the claims of a broad patent are likely to be restricted during examination, or a patent could be denied, but the applicant may be able to get a head start in using the claimed technology or even sell it, as long as the outcome is still uncertain; and (5) applications containing broad claims may assist the applicant or prospective licensees in attracting development capital.

We are unable to determine how broadly applicable these motivations for deferment are. Tentatively, we conclude that because of reason (1), deferment may promote diffusion as new knowledge may be disclosed earlier. Reasons (4) and (5) taken by themselves may point in the same direction, thus uncertainty could sometimes speed up diffusion, once *prima facie* validity is established (*ibid.*, p. 67). Reason (2) seems neutral as far as its impact on diffusion is concerned. However, reason (3) must be considered a clear impediment to diffusion that could not prevail for as long a period of time if the deferment period was shorter. If deferment should remain an option in Canada for any of the other reasons, the blocking effect of reason (3) could be reduced by giving third parties a right to request an early examination.²⁷

As a practical matter, it seems that applicants who file for priority outside Canada could always defer examination of their Canadian applications by up to 12 months without losing priority here. To that, one could add the time taken by the Patent Office to examine the application. Deferment periods do not exist in other important jurisdictions. In the United States, the examination sequence is initiated with the filing of the application; examination does not have to be requested as in Canada (Wainwright, 1997, p. 68). In Japan, deferment does not exist either under current law (Ohtsuka, 1997, p. 343).

ADDITIONAL GROUNDS FOR PRE-GRANT AND POST-GRANT OPPOSITION

IN SEVERAL JURISDICTIONS, patent law provides for opposition procedures to allow third parties to present objections to the grant of a patent or certain claims stated in the patent application. An opposition may be filed before a patent is granted (pre-grant opposition), or after (post-grant opposition). Canadian law currently does not have a formal opposition procedure; however, Canada has taken two modest steps in the direction of such procedures (Garland and Want, 1999, pp. 45-47; also 2005, pp. 6-8).

Pursuant to s. 34.1 of the *Patent Act*, any person may file with the Commissioner of Patents *prior art* consisting of patents, published applications and printed publications which the person believes to have a bearing on the patentability of a claim in a pending application. After a patent has been granted, any person may, pursuant to s. 48.1, request a re-examination of any claim of a patent by filing prior art and submitting written representations. A re-examination board then determines whether a substantial question of patentability has been raised. In the affirmative, the patentee is given an opportunity to reply and set out its case. The re-examination board has the power to cancel any or all claims it determines to be unpatentable.

According to Garland and Want (1999, p. 47), both provisions have not been used to any great extent. They speculate that “this is because of the belief that, should the adverse party be unsuccessful at this stage, the result may prejudice its position if it should subsequently need to challenge the validity of the patent before a court.” A court proceeding offers greater opportunities, for parties that have the resources, to challenge the validity of a patent, because in a trial all aspects of a patent can be re-examined and expert testimony can be introduced. The mere right to file prior art with the Commissioner of Patents obviously pales in comparison with what can be done before a tribunal.

While the actual effect appears to be very limited, Garland and Want (1999, p. 46) argue that the rudimentary opposition provisions are among the “checks and balances in the Canadian patent system” intended to correct for the “initial imbalance” favouring the interests of the patentee over the interests of the general public. In their opinion, such imbalance can result from the relatively weak Canadian examination process, which is less rigorous than the process conducted by the U.S. Patent Office or the EPO. This is the principle of opposition provisions. As Kingston (2001, pp. 416-417) stated in a slightly different context, “... the best imaginable search engine is the vigilance of firms likely to be affected competitively” if a disputed patent claim were granted. Opposition provisions should help rid the market of patent protection for technology that ought to be free for all to use because it does not meet the conditions

of patentability. Successful opposition thus can promote the diffusion of technology that no one should be allowed to monopolize.²⁸

Canada could make several changes to achieve this objective. First, it should be possible to base an opposition on non-compliance with any substantive patentability requirement. In addition to the lack of novelty as evidenced by prior art, opposition could be based on the lack of an inventive step or of industrial application, or on insufficient disclosure of the invention. The European Patent Convention (EPC) allows all of these grounds for post-grant opposition, which will be reviewed here because it is more explicit and formal than the EPC's provision for pre-grant opposition known as the filing of *observations* by third parties.²⁹ Opposition can also be based on the ground that something is not regarded as an invention under the EPC, a relevant example being "discoveries, scientific theories and mathematical methods" [Art. 52 (2)(a)]. This could be a ground on which to oppose the patenting of research tools, if such patenting cannot be challenged for lack of industrial application.

Finally, opposition could be based on the ground that something is considered an exception to patentability. Article 53 of the EPC contains two categories for which patents shall not be granted: "(a) inventions the publication or exploitation of which would be contrary to the 'ordre public' or morality ..." and "(b) plant or animal varieties or essential biological processes for the production of plants or animals" with the exception of microbiological processes or the products thereof. For both categories, opposition from third parties presumably could help prevent patenting in borderline cases. However, for the first category, one probably would not wish the lack of patentability to result in broader diffusion. Besides, for both categories the TRIPs Agreement stipulates that inventions thus excluded from patentability must not be commercially exploited in the acting country (Maskus, 2000, p. 20).

Providing additional grounds for opposition is one way of reducing the risk that patents may be granted for technologies that do not meet patentability requirements. Another way is a procedural reform aimed at reducing the cost of resolving patent disputes. Indeed, the two types of reform are close complements because available grounds for opposition will not be used if the cost of winning an opposition procedure is prohibitive. To reduce the high cost of patent litigation, Kingston (2001, pp. 411-415) has proposed compulsory arbitration of disputes, with legal aid for the respondent party in the event of an appeal to the courts of an arbitration decision. We believe that this proposal can be adapted to turn Canada's post-grant examination procedure into a more effective tool of diffusion policy.

As Kingston sees it, an "important reason for the high levels of patent litigation cost is the use of the same Court arrangements for settlement of what are at heart technical issues, as for non-technical disputes" (p. 413). Therefore, he recommends arbitration by a panel of independent technical experts, as exists

in the United States in the form of the Board of Patent Appeals and Interferences (p. 414). This type of board, which would decide on the merits of opposition at the re-examination stage under Canadian law, should provide for compulsory arbitration with limited appeals to the courts. If arbitration is voluntary, it is not used in intellectual property disputes “where the cost of litigation intimidates — and is indeed intended to intimidate — attempts by a weaker party to obtain justice” (p. 413). Since any form of arbitration must allow for appeal to the courts, it may seem that the cost and intimidation would still discourage weaker parties from using opportunities for opposition. Therefore, Kingston recommends compulsory arbitration with a special feature added: legal aid for the party which accepted the arbitrator’s decision, i.e. the respondent in an appeal case. Kingston considers that it is most unlikely such legal aid would cost very much. His argument in support of legal aid is based on the assumption that, without it:

[n]o small- or medium-size firm would ever appeal, both because it would lack the resources to litigate and because to do so would give a gratuitous advantage to its opponent by shifting the ground of the battle to where the latter is likely to be stronger. Large firms would also see many convincing reasons for not appealing, once they were no longer able to bring their financial advantage to bear (pp. 414-415).³⁰

Elsewhere in this series, Hall (2005) reports on joint work in progress, comparing the effects of patent opposition under U.S. and European (EPC) law. We can only refer to this research, which is much more comprehensive and analytical than anything available in the literature, but not sufficiently advanced at the time of writing for us to comment on the implications for Canada’s options for opposition procedures.

PATENT TERM RESTORATION AND THE DIFFUSION OF INNOVATION

PATENT TERM RESTORATION (PTR) is a relatively recent issue in patent policy, and is entirely specific to the pharmaceutical sector. The basic idea of PTR is that, in the case of innovative prescription drugs, the patent term should be extended beyond the standard length of 20 years from the date of filing to compensate the patent owner (fully or partially) for the time taken by the government’s regulatory review before a patented drug is approved for marketing. This concept has been implemented under U.S. patent law since the passage of the *Hatch-Waxman Act* in 1984. Japan followed with a PTR amendment to its patent law in 1987 (Ohtsuka, 1997, p. 344), and the European Union adopted a regulation in 1992 requiring member countries to provide for the equivalent of PTR with a construct outside patent law, named the Supplementary Protection Certificate (Tritton, 1996, pp. 115-120; and Moore, 1998). Canada does not

grant PTR. Research-based pharmaceutical producers have suggested that this constitutes a *gap* in Canada's protection of drug patents which needs to be closed. The TRIPs Agreement does not require PTR and is silent on the issue. The NAFTA (Art. 1709:12) recognizes that a member country may provide for PTR "in appropriate cases, to compensate for delays caused by regulatory approval processes."

The official name of the *Hatch-Waxman Act* is *The Drug Price Competition and Patent Term Restoration Act* of 1984. As Wheaton (1986) has shown, the Act was a quid pro quo to satisfy simultaneously the demands for legislative action expressed by two segments of the U.S. pharmaceutical sector: the generic drug producers and the brand-name or research-intensive drug producers. For the generic producers, the Act made two key changes to speed up the introduction of generic copies of brand-name drugs as their patent expires (CBO, 1998, pp. 43-45). One was an amendment to the U.S. *Food, Drug, and Cosmetic Act* to permit generic producers to submit generic copies for approval under an abbreviated New Drug Approval Application (ANDA) procedure. Prior to the amendment, the U.S. Food and Drug Administration (FDA) for a time had "insisted that each application for the approval of a generic drug must be supported by test data of the same quantity and scope that a full New Drug Application (NDA) for a pioneer drug would contain" (Wheaton, 1986, p. 440). Subsequent to the amendment, ANDAs for generic copies were acceptable if they contained the following information (*ibid*, p. 458):

that the approval is sought only for uses already approved for the pioneer drug; that the active ingredients and the route of administration, dosage form, and strength of the new drug are the same as those of the pioneer drug; that the generic is bioequivalent to, and bioavailable to the same extent as, the pioneer; that the labelling of the generic will be the same as that for the pioneer; the details of the ingredients and manufacturing process of the generic; and a certification that approval of the ANDA will not violate a patent held by the maker of the pioneer.³¹

The other important pro-generic amendment enacted by the *Hatch-Waxman Act* was the statutory reversal of the *Bolar* decision rendered by the U.S. Court of Appeals for the Federal Circuit (*Roche Products, Inc. v. Bolar Pharmaceutical Co.* 1984). In that case, the court held that a firm's use of another firm's patented active ingredients to perform the tests necessary to obtain approval of a generic version of the patented drug was an infringing use under patent law; testing by a competitor would not fall within the experimental use exception. As a result, because the active ingredient essentially is the drug to which a generic copy must be equivalent, the *Bolar* decision prevented any meaningful testing, including testing for bioequivalence and bioavailability, until the relevant patents expired; and this could have delayed the market

entry of generic copies for several years (Wheaton, 1986, p. 448). The *Hatch-Waxman Act* overruled the *Bolar* decision by amending the U.S. *Patent Act* to say that it is not a patent infringement to make use of a patented invention solely for uses reasonably related to the development and submission of information under a federal law regulating the manufacture, use or sale of drugs. According to Wheaton (*ibid*, pp. 462, 484), this amendment was broad enough to permit the use of a patented product for testing not only to submit an ANDA for an exact generic copy, but also for testing to submit a full or supplemental NDA on a new drug use, a new dosage form, or a combination drug product that could not be formulated without the pioneer compound.

In exchange for the two major pro-generic measures, the *Hatch-Waxman Act* made available two forms of enhanced protection for products of research-intensive pharmaceutical firms. One of these was a set of Market Exclusivity Grants for drugs approved by the FDA in full or supplemental NDAs (*ibid*, pp. 463-464; and CBO, 1998, pp. 41-42). This form of incentive for invention had previously been legislated for a more limited purpose in the 1982 *Orphan Drug Act*. The other measure of the Hatch-Waxman package favouring research-intensive firms was an amendment to the U.S. *Patent Act* to provide for PTR. In principle, an extension of a drug patent's basic term is granted to compensate for the regulatory review period, subject to three limits: the maximum extension is 5 years; the sum of the extension and the portion of the basic term remaining after the regulatory review is completed cannot exceed 14 years; and PTR can be granted only for one patent per newly approved chemical entity (Wheaton, 1986, p. 466).

At the request of the Chairman of the U.S. Senate Committee on the Budget, the CBO has studied the effects of changes made by the *Hatch-Waxman Act* along with other changes affecting the U.S. pharmaceutical sector (CBO, 1998). The study found that, on average, PTR added 3 years to the term of new drugs approved between 1992 and 1995 (*ibid*, pp. 39-40). Taking into account the change in the basic patent term (previously 17 years from patent grant, now 20 years from filing) and increases in the time needed for approval, the average period of marketing under patent protection rose from 9 years before the Hatch-Waxman changes were made in 1984 to about 11.5 years in 1994. During the same period, the lag between the expiry of a patent and generic entry into the market declined from usually 3 to 4 years before the *Hatch-Waxman Act* to frequently 1 to 3 months in 1994 (*ibid*, pp. 38-40). Thus, on balance, the average point of entry of generic competition now occurs slightly earlier than before the *Hatch-Waxman Act* for patents affected by it; on average, the 2.5 years of extra patent protection for innovative drugs did not fully compensate for the effects of much speedier generic entry. Moreover, in 1983, only 35 percent of the top-selling drugs no longer covered by patents had to compete with generic copies. Today, nearly all do (*ibid*, pp. 37, 45).

The CBO estimates that the present value of the total profit stream from marketing an innovator drug throughout its productive life, discounted to the date of market introduction, has declined by roughly 12 percent between 1984 and 1994 (*ibid*, p. 47). However, in response to industry proposals to further increase the term of patent protection for research-intensive pharmaceutical products, the CBO points out that accelerating the FDA review by one year would have a much greater effect on the present discounted value of the returns from marketing a new drug than lengthening the patent term by one year. “Thus, reducing FDA approval times — if it could be done without sacrificing safety concerns — would be more effective in helping both the drug industry and consumers” (*ibid*, p. 49).

In the section entitled *Implications of Patent Theory for Canada's Patent and Diffusion Policy*, we distinguished four basic functions of patent grants. Only two could be served by PTR, the invention motivation function and the induce commercialization function. The information disclosure function and the exploration control function are clearly not affected when the issue is whether the term of patent grants for new chemical entities should be extended by a couple of years. Indeed, in its study of the effects of the *Hatch-Waxman Act*, the CBO refers exclusively to the invention motivation function of drug patents stating that “temporary monopoly status is often necessary to provide sufficient incentives for drug companies to invent new products that benefit consumers” (p. 3). However, it should be understood that the CBO does not resolve the question of whether the term of the temporary monopoly status that resulted from the *Hatch-Waxman Act* and other changes affecting the U.S. pharmaceutical sector is too short, too long, or just right. “No one knows whether that (the current) amount of investment in R&D is over or under the optimal level” (p. 48). This is just too difficult a question to answer.

The CBO estimated the effects of changes in the length of the patent term, including PTR, on the returns from marketing the average innovator drug (*ibid*, pp. 45-49). The CBO assumes, probably correctly, that a further extension of the patent term would result in additional invention of new drugs because a longer term means higher profits, and then concludes that reducing the time needed for drug approval would be a better policy option. Yet, if legislators chose to grant further PTR or an enhanced period of market exclusivity, perhaps because approval delays could not be shortened significantly, nobody would know whether the benefits of increased inventive activity would cover the costs to the U.S. national welfare of higher drug prices and delayed diffusion of new technology. When the *Hatch-Waxman Act* and prior attempts at legislating PTR were debated, the proponents of longer patent terms claimed that research-intensive drug producers were near an innovation crisis, whereas opponents, including then Congressman Al Gore, called PTR an expensive and unnecessary giveaway (Wheaton, 1986, p. 450; and Gore, 1982).

With respect to industry demands to make PTR available in Canada, the issue is clearer. We can refer back to the discussion about the implications of the invention motivation function of patents in the section above entitled *The Invention Motivation Function*. Decisions on research programs for discovering new chemical entities are made in relation to the expected profitability of research expenditures on a worldwide basis. It is inconceivable that PTR in Canada would significantly affect those decisions. Making PTR available for patented innovator drugs sold in the Canadian market would not result in significant benefits to Canadians from additional invention on a worldwide scale. Even if there were some marginal benefits, they would not compensate for the costs of PTR in terms of delayed diffusion and higher prices for the vast majority of innovator drugs that would also be available without PTR in Canada.³² The effects on diffusion could be drastic if PTR sufficiently shortened the remaining commercial life of a product to discourage the entry of a generic producer who might have entered at the end of the standard patent term.³³

A counter argument has been made that the absence of PTR could cause Canadian innovative firms to re-locate in the United States (Heller, 1995, p. 255). We wonder what the logic of this argument is. Canadian inventors of new drugs always apply for U.S. patents. Indeed, they typically apply for a U.S. patent before they apply for one in Canada because the U.S. market is much more lucrative. Re-locating to the United States could not generate any benefit in the form of added patent protection, because Canadian innovators obtain the benefits of U.S. patent law in any event. It is hard to imagine that U.S. patent law would deny PTR to Canadian nationals and firms because of the location of their business if their inventions otherwise qualify for it. This would be ruled out by the non-discrimination provisions of international agreements and conventions discussed in the subsection above entitled *Canada Needs to Toe the Line on TRIPs and NAFTA*, of which the United States is also a member.

Introducing PTR in Canada could accentuate the timing problem faced by Canadian generic producers when the viability of producing a generic substitute depends on exports to the U.S. market. The timing problem arises because inventors often delay filing of patent applications from one country to the next, and applications are filed in Canada with a delay. Let us first consider the consequences of this delay for generic producers without PTR in any country. "If a company files first in the United States and second in Canada one year later, then the U.S. patent would expire one year sooner. But a Canadian based generic drug company would not be able to manufacture in Canada for export to the U.S. market for the one year during which the patent is still in effect in this country. Hence, Canadian generic drug exporters are disadvantaged by this rule, which enables the U.S. patent holder (or another U.S. producer) to corner the generic market for its product in the United States while the Canadian company is effectively blocked from market entry" (Heller, 1995, p. 258).

As McFetridge (1998, pp. 85, 88) pointed out, Canadian producers of generic copies still had a head start in export markets when they were able to obtain early compulsory licences for production in Canada. Of course, these are long gone. When PTR was granted in the United States, but not in Canada, the timing problem must have shifted to the disadvantage of U.S. generic producers whenever the U.S. patent over a pioneer drug was granted an extension of more than one year. With equivalent PTR in Canada (for the same product and same duration), the timing advantage of U.S. generic producers (as described by Heller, quoted above) would be restored. Thus, if one is concerned about Canadian generic firms re-locating production to the United States, introducing PTR in Canada could be a counter-productive move.

SUMMARY AND CONCLUSIONS

DIFFUSION OF INNOVATION IS DEFINED as the way in which innovations spread throughout the economy. It can be traced with the help of three sets of indicators.

First, diffusion of new products and processes can be measured by the rate of their adoption among potential users, or by their share of total industry output. In some studies, the definition of innovation is narrowed down to a selection of significant breakthrough products, and their diffusion is measured by the market share they capture over a specified period of time. These indicators have been used in studies of drug innovation. Their advantage is the availability of detailed marketing data. One of their weaknesses is the different definitions of innovation (a product or process new to the firm, to the industry, to the country, or to the world). The various lists of significant innovations by definition include an element of subjectivity.

The second set of measures of diffusion is based on patent counts, patent citations, and bibliometric analysis of citations of scientific literature in patents. The strength of these measures derives from the pervasiveness of patents (especially in the pharmaceutical industry) and relatively easy access to this information. Their weaknesses (discussed in detail in the third section) include the varying propensities to patent across firms and industries, and the highly uneven distribution of patents' economic value. Published studies of patent citations of scientific literature demonstrate heavy dependence of pharmaceutical innovation on the diffusion of knowledge from universities and government laboratories. In contrast to many other industries, innovation in the drug industry depends much less on the interaction of innovating firms with users and suppliers.

The third set of indicators focuses either on supply-side aspects of innovation, for example, on R&D spending and the number of scientific personnel, or on demand-side factors, for example, public and private spending on drugs, or

more generally health care spending. (Some of these indicators measure the potential for creation of new knowledge, rather than the diffusion of innovation narrowly defined).

Theories of innovation diffusion emphasize the importance of profitability and the risk and uncertainty surrounding the adoption of innovations. In the pharmaceutical industry, the risk and uncertainty are mediated by the regulatory approval process. The profitability of innovation and its adoption is significantly affected by patent protection and by generic competition. Our review of the literature suggests that a tightening of regulatory standards may improve the quality of innovations (Jacobzone, 2000, p. 18). The imposition of government controls on prices of prescription drugs in major world markets not only reduces the amount of innovation, but may also negatively affect its quality (*ibid*, p. 37).

Patents are important for innovation generally, but more so in the pharmaceutical industry than in most other industries. In the United States, the adoption of the *Hatch-Waxman Act* in 1984 strengthened patent protection for innovative drugs by extending the patent term; at the same time, it weakened the market position of brand-name drugs by facilitating the entry of generic competitors after patent expiry. Several studies (for example, Grabowski and Vernon, 1987; and CBO, 1998) concluded that the net impact of this initiative was a slight encouragement of innovation. However, additional extensions of the patent term would be less desirable than a shortening of the drug approval process: An extension of patent life adds cash flow at the end of the product cycle, where the present value of the cash flow is low. In contrast, a shorter regulatory approval period would increase cash flow at the beginning of the product cycle, enhance the value of the innovation substantially, and stimulate early additional innovation.

Our analysis of the implications of patent theory for Canada's patent and diffusion policy in the pharmaceutical industry adopts the general framework from Mazzoleni and Nelson (1998). They postulate four functions of the patent system: Motivation of innovation, inducement of commercialization, information disclosure, and exploration control. A summary of our conclusions follows.

It would be difficult to rationalize strong patent protection in Canada on the grounds of the motivation of innovation function because the Canadian market is too small to affect more than marginally the R&D policies of pharmaceutical producers who invent new drugs with a view to marketing them all over the world. Thus, rapid diffusion of innovation should be the primary objective of Canadian patent policy. Canada provides strong patent protection for pharmaceuticals for the reason that this is required by its obligations under international agreements. Canada is paying its dues and cannot be accused of being a free rider on the international R&D system if its patent policy is modified to

promote faster diffusion of pharmaceutical innovations within the scope of discretion remaining under these international agreements.

The induce commercialization function of patents could be a separate reason for extending patent protection in Canada. The notion here is that investors wish to minimize the risk inherent in committing resources to the development and commercialization of innovation. When an invention is protected by a patent, the risk may be reduced. Thus, patent protection could help promote the diffusion of innovation. This is relevant to the debate on the desirability of patenting inventions that result from publicly funded research. We note that the empirical evidence on the induce commercialization function of such patents is the subject of some debate, but do not elaborate the argument, since publicly funded research is the subject of a separate study in this series.

Patents have a well-known function of information disclosure which, in turn, is expected to stimulate the diffusion of new knowledge. However, pharmaceutical patents may be an exception to this general proposition. Once released, a new drug can easily be copied, regardless of whether the information is released through a patent. Rather than promoting the diffusion of new knowledge, a patent delays the diffusion of pharmaceutical innovation, often until after the expiry of the patent. As such, the Canadian patent system cannot contribute much to information disclosure in any event, because most inventions are patented and published elsewhere in the world.

Finally, the exploration control theory of patents applies to situations where an initial discovery opens up many different prospects for subsequent discoveries and inventions. This theory contends that a broad patent is needed to promote orderly development of the full range of possibilities. This may be important in the pharmaceutical industry, since drug innovation has often been characterized by clusters of innovative products derived from a major medical or biochemical discovery. The application of broad patents for results of biotechnological research has become controversial. A meaningful assessment of this controversy would require considerable knowledge of the relevant sciences, and we do not pursue it in this study.

We consider a range of possible changes in Canadian patent policy and their impact on the diffusion of innovation. A discussion of these changes is relevant in that they are currently on the policy agenda, and they are considered within the room for discretion available under Canada's international obligations. In particular, we examine the following: opportunities for fuller and earlier disclosure of Canadian patent applications; changing the length of the deferment period by which the examination of patent applications can be postponed; adding new grounds for pre- and post-grant opposition, as provided by the European Patent Convention; and, finally, providing Patent Term Restoration (PTR) for new drugs in order to compensate for the marketing delay imposed by the regulatory approval process.

PTR was made available in the United States by the *Hatch-Waxman Act* of 1984. The measure was controversial at the time, and a recent study by the Congressional Budget Office (1998, p. 48) concluded that “no one knows” whether the current amount of investment in pharmaceutical R&D is over or under the socially optimal level. For Canada, the issue is more clear-cut. As has been explained, the invention motivation function is not a reason for strong, let alone stronger, patent protection in Canada. The other three functions of patents would not be affected by making PTR available, and PTR is not required by the TRIPs Agreement or any other international agreement.

ENDNOTES

- 1 Knowledge transfer is defined as the use of scientific knowledge by other scientists for the purpose of enhancing science. Technology transfer is defined as the use of scientific knowledge by scientists and others in new applications, or as the movement of know-how, technical knowledge, or technology from one organizational setting to another (Bozeman, 2000, p. 629 and 642). Salter and Martin (2001, p. 521) draw a distinction between information and knowledge. They argue that information only becomes knowledge (and thus valuable) when users have the capability to make use of it.
- 2 By analogy with the transmission of infectious diseases in a population, the probability that a member of the population contracts the disease (that an agent adopts the innovation) initially rises as the number of infected people increases. Eventually, however, the probability declines as the number of members not yet infected (the number of agents available to adopt the innovation) decreases.
- 3 There are exceptions. For example, in Japan, physicians dispense the drug they prescribe and benefit financially from the margin between the reimbursement price and the acquisition price. Similarly in the United Kingdom, *fund-holding* general practitioners who do not spend all their drug budget could reinvest the savings in their practice (Danzon and Chao, 2000, p. 316).
- 4 According to press reports, the French government exhibited considerable reluctance to withdraw from the market drug products shown to be ineffective (or even to reduce the reimbursement for such products). The justification for this reluctance is the damage such withdrawal would cause to drug producers, in particular smaller, French-owned firms. This policy does, of course, have a negative impact on the diffusion of better, but more expensive, new products. (“Pourquoi rembourser les médicaments inutiles?,” *Le Monde interactif*, July 20, 2001).
- 5 More than 88 percent of these agreements were initiated before the project reached the development stage, while 76 percent included a licensing contract (Orsenigo, Pammoli and Riccaboni, 2001, p. 491).

- 6 The list of the leading 15 firms participating simultaneously in agreements of both types includes most of the largest multinational pharmaceutical companies, including Hoffmann La-Roche, Smith-Kline, Abbott, Bayer, Bristol-Myers-Squibb, Merck, Pfizer, etc. (Orsenigo, Pammoli and Riccaboni, 2001, p. 499).
- 7 Several studies show that drug companies with better in-house scientific research programs have exploited more effectively outside scientific information, or that large firms are better able to capture and use both internal and external knowledge spillovers. Similarly, large biotechnology firms with higher internal knowledge pursue more actively external linkage strategies (Veugelers, 1997, p. 305).
- 8 Historically, prescription drugs advertised only to prescribing doctors were described as *ethical* drugs (meaning that it would be unethical to advertise them to the general public). More recently, an increasing number of well-known prescription drugs have been advertised to the public (especially in the United States). This development is the subject of considerable controversy. The amount spent on advertising of prescription drugs to the public in the United States rose from \$35 million in 1987 to \$357 million in 1995, to \$610 million in 1996, and to more than \$1 billion in 1997 (Coscelli, 2000, p. 350). The estimates for 2000 are as high as US\$2.5 billion ("Pill Pushers," *The Economist*, April 1, 2001).
- 9 The IMS database is the usual source of this information.
- 10 Santarelli and Piergiovanni (1996) report the results of their study of product innovations introduced in the Italian industry in 1989, based on a sample of 25 Italian technical and trade journals.
- 11 The others include trade-marks, industrial design, commercial secrecy, imitation lag, learning curve effects, firm-specific skills and know-how, investment in marketing, and customer service.
- 12 This can be remedied by asking patent holders if a commercialized innovation actually exists.
- 13 To minimize the biases in international comparisons of the intensity of innovation diffusion in different industries, patenting of various types of innovations should therefore be expressed as a percentage of total patenting in the country (Lanjouw and Mody, 1996, p. 559).
- 14 There is some evidence that firms whose patents are cited more frequently have higher stock market value (Harhoff, Narin, Scherer and Vopel, 1999, p. 511).
- 15 They obtained estimates of the dollar value of each patent by contacting the owners of a sample of patents. They asked what minimum amount of money the owners would be prepared to accept for selling the patent 17 years before if they had knowledge of the profit history of the invention they presently hold.
- 16 However, leading pharmaceutical companies frequently report R&D spending on human pharmaceuticals as a separate item.
- 17 Some research-based pharmaceutical companies have established generic subsidiaries and are selling both the brand-name and the generic versions of some of their products in two segments of the market (Jacobzone, 2000, p. 25).
- 18 Biotechnology firms are frequently founded by academic entrepreneurs who own patents and possess the tacit knowledge, which no one else is able to exploit.

- 19 This sample accounted for 67 percent of invention disclosures, 70 percent of licences, and 68 percent of revenues received by member institutions of the Association of University Technology Managers (Jensen and Thursby, 2001, p. 242).
- 20 The licensee is also subject to moral hazard in that it may shelve the innovation, or use it for blocking purposes, instead of attempting commercialization. The *Bayh-Dole Act* includes a *march-in* provision allowing the government to take back the invention when this occurs (Jensen and Thursby, 2001, p. 247).
- 21 The first five sources of cited U.S. drug and medicine research papers were the various components of the National Institutes of Health, followed by the American Cancer Society and the National Science Foundation (Narin, Hamilton and Olivastro, 1997, p. 327).
- 22 Mazzoleni and Nelson (1998, p. 278) point out that the *Bayh-Dole Act* has led universities to advertise their inventions more actively. In some instances at least, a patent with information regarding the nature of the invention and its contemplated applications may provide potential users with more, and more practical information than would a scientific publication alone, or the patent may be noticed by a different audience.
- 23 See Maskus (2000, Chapter 3) for a general overview of key provisions of the TRIPs Agreement. Trebilcock and Howse (1999, Chapter 12) offer a more detailed analysis. Watal (2000) provides a most comprehensive and detailed legal interpretation of the Agreement from a developing nation's perspective.
- 24 The United States started publishing patent applications only in 1996 (Todaro, 1996, p. 228). But U.S. inventors can prevent disclosure of their applications if they decide not to file abroad. In such cases, disclosure occurs only if and when a U.S. patent has been granted.
- 25 For these and other reasons it is sometimes advisable to publish the patent application as early as possible (Wainwright, 1997, p. 63 and 67). Canada provides for early publication at the applicant's request, as do the United States and the EPO.
- 26 It seems that international rules would permit Canada to preempt publication in other jurisdictions by six months because, as stated in the preceding footnote, it is possible for applicants to request early publication under present law.
- 27 Under current law, the Commissioner of Patents "may advance an application for examination out of its routine order upon the request of any person ... where the Commissioner determines that failure to advance the application is likely to prejudice that person's rights" [Patent Rules, s. 28(1)]. But this applies only after the applicant has made a request for examination (*ibid*, s. 28(2)).
- 28 For the United States, where previously *impossible* patents have become increasingly possible, Merges (1999, p. 614) concludes: "Creation of a coherent, efficient opposition procedure would be the ideal solution to a number of problems plaguing the current patent system."
- 29 The grounds for post-grant opposition are set out in the EPC, Art. 100 (a) and (b) in combination with Art. 52-57. Pursuant to Art. 99 (1), within nine months of the publication of a European patent, any person may give notice to the EPO of an opposition to the patent granted. The provision for pre-grant opposition in Art. 115(1) says that following the publication of a European patent application, any person may present observations concerning the patentability of the invention

- concerned; the observations must be filed in writing and must include a statement of the grounds on which they are based. There is no restriction to any particular requirements for patentability. For details of the procedures of the EPO Opposition Division, see Tritton (1996, pp. 98-100).
- 30 Kingston (2001, p. 415) lists five convincing reasons which are not reproduced here for reasons of space limitations.
 - 31 If the pioneer then sues the generic firm, it must remain off the market for 30 months or until the infringement suit is resolved, whichever is shorter. (Harris and Adams, 2001). In Canada, the Patented Medicines (Notice of Compliance) Regulations of 1993 have a similar entry-delaying effect, except that the delay is not limited to 30 months (Wilcox and Ripley, 2000).
 - 32 See the sections entitled *The Invention Motivation Function*, and *Counter-arguments to a Dues-Paid Approach*, on Canada's dues-paid approach to patent policy.
 - 33 The arguments against PTR in this paragraph apply also to the lengthening of the basic patent term beyond the mandatory term of 20 years from filing.

ACKNOWLEDGMENTS

WE THANK THE EDITOR for his very helpful comments on a draft of this study.

BIBLIOGRAPHY

- Arundel, Anthony, and Isabelle Kabla. 1998. "What Percentage of Innovations Are Patented? Empirical Estimates for European Firms." *Research Policy* 27, 2 (June): 127-141.
- Berndt, Ernst R., Davina Ling and Margaret K. Kyle. 2003. "The Long Shadow of Patent Expiration: Do Rx to OTC Switches Provide an Afterlife?" In *Scanner Data and Price Indexes*. Edited by Robert C. Feenstra and Matthew Shapiro. Chicago: University of Chicago Press.
- Bozeman, Barry. 2000. "Technology Transfer and Public Policy: A Review of Research and Theory." *Research Policy* 29, 4-5 (April): 627-655.
- Braithwaite, John, and Peter Drahos. 2000. *Global Business Regulation*. Cambridge University Press.
- Congressional Budget Office (CBO). 1998. *How Increased Competition from Generic Drugs Has Affected Prices and Returns in the Pharmaceutical Industry*. Washington (D.C.): Congress of the United States, Congressional Budget Office (July).
- Callan, Bénédicte, and Mario Cervantes. 2005. *Managing Intellectual Property Rights from Public Research*. Ottawa: Industry Canada, Study No. 14 in this series.

- Campbell, Robert M., and Leslie A. Pal. 1989. "The Long and Winding Road: Bill C-22 and the Politics of Drug Patents." In *The Real Worlds of Canadian Politics: Cases in Process and Policy*. Edited by the same authors. Peterborough (Ont.): Broadview Press, Chapter 2, pp. 53-106.
- Cohen, Wesley M., and Daniel A. Levinthal. 1989. "Innovation and Learning: The Two Faces of R&D." *Economic Journal* 99: 569-596.
- Coscelli, Andrea. 2000. "The Importance of Doctors' and Patients' Preferences in the Prescription Decision." *Journal of Industrial Economics* 48, 3 (September): 349-369.
- Danzon, Patricia M., and Li-Wei Chao. 2000. "Does Regulation Drive out Competition in Pharmaceutical Markets?" *Journal of Law and Economics* 43 (October): 311-357.
- Eastman Report. 1985. *Report of the Commission of Inquiry on the Pharmaceutical Industry*. Ottawa: Minister of Supply and Services Canada.
- Eisenberg, Rebecca S. 1996. "Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research." *Virginia Law Review* 82, 8 (November): 1663-1727.
- Freeman, Christopher. 1982. *The Economics of Industrial Innovation*. London: Frances Pinter.
- Gambardella, Alfonso. 1995. *Science and Innovation. The US Pharmaceutical Industry during the 1980s*. Cambridge University Press.
- Garland, Steven B., and Jeremy E. Want. 1999. "The Canadian Patent System: An Appropriate Balance between the Rights of the Public and the Patentee." *Canadian Intellectual Property Review* 16, 1 (September): 43-63.
- . 2005. *The Enforcement of Intellectual Property Rights in Canada*. Ottawa: Industry Canada, Study No. 16 in this series.
- Geroski, Paul A. 2000. "Models of Technology Diffusion." *Research Policy* 29, 4-5 (April): 603-625.
- Gervais, Daniel. 1998. *The TRIPs Agreement: Drafting History and Analysis*. London: Sweet & Maxwell.
- Giesecke, Susanne. 2000. "The Contrasting Roles of Government in the Development of Biotechnology Industry in the US and Germany." *Research Policy* 29, 2 (February): 205-223.
- Gore, Albert Jr. 1982. "Patent Term Extension: An Expensive and Unnecessary Giveaway." *Health Affairs* (Spring): 25-33.
- Gorecki, Paul K. 1986. "The Importance of Being First. The Case of Prescription Drugs in Canada." *International Journal of Industrial Organization* 4: 371-395.
- Grabowski, Henry G., and John M. Vernon. 1987. "Pioneers, Imitators, and Generics – A Simulation Model of Schumpeterian Competition." *Quarterly Journal of Economics* 102, 3: 491-525.
- Grandstrand, Ove. 2000. "The Shift Towards Intellectual Capitalism – The Role of Infocom Technologies." *Research Policy* 29, 9 (December): 1061-1080.
- Hall, Bronwyn H. 2005. "The Global Nature of Intellectual Property: Discussion." Comments on *Canadian Patent Policy in the North American Context*, by Keith Maskus, published as Study No. 11 in this series.

- Harhoff, Dietmar, Francis Narin, Frederic M. Scherer and Katrin Vopel. 1999. "Citation Frequency and the Value of Patented Inventions." *Review of Economics and Statistics* 81, 3 (August): 511-515.
- Harris, Gardiner, and Chris Adams. 2001. "Delayed Reaction. Drug Manufacturers Step up Legal Attacks that Slow Generics." *Wall Street Journal* (Thursday, July 12): A1 and 10.
- Heller, James G. 1995. *Background Economic Study of the Canadian Biotechnology Industry*. Toronto: James G. Heller Consulting.
- Heller, Michael A., and Rebecca S. Eisenberg. 1998. "Can Patents Deter Innovation? The Anticommons in Biomedical Research." *Science* 280 (May 1): 698-701.
- Howse, Robert. 2000. "The Canadian Generic Medicine Panel: A Dangerous Precedent in Dangerous Times." *Journal of World Intellectual Property* 3, 4 (July): 493-507.
- Jacobsson, Staffan, Christer Oskarsson and Joakim Philipson. 1996. "Indicators of Technological Activities – Comparing Educational, Patent, and R&D Statistics in the Case of Sweden." *Research Policy* 25, 4 (June): 573-585.
- Jacobzone, S. 2000. *Pharmaceutical Policies in OECD Countries: Reconciling Social and Industrial Goals*. Labour Market and Social Policy, Occasional Paper No. 40. Directorate for Education, Employment, Labour and Social Affairs. Paris: OECD.
- Jaffe, Adam. 2000. "The U.S. Patent System in Transition: Policy Innovation and the Innovation Process." *Research Policy* 29, 4-5 (April): 531-557.
- Jensen, Richard, and Marie Thursby. 2001. "Proofs and Prototypes for Sale: The Licensing of University Inventions." *American Economic Review* 91, 1 (March): 240-259.
- Karshenas, Massoud, and Paul Stoneman. 1995. "Technological Diffusion." In *Handbook of the Economics of Innovation and Technological Change*. Edited by Paul Stoneman. Blackwell, pp. 265-297.
- Kingston, William. 2001. "Innovation Needs Patent Reform." *Research Policy* 30: 403-423.
- Kitch, Edmund W. 1977. "The Nature and Function of the Patent System." *Journal of Law and Economics* 20, 2 (October): 265-290.
- Klevorick, Alvin K., Richard C. Levin, Richard R. Nelson and Sidney G. Winter. 1995. "On the Sources and Significance of Interindustry Differences in Technological Opportunities." *Research Policy* 24: 185-205.
- Kumar, Nagesh. 2001. "Determinants of Location of Overseas R&D Activity of Multi-national Enterprises: The Case of US and Japanese Corporations." *Research Policy* 30, 1 (January): 159-174.
- Lanjouw, Jean Olson, and Ashoka Mody. 1996. "Innovation and the International Diffusion of Environmentally Responsive Technology." *Research Policy* 25, 4 (June): 549-571.
- Lanjouw, Jean Olson, and Iain M. Cockburn. 2001. "New Pills for Poor People? Empirical Evidence After GATT." *World Development* 29, 2 (February): 265-289.
- Laursen, Keld. 1996. "Horizontal Diversification in the Danish National System of Innovation: The Case of Pharmaceuticals." *Research Policy* 25, 7 (October): 1121-1137.
- Lichtenberg, Frank R., and Tomas J. Philipson. 2001. "Creative vs. Uncreative Destruction of Innovative Returns: An Empirical Examination of the U.S. Pharmaceutical Markets." *The Rand Journal of Economics*.

- Lissoni, F., and J.S. Metcalfe. 1994. "Diffusion of Innovation Ancient and Modern: A Review of the Main Themes." In *The Handbook of Industrial Innovation*. Edited by Mark Dodgson and Roy Rothwell. Edward Elgar, pp. 106-141.
- Machlup, Fritz. 1958. *An Economic Review of the Patent System*. Study No. 15 of the Subcommittee on Patents, Trademarks and Copyrights of the Committee on the Judiciary, United States Senate, 85th Congress, Second Session. Washington (D.C.).
- Mansfield, Edwin. 1998. "Academic Research and Industrial Innovation: An Update of Empirical Findings." *Research Policy* 26, 7-8 (April): 773-776.
- Martin, Stephen, and John T. Scott. 2000. "The Nature of Innovation Market Failure and the Design of Public Support for Private Innovation." *Research Policy* 29, 4-5 (April): 437-447.
- Maskus, Keith E. 2000. *Intellectual Property Rights in the Global Economy*. Washington, (D.C.): Institute for International Economics.
- . 2005. *Canadian Patent Policy in the North American Context*. Ottawa: Industry Canada, Study No. 11 in this series.
- Mazzoleni, Roberto, and Richard R. Nelson. 1998. "The Benefits and Costs of Strong Patent Protection: A Contribution to the Current Debate." *Research Policy* 27, 3: 273-284.
- McFetridge, Donald G. 1998. "Intellectual Property, Technology Diffusion, and Growth in the Canadian Economy." In *Competition Policy and Intellectual Property Rights in the Knowledge-Based Economy*. Edited by Robert D. Anderson and Nancy T. Gallini. Industry Canada Research Series, Volume No. 9. Calgary: University of Calgary Press, pp. 65-104.
- McMillan, Steven G., Francis Narin and David L. Deeds. 2000. "An Analysis of the Critical Role of Public Science in Innovation: The Case of Biotechnology." *Research Policy* 29, 1 (January): 1-8.
- Merges, Robert P. 1999. "As Many as Six Impossible Patents Before Breakfast: Property Rights for Business Concepts and Patent System Reform." *Berkeley Technology Law Journal* 14, 2 (Spring): 577-615.
- Merges, Robert P., and Richard R. Nelson. 1990. "On the Complex Economics of Patent Scope." *Columbia Law Review* 90: 839-916.
- Metcalfe, Stan. 1995. "The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspectives." In *Handbook of the Economics of Innovation and Technological Change*. Edited by Paul Stoneman. Blackwell, pp. 409-512.
- Meyer, Martin. 2000. "Does Science Push Technology? Patents Citing Scientific Literature." *Research Policy* 29, 3 (March): 409-434.
- Moore, James W. 1998. "Patent Term Restoration for Pharmaceutical Products in Europe: The Supplementary Protection Certificate." *Canadian Intellectual Property Review* 14, 2 (March): 137-140.
- Mowery, David C. 1995. "The Practice of Technology Policy." In *Handbook of the Economics of Innovation and Technological Change*. Edited by Paul Stoneman. Blackwell, pp. 513-557.

- Mowery, David C., Richard R. Nelson, Bhaven N. Sampat and Arvids A. Ziedonis. 2001. "The Growth of Patenting and Licensing by U.S. Universities: An Assessment of the Effects of the Bayh-Dole Act of 1980." *Research Policy* 30, 1 (January): 99-119.
- Narin, Francis, Kimberley S. Hamilton and Dominic Olivastro. 1997. "The Increasing Linkage Between U.S. Technology and Public Science." *Research Policy* 26, 3 (October): 317-330.
- Narin, Francis, and Dominic Olivastro. 1992. "Status Report: Linkage Between Technology and Science." *Research Policy* 21: 237-249.
- Ohtsuka, Fumiaki. 1997. "Recent Developments in the Japanese Patent Law." *Canadian Intellectual Property Review* 13, 2 (April): 333-344.
- Ordovery, Janusz A. 1991. "A Patent System for Both Diffusion and Exclusion." *Journal of Economic Perspectives* 5, 1 (Winter): 43-60.
- Orsenigo, L., F. Pammoli and M. Riccaboni. 2001. "Technological Change and Network Dynamics." *Research Policy* 30, 3: 485-508.
- Pavitt, K., M. Robson and J. Townsend. 1987. "The Size Distribution of Innovating Firms in the U.K.: 1945-1983." *Journal of Industrial Economics* 35: 297-316.
- Ragusa, Paul A. 1992. "Eighteen Months to Publication: Should the United States Join Europe and Japan by Promptly Publishing Patent Applications?" *George Washington Journal of International Law and Economics* 26, 1: 143-180.
- Rizzo, John A. 1999. "Advertising and Competition in the Ethical Pharmaceutical Industry: The Case of Antihypertensive Drugs." *Journal of Law and Economics* 42 (April): 89-116.
- Ryan, M.P. 1998. *Knowledge Diplomacy: Global Competition and the Politics of Intellectual Property*. Washington (D.C.): Brookings Institution Press.
- Salter, Ammon J., and Ben R. Martin. 2001. "The Economic Benefits of Publicly Funded Basic Research: A Critical Review." *Research Policy* 30, 7: 509-532.
- Santarelli, Enrico, and Roberta Piergiovanni. 1996. "Analyzing Literature-based Innovation Output Indicators: The Italian Experience." *Research Policy* 25, 5 (August): 689-711.
- Scherer, Frederic M. 1985. "Post-patent Barriers to Entry in the Pharmaceutical Industry." *Journal of Health Economics* 4: 83-87.
- . 1998. "Comment." In *Competition Policy and Intellectual Property Rights in the Knowledge-Based Economy*. Edited by Robert D. Anderson and Nancy T. Gallini. Industry Canada Research Series, Volume No. 9. Calgary: University of Calgary Press, pp. 104-109.
- Scherer, Frederic M., and Dietmar Harhoff. 2000. "Technology Policy for a World of Skew-distributed Outcomes." *Research Policy* 29, 4-5 (April): 559-566.
- Scherer, Frederic M., and David Ross. 1990. *Industrial Market Structure and Economic Performance*. 3rd ed. Boston: Houghton Mifflin.
- Schiff, Eric. 1971. *Industrialization without National Patents. The Netherlands, 1869-1912. Switzerland, 1850-1907*. Princeton University Press.
- Sell, Susan K. 1998. *Power and Ideas. North-South Politics of Intellectual Property and Antitrust*. Albany (N.Y.): State University of New York Press.
- Stegemann, Klaus. 2000. "The Integration of Intellectual Property Rights into the WTO System." *The World Economy* 23, 9 (September): 1237-1267.

- Todaro, John C. 1996. "Potential Changes in U.S. Patent Laws: The Publication of Patent Applications." *Canadian Intellectual Property Review* 12, 2 (August): 227-244.
- Trebilcock, Michael J., and Robert Howse. 1999. *The Regulation of International Trade*. 2nd ed. London and New York: Routledge.
- Tritton, Guy. 1996. *Intellectual Property in Europe*. London: Sweet and Maxwell.
- Vaver, David. 1997. *Intellectual Property Law. Copyright, Patents, Trade-marks*. Concord (Ont.): Irwin Law.
- Veugelers, Reinhilde. 1997. "Internal R&D Expenditures and External Technology Sourcing." *Research Policy* 26, 3 (October): 303-315.
- Wainwright, David S. 1997. "Patent Filing Strategy – Consider Filing More Often, Faster, and in Canada First." *Canadian Intellectual Property Review* 14, 1 (September): 61-73.
- Watal, Jayashree. 2000. "Pharmaceutical Patents, Prices and Welfare Losses: Policy Options for India Under the WTO TRIPS Agreement." *The World Economy* 23, 5 (May): 733-752.
- Wheaton, James J. 1986. "Generic Competition and Pharmaceutical Innovation: The Drug Price Competition and Patent Term Restoration Act of 1984." *Catholic University Law Review* 35: 433-487.
- Wilcox, Peter R., and Daphne C. Ripley. 2000. "The Patented Medicines (Notice of Compliance) Regulations." *Canadian Intellectual Property Review* 16, 2 (April): 429-448.
- WIPO. 1998. *Intellectual Property Reading Material*. Geneva: World Intellectual Property Organization.
- WTO. 1999. *Annual Report 1999*. Geneva: World Trade Organization.

OTHER REFERENCES

- David, Paul A., and Bronwyn H. Hall. 2000. "Heart of Darkness: Modeling Public-private Funding Interactions Inside the R&D Black Box." *Research Policy* 29, 9 (December): 1165-1183.
- David, Paul A., Bronwyn H. Hall and Andrew A. Toole. 2000. "Is Public R&D a Complement or Substitute for Private R&D? A Review of the Econometric Evidence." *Research Policy* 29, 4-5 (April): 497-529.
- Ernst, Holger. 2001. "Patent Applications and Subsequent Changes of Performance: Evidence from Time-series and Cross-section Analyses at the Firm Level." *Research Policy* 30, 1 (January): 143-167.
- Georgiou, Luke, and David Roessner. 2000. "Evaluating Technology Programs: Tools and Methods." *Research Policy* 29, 4-5 (April): 657-678.
- Gorecki, Paul K. 1987. "Barriers to Entry in the Canadian Pharmaceutical Industry." *Journal of Health Economics* 6: 59-72.
- Grandstrand, Ove. 1998. "Towards a Theory of the Technology-based Firm." *Research Policy* 27, 5 (September): 465-489.
- Hitchman, Carol. 1998. "Pharmaceutical Litigation – 1996-97: Where Are the Canadian Courts Going?" *Canadian Intellectual Property Review* 14, 2 (March): 149-172.

- Kingston, William. 2000. "Antibiotics, Invention and Innovation." *Research Policy* 29, 6 (June): 679-710.
- Landry, Réjean, Nabil Amara and Moktar Lamari. 2001. "Utilization of Social Science Research Knowledge in Canada." *Research Policy* 30: 333-349.
- Langford, Cooper H., and Martha Whitney Langford. 2000. "The Evolution of Rules for Access to Megascience Research Environments Viewed from Canadian Experience." *Research Policy* 29, 2 (February): 169-179.
- Stephan, Paula. 1996. "The Economics of Science." *Journal of Economic Literature* 34, 3 (September): 1199-1262.
- Stewart, John H. 1998. "Issues in Canadian Pharmaceutical Patent Legislation: R&D Investments, Drug Prices, and Growth of the Generic Sector." *Canadian Intellectual Property Review* 14, 2 (March): 141-148.



On the Role of Patenting in Innovation for the Biotechnology Industry in Canada

INTRODUCTION

IN MUCH THE SAME WAY that Ponce de Leon explored the New World (1513) in a fruitless attempt to find the Fountain of Youth, Jaffe (2000, p. 531) observed that economists have explored the New Economy trying unsuccessfully to position patent counts as a leading indicator of innovation and economic growth.

Certainly, there is anecdotal evidence to suggest that patent policy and an observed surge in patenting may be precursors to these desirable outcomes. By way of example, Kingston (1999) has highlighted the fact that something akin to a policy shift may have occurred between the failure to patent penicillin — the first great antibiotic — and the patent granted for streptomycin. He suggested that patent policy has changed to protect the underlying investment instead of the flash of creative genius demonstrated by an individual inventor (p. 224). This development predates an increase in the number of patentable inventions from pharmaceutical companies and the development of the pharmaceutical industry, primarily based in the United States.

With the clear success of first-to-market patents to protect investment, an emerging pattern demonstrates that the patenting of new technology products could help new, young businesses and lead to the development of entire industries in the home economy.¹

More recently, the United States has returned to the arena of rights for protecting industrial property to help U.S.-based innovative businesses in general, but more particularly to provide the needed catalyst for the rapid development of young businesses and emerging industries. Examples of the latter

follow from what is arguably the relaxation of the thresholds for patentability on the part of the United States Patent and Trademark Office (USPTO), which has led to patent grants for software since *Diamond, Commissioner of Patents and Trademarks v. Diehr and Lutton* in 1981², for higher life forms since *Diamond v. Chakrabarty* in 1980 for the so-called Harvard mouse in 1988³, and for business methods since *State Street*.⁴

A catalyst with the potential to influence the marketplace more broadly was the creation of the Court of Appeals for the Federal Circuit (CAFC) in 1982, which affected the impact of the U.S. court system in the enforcement of patent rights. Prior to the establishment of the CAFC, there was an element of randomness associated with decisions of U.S. courts on patents. But once sufficient time had elapsed for the CAFC to establish a track record measured by the rate at which it found in favour of patentees, it became clear that USPTO-issued patents were effectively CAFC-backed (government agency issued and backed). One of the interesting outcomes was that patents in the United States could now be perceived to possess traits such as *store of value* and *medium of exchange* normally associated with currencies.⁵ The second noteworthy outcome, in part a spin-off of the first, was the development of an interest among U.S. investors who had previously looked elsewhere for money-making opportunities.⁶

It could be argued that both of these outcomes in the wake of the creation of the CAFC have contributed to the recent observed surge of patenting by U.S. firms. Kortum and Lerner (1999) found that the increase was not limited to larger firms only. However, the literature has tended to concentrate on the patenting activities of larger firms and established industries. For example, Hall and Ham (1999) looked at the semiconductor chip industry in the United States; Levin, Klevorick, Nelson and Winter (1987), and Cohen, Nelson and Walsh (2000) looked at manufacturing in the United States; and Baldwin (1997), and Baldwin, Hanel and Sabourin (2000) looked at manufacturing in Canada. These larger firms tended to engage in patenting activity primarily for the purposes of rent appropriation.

However, Mazzoleni and Nelson (1998, p. 274) pointed to recent studies focusing on the importance of patents for new entrants or small firms, and stressing functions associated with patents that are different from those examined in studies of larger firms. Therefore, it is important to gain a better understanding of what leads these new businesses to patent. The biotechnology industry provides a useful base for such a study because it encompasses many firms that have begun as spin-offs from university research. There are many firms attempting to operate where entry-related costs are relatively low, while the marketplace struggles to differentiate across biotechnologies. In this monopolistic-competitive setting, biotechnology firms use the two levers at their disposal — intellectual or human capital/star scientist appeal and patenting —

to differentiate themselves and their technologies from their competitors in order to attract investment.

The situation facing biotechnology firms in Canada is hardly comparable in these respects to the context in which U.S.-based firms operate. There is no Canadian equivalent for the CAFC, and Garland and Want (1999) found court support for patent holders to be somewhat less than a sure thing. Patenting in the newer technologies such as software and business methods remains very much a policy issue, and the issue surrounding the ability to patent the Harvard mouse is before the Supreme Court of Canada.

Biotechnology firms located in Canada are able to obtain patents from the USPTO, which permits an examination of the patenting behaviour of the biotechnology industry in Canada. In particular, this study will evaluate the roles of expenditures on research and development (R&D) and counts of patent applications premised on the Kingston (1999) argument that patents aim to protect investment. We shall attempt to find empirical support for the hypothesis that applying for patents helps firms to create new economically valuable knowledge, leading to more innovation and economic growth through investment stimulation. We shall also explore the importance of liquidity concerns for small- and medium-sized enterprises (SMEs) in terms of their propensity to patent. Furthermore, we shall focus on the related importance of networking activity and ownership status for biotechnology firms in Canada. Because the climate for innovation and growth is particular to the United States, we do not expect to find that these relationships are particularly strong. Nevertheless, such a study is particularly timely as growth in innovation is seen to be a government priority.

The study is organized as follows. The next section examines the issues. The third section introduces the data and the methodology. The fourth section contains the empirical results, and the last section presents a summary and conclusions.

ISSUES

LIQUIDITY AS A DETERMINANT OF PATENT APPLICATIONS

MERZ AND PACE (1994) considered the hypothesis that the creation, in 1982, of the Court of Appeals for the Federal Circuit, a tribunal with exclusive jurisdiction over patent appeals, had led to increased patent litigation in the United States. They found empirical evidence to support their theory, but their data showed essentially that the growth in patent litigation was most evident between 1982 and 1986, and more or less levelled off thereafter. More striking was the clear and dramatic increase in the number of patent applications over the period 1983-1991, which led the authors to hypothesize that the

creation of the CAFC triggered an increase in patent applications due to a perceived improvement in the ability to enforce patents. They worried about the influence of other factors on patenting activities, such as the patenting of new technologies — software and biotechnology — but did not pursue this aspect further.

When Kortum and Lerner (1999) proceeded to test the hypothesis developed by Merz and Pace (1994), they labelled it the “Friendly Court Hypothesis” (FCH) and suggested that the observed increase in patent applications was due to the fact, as Jaffe (2000, pp. 537-538) put it, that the creation of the CAFC made patents more valuable and hence increased the *propensity to patent* of U.S. inventors.

According to Kortum and Lerner (1999), if the FCH were true, then both U.S. and foreign firms should find patenting in the United States increasingly attractive both in absolute terms and relative to other countries. The FCH should also suggest that the increase in patenting be relatively uniform across both technologies and patentees.

Kortum and Lerner’s key findings (1999, p. 21) were as follows: The recent surge in domestic patenting was particular to the United States; foreign patenting in the United States increased since 1985 but was also increasing prior to that period; patenting abroad by U.S. inventors increased roughly in parallel with U.S. domestic patenting; the United States did not become a more attractive destination for patents; the recent increase in patenting was experienced across the spectrum of technologies; the growth of biotechnology and software patenting does not explain a large fraction of the overall increase; new and less established patentees were more aggressively exploiting the patent system.

In the end, Kortum and Lerner (1999, p. 21) had to reject the FCH on empirical grounds and went on to try to explain the observed increase in patenting with other hypotheses.

Underlying much of the empirical work in this area is the assumption that patenting activity stems primarily from appropriability concerns. As Levin et al. (1987, pp. 783-784) indicated, a patent confers at least theoretically perfect appropriability (monopoly over the invention) for a limited time. They noted two other motives for patenting: as a performance measure of R&D employees, and as a tool to gain access to foreign markets.

But Levin et al. (1987) suggested also that the exclusion from their Yale Survey sample of firms not offering publicly-traded securities may have biased their findings and that patents held by a small technology-oriented firm could be its most marketable asset.

In reporting on the 1994 Carnegie-Mellon Survey (CMS), Cohen, Nelson and Walsh (2000, p. 17) explored several motives for patenting: prevention of copying; prevention of other firms’ attempts to patent a related invention

(i.e. patent blocking); revenues flowing from licences; strengthening of the firm's bargaining position in negotiations with other firms; prevention of infringement suits; enhancement of the firm's reputation; and as a measure of the internal performance of the firm's technologies. Among these, they found prevention of copying and patent blocking to be the most important factors, and enhancement of the firm's reputation to be the least important. Nevertheless, they noted that, of all the motives to patent product innovations, only patenting to enhance the reputation of the firm or of its employees was significantly and negatively correlated with size.

Klofsten and Dahlstrand (2000, p. 127) observed that relatively young new technology-based firms face high levels of financial uncertainty and risk, and that they experience several rounds of external financing before they can reap any economic returns from their technological developments. The authors go on to argue that the difficulties these firms have in attracting potential financiers and investors lie in their inability to achieve credibility. They discuss three means of obtaining credibility: the *history launch*, where investors can use the history of an entrepreneur's past projects to help judge his credibility; the *momentum launch*, where entrepreneurs can create perceptions of their trustworthiness in terms of how they start activities; and the *network launch*, where trust might be established even in the absence of a track record, if enough believers are assembled in advance.

New biotechnology firms are unlikely to be able to exploit any of these three strategies for achieving the prerequisite credibility they so badly need. Other things being equal, investors are not able to differentiate between firms or their biotechnologies. These firms may have two levers at their disposal to generate the necessary degree of credibility and attract investment. They can argue that their researchers are superior, along the lines of the theory developed by Zucker and Darby (1996) about star scientists, or they can exploit what Gompers and Lerner (1999, p. 128) referred to as an asymmetry in information by using patent applications or patent grants to signal what they believe to be the superiority of their biotechnology.

These strategies are considered elsewhere. Bollinger, Hope and Utterback (1983, p. 12) noted that patents attract outside capital. Audretsch and Stephan (1996, p. 646) wrote that in the early stages of development, biotechnology firms make special efforts to signal the abilities of their scientists as well as their scientific undertakings. They further noted that these signals could be transmitted through publications in learned journals, patent applications, or both.⁷ Joly and DeLooze (1999, p. 189), who looked at biotechnology firms in particular, found that the need to publish is more important for small businesses as they use publications to signal their competence as part of a strategy to gain greater visibility.

A second element that could be related to the observed surge in patenting is the reaction of economic agents to the creation of the CAFC. It could be argued that the impact was probably felt in two waves. In particular, it might be suggested that firms already in the practice of patenting behaved as if their expectations were rational. That is, they were immediately aware of the fact that the CAFC was to be created and would adjust their patenting strategies accordingly. For example, large pharmaceutical companies could be expected to patent more frequently and to enforce their patents more aggressively.⁸

The second reaction would have been delayed until the CAFC's unprecedented record of providing virtually guaranteed support for USPTO-granted patents was measured and generally known. The CAFC's record is borne out by the statistics. Mazzoleni and Nelson (1998, p. 274), citing Dunner (1988), found that from 1953 to 1978, circuit courts upheld 30 percent of district court decisions holding patents to be valid and infringed. From 1982 to 1989, the CAFC affirmed 89 percent of district court decisions holding patents to be valid and infringed.

As Kortum and Lerner noted (1999, pp. 2-3) and Gans, Hsu and Stern (2000) reiterated, specialized financial intermediaries that are critical in the funding of start-up firms (i.e. venture capital organizations), have grown by more than ten-fold in inflation-adjusted U.S. dollars. Lerner and Merges (1998, p. 128) showed the robust growth in venture capital investment in the U.S. biotechnology industry from 1978 to 1995, but the real growth appears to have started between 1985 and 1986 with a second push occurring between 1991 and 1992. The timing of the second push coincided roughly with the moment one might expect investors to have discovered and digested the new developments on the patent enforcement front. Hence, the second wave in the surge of patenting activity was driven by smaller businesses, such as start-up biotechnology firms, exploiting the signalling ability of patent applications or grants as a device to attract investment.

A third element that came into play in the 1990s is the arguably reduced patentability thresholds that resulted in the patenting of software and financial services products and related processes. The gist of the argument is that the USPTO lowered its novelty, non-obviousness and utility requirements for granting patents, and only in this way was it possible for business methods to be patentable. Kortum and Lerner (1999) were unable to find empirical support for the notion that the observed increase in patenting was due to patenting in the areas of software and biotechnology, but very little of the effects of the *State Street* decision and perhaps only the early increase in patenting activity in the biotechnology industry would be found in their database.

**LIQUIDITY CONCERNS AND THE CAUSAL RELATIONSHIP
BETWEEN R&D AND PATENT APPLICATIONS**

ONE OF THE CATALYSTS for this study is a report published by the NBER in which Hall and Ham (1999) looked at the determinants of patenting in the U.S. semiconductor chip industry. We hoped to apply their approach to the Canadian biotechnology industry, but the preceding discussion on the importance of liquidity as a motive for patenting suggests that their model cannot be used in this case without at least some modifications. When liquidity concerns lead to patent applications, then patent applications surely precede much of the R&D expenditures, as Stoneman (1983) argued with regard to the direction of the relationship between patents and R&D expenditures.⁹

The reason(s) for patenting may help to indicate the proper order of causality. When liquidity concerns motivate a biotechnology firm to apply for a patent, then it can be understood that the patent application predates R&D. This argument suggests that the underlying motive for patent applications can be very important for the proper specification of a determinants model. Unfortunately, this information cannot be obtained from the Patent Office, though it might be acquired through surveys.¹⁰ Furthermore, with motive being a driving force of patent applications, it can be argued that R&D and patent activity do occur simultaneously, so both R&D expenditures and patent applications must be treated as endogenous in a properly specified determinants model.

Liquidity concerns may drive the firm's first, second or even third application, but other concerns take over subsequently. In a growing industry consisting primarily of small or young firms, one might expect that the share of patent applications caused by liquidity concerns is higher than in a mature industry.

Essentially, three models have been used to study the determinants of public goods, two of which have been applied to patents. A method used by Fleischer (1999, p. 98), referred to as success-factor research or strategy research, tries to identify a small number of key factors that vitally affect the performance of firms. The assumption is that the impact of these key factors explains a significant portion of the firm's performance.

A second method applied to patents is based on a production function model presented first in Pakes and Griliches (1984), and in a more detailed fashion in Griliches (1990). Examples of recent applications can be found in Hall and Ham (1999), Jaffe (1989) and Feldman (1994). This method essentially attempts to link R&D expenditures to the number of patent applications. However, the key variable represents additions to economically valuable knowledge which, in turn — and in tandem with other observed variables — may predict important economic indicators such as productivity or economic growth.

The model diagrammed by Griliches (1990, p. 1671) clearly shows that a determinant of patents is additions to economically valuable knowledge, independently of key indicators such as economic growth or productivity. However, there is no connection in the model between the number of patent applications and key economic indicators. On the pretext that the variable representing additions to economically valuable knowledge is unobserved, analysts have tried to draw such a connection, although the structure of the Pakes-Griliches model as diagrammed by Griliches makes no allowance for it, and has not been the subject of criticism in this regard.

Nevertheless, the liquidity argument described above suggests that the relationship between expenditures on R&D, patent application counts and additions to economically valuable knowledge may be more complex than the state of the world represented by the Pakes-Griliches model.¹¹

Hypothesis Liquidity concerns are an important factor in patenting for Canadian biotechnology firms.

THE ROLE OF PATENTS AND THE VIABILITY OF PATENT COUNTS AS AN OUTPUT MEASURE

SOME AUTHORS HAVE USED PATENT GRANTS, but the Pakes-Griliches model proposes a production function for the firm, and it is the national patent office that grants patents. So the discussion will focus primarily on patent applications and counts thereof.

The number of patent applications has represented the output of inventive activity or of innovative activity. On the latter, Lanjouw, Pakes and Putnam (1998, p. 405) described patents as a unique measure of the extent of innovation, while Licht and Zoz (2000, p. 308) indicated that patents reflect the results of innovative processes. Alternatively, Pakes and Griliches (1984, p. 59) used patents as their indicator of knowledge increments, while Scherer and Weisburst (1995, p. 1015) noted that patent statistics have been widely used by scholars as a measure of inventive activity. As innovation is typically understood to be a process that begins with an invention, then proceeds to the development of that invention and results in the introduction of a new product, process or service to the marketplace,¹² there is a clear difference between the two schools of thought as to what patent counts represent.

The difference is highlighted by Macdonald and Lefang (1997, p. 331), who pointed out that not all inventions contribute to innovation and that most inventions have no impact at all. The authors further indicated that although society may want innovations from its patent system, the patent is really only concerned with invention. Patents are generally seen to protect the embodiments of ideas or inventions (sometimes referred to as discoveries), and Kingston (1999)

has suggested that since the 1940s, patents seek to protect the investment of labour, time and money rather than the underlying creativity found in the embodiment of the idea. The choice made by some analysts to suggest that patent counts represent the output of innovative activity is thus somewhat debatable as they are using a measure that is systematically biased.

There has been considerable debate as to whether patent counts are, in fact, the best measure of additions to economically valuable knowledge as proposed in the Pakes-Griliches model. In part, the debate arises from the fact that the appropriate measure of additions to economically valuable knowledge poses a challenge — a common difficulty associated with output that possesses public goods characteristics.¹³

Griliches (1992, p. S31) recognized the public goods nature of discovered ideas and bemoaned the difficulties associated with measuring the output of public goods.¹⁴ In earlier work, he restricted his measurement concerns to the output of the government and services sectors. Many scholars have taken advantage of the abundance of data on patents, arguing that patents are, in effect, the best available direct measure of inventive output, also referred to as increments to economically valuable knowledge.¹⁵

The commonly used alternative measure, expenditures on R&D, is quickly cast aside because R&D is more of an input than an output,¹⁶ the R&D variable is measured with much error,¹⁷ there is inconsistency in the reporting of R&D expenditures across firms and over time,¹⁸ and R&D data are at best available for a subset of larger firms.¹⁹

However, the use of patent counts per year (either applications or grants) could also stand some scrutiny. Up to November 2000, patent applications to the USPTO became known only when the patent was granted.

There are several noteworthy implications. First, the USPTO produces patents; firms produce only patent applications. Hence, the use of data on successful patent applications should take into account supply-side factors that affect the granting of patents but are external to the firm and its production of additions to economically valuable knowledge. Second, as noted by Griliches (1990, p. 1669) and reiterated by Archibugi (1992, p. 358) and Licht and Zoz (2000, p. 310), not all inventions are patentable, and not all inventions are patented. Griliches (1990) suggested, based on long-run data, that on average only about two-thirds of applications are granted by the USPTO. So the true value of patent applications is undercounted in aggregate, and more importantly, the USPTO's grant rate for each applicant is unknown and the extrapolation from the overall mean on a year-to-year basis introduces another source of variability.

There is another implication that derives from the observation that not all inventions are patentable: not all inventions are patented. As Griliches, Pakes and Hall (1987, p. 106) pointed out, patents do not represent all of the output

of R&D. Trade secrecy, plant breeders' rights and rights for the protection of integrated circuit topographies (in Canada) all protect increments to economically valuable knowledge in addition to patents. All of these arguments suggest that the use of patent counts to measure the additions to economically valuable knowledge is inappropriate from a coverage standpoint.

Another problem associated with using annual patent counts as an output measure has to do with the timing aspect. Barré and Laville (1996, p. 31) referred to a patent as an *a posteriori* sign of the existence of research activity. Patent grants occur usually within five years from the date of application. The time elapsed between patent application and patent grant varies from case to the next, but the point is that the economically valuable knowledge is produced many years before a patent is granted. Clearly, the use of the application date is an improvement over the date of the patent grant, but Grenzmann and Greif (1996, p. 88) and Kondo (1999) have noted that there is still a one to two-year lag between the discovery and the date the application is filed. Hence, on a case-by-case basis, the period between the patent application and the increment in economically valuable knowledge is one to two years, and the period between the patent application and grant is three to seven years.

The filing date is typically the result of first-to-file pressures or perhaps attempts to achieve economies of scale by submitting applications at or nearly at the same time, but neither of these factors is particularly helpful in pinpointing the timing of the discovery itself. Additions to economically valuable knowledge match up better with payments to R&D than any patent count measures.

There remains a strategic issue regarding the choice of patent counts or R&D expenditures as the appropriate output measure. Jaffe (2000) concluded that patents have had little impact on innovation and economic growth based on a survey of the literature that showed a strong preference for using patent counts as the output measure. The theoretical issue associated with this approach is that it conflicts with the argument that patents aim to protect investment. The related methodological problem is that by embedding R&D expenditures as a determinant of patent counts, these models are unable to discern the possible alternative that patents impact indirectly on innovation and economic growth through investment. One method for testing this hypothesis is to posit R&D expenditures as the output measure and patent counts as a determinant. A significant coefficient for the patent counts variable would suggest that there is indeed reason to believe that patenting affects innovation and economic growth, but that the impact is felt via investment as represented by expenditures on R&D.

In conclusion, the review of the literature suggests that there is a need to model R&D expenditures and patent counts together based on the fact that R&D and patenting occur simultaneously. We opt for R&D expenditures as the preferred output measure as it allows us to test the following hypothesis.

Hypothesis Patent applications are important in stimulating the creation of new economically valuable knowledge and investment.

THE IMPORTANCE OF ALLIANCES FOR BIOTECHNOLOGY FIRMS

MOWERY, OXLEY AND SILVERMAN (1998, p. 509) described the growth of alliances showing that the phenomenon tends to concentrate in high-technology industries. One high-tech industry operating in such an environment is biotechnology. Niosi (2000, p. 16) found that 70 percent of biotechnology firms in Canada considered alliances and collaborative agreements to be a major factor in growth. Cullen and Dibner (1993, p. 116) reported a survey finding to the effect that, on average, therapeutic and diagnostic biotechnology firms in the United States participated in two to four corporate alliances in 1990 with both types of firms anticipating a doubling of that number in 1991.

Barley, Freeman and Hybels (1992, pp. 316-317) suggested that it is constraints and opportunities specific to commercial biotechnology that may have compelled constituent firms to collaborate. These constraints derive from the fact that biotechnology firms are frequently established by scientists associated with universities. They bring subject-matter expertise but have little knowledge of the production and marketing aspects. Even in the subject matter, they noted that it is an extraordinary challenge for a firm's researchers to keep track of, let alone exploit, relevant scientific advances without some help from outside sources. Cullen and Dibner (1993, p. 116) suggested that biotechnology firms also form alliances for financial reasons.

The nature of the alliance may be related to where the firm is in its life cycle. Woiceshyn and Hartel (1996, p. 234) followed the firm from its inception, at which time it desperately needs financial assistance, to the stage where it starts to generate revenue by licensing out its technology, to the stages when it might start selling research products, final products for small markets and, finally, launching products that achieve substantial sales volumes.

Along the way, the firm forms alliances with partners who can provide financial support, who might be helpful in advancing its R&D agenda, who can undertake the production of a developed product, who can assist with patent applications and regulatory approvals, and who can market the products. Hence, as Dodgson (1992, p. 142) noted, the motives for collaboration vary, with the three most common being technological complementarity, reduction of innovation lead times and lack of financial resources.

A study by McMahon and McVean (2001), prepared for Donahue, Ernst & Young, looked at the situation of biotechnology firms in Canada in some detail.²⁰ It revealed that 80 percent of the respondents entered into alliances. All of the responding firms operating in the health area reported participation

to alliances, with the percentage for firms in the agri-food area falling to 80 percent. They also found that almost 90 percent of participants believed that patents were important in forming alliances.

It is evident, therefore, that biotechnology firms can produce economically valuable knowledge, patents and alliances roughly at the same time. Colombo and Garrone (1996) found that decisions about inter-firm technological collaboration both caused and resulted from decisions related to internal R&D investments. They suggested that firms' decisions concerning intramural innovative effort and technological cooperation are endogenous and should be studied through a simultaneous two-equation model.

Powell and Brantley (1992) and Barley, Freeman and Hybels (1992) both provide model specifications for exploring the determinants of alliances. Neither specification includes a proxy variable for patenting. This could be an important omission. McMahon and McVean (2001) found that almost 90 percent of respondents believed that patents were important in forming alliances. Another recent report on the Canadian biotechnology industry, by Environics (2000), showed that firms who own patents are more likely to pursue networking activities than those who do not. Hoang (1997) included patents as a determinant in a model of acquisitions and minority acquisition activity in the U.S. biotechnology industry and found that variable to be statistically significant.

Hypothesis Patenting is an important determinant of networking and of the creation of alliances.

LIQUIDITY CONCERNS, OWNERSHIP STATUS, PATENT APPLICATIONS AND THE CREATION OF NEW KNOWLEDGE

EARLIER IN THE STUDY, we pointed to the fact that liquidity concerns may lead firms, especially small and/or young firms, to apply for patents. Therefore, liquidity concerns were one reason to suggest that applications for patents precede much of the R&D.

Liquidity concerns are a constant concern for firms as they develop and grow. According to Pagano, Panetta and Zingales (1995), the conventional wisdom is that *going public* is one of the stages in the growth of a firm. They also noted that going public is not a stage eventually reached by all firms, but is rather a choice.

The choice involves an information asymmetry problem similar to that discussed earlier. Profit-maximizing firms will clearly want to get the best price from an initial public offering (IPO). However, investors are likely to prefer older and larger firms to younger and smaller ones that have little track record and visibility.

It can be argued, however, that firms that undertook measures to reduce or eliminate information asymmetry problems with stakeholders in the past are better equipped to do so should they opt to go public. As a result, there is a causality issue surrounding the relationship between ownership status, applying for patents, forming alliances and creating new knowledge. In the time elapsed between filing a patent application and the moment when the firm faces ownership decisions, it is quite possible that the patent will have been granted. The value of the patent, along with the firm's own human capital, the network of firms it is known to be cooperating with, and its record for creating new economically valuable knowledge, all can be seen as assets that positively affect the price of an IPO and increase the likelihood that the firm will go public.

As a result, we recognize the possibility that the model requires a fourth equation to take into account the determinants of ownership status. Inclusion of such an equation allows us to explore in greater detail the concern expressed by Levin et al. (1987) about the possible bias inherent in a study of publicly-held firms. In particular, we can consider the following tests.

Hypothesis Firms that apply for patents are more likely to go public.

Hypothesis Firms that are more active in generating alliances are more likely to go public.

Hypothesis Higher levels of creation of new economically valuable knowledge/investment are a precursor to public ownership.

SUMMARY

THIS SECTION HAS PROVIDED A CRITICAL REVIEW of the literature with regard to the role of patents in innovation in the Canadian biotechnology industry. We found that the model used by Hall and Ham (1999) to study the determinants of patenting in the U.S. semiconductor industry is not readily applicable to a study of the determinants of innovation in the Canadian biotechnology industry.

Moreover, the Pakes-Griliches model, as depicted in Griliches (1990, p. 1671), showing R&D expenditures as an input into patenting, is not particularly helpful. We need a model allowing for the fact that, in some cases, patent applications precede most R&D expenditures, while the reverse holds in other cases. This suggests that we require a simultaneous system of equations where both counts of patent applications and R&D expenditures are endogenous. We further require a model that recognizes that spin-off outcomes from patenting may be seen in both the networking behaviour and ownership status of firms.

Hence, alliances and ownership status should be treated endogenously and an equation is required for each of these effects.

Finally, we need to choose the study variable, i.e. the endogenous variable that would represent increments to economically valuable knowledge in the reduced form equation, from among these four variables. There are clearly arguments that support the use of patent counts for this purpose and we have argued that there are also serious arguments to support the use of R&D expenditures. We started the study by highlighting the point made by Jaffe (2000) that economists have struggled in their attempts to position patent counts as a leading indicator of innovation and economic growth. If it is true that patents affect innovation and economic growth through investment, then one way of trying to find empirical support for this relationship is to use expenditures on R&D as the study variable and the number of patent applications as a determinant. We consider a number of hypotheses based on the four equations of the simultaneous system. Some of these are listed below.

- Hypothesis 1* Patent applications stimulate increments in economically valuable knowledge/investment.
- Hypothesis 2* Liquidity concerns are an important motive of patenting for Canadian biotechnology firms.
- Hypothesis 3* Ownership affects the behaviour of firms with regard to increments to economically valuable knowledge, patenting and networking.
- Hypothesis 4* Patent applications impact on the networking record of firms.
- Hypothesis 5* Publicly-owned firms are more likely to create more new economically valuable knowledge, and to engage more in patenting and networking activity. They are also more likely to be larger and older.

DATA AND METHODOLOGY

THE BIOTECHNOLOGY INDUSTRY IN CANADA

AN INDUSTRY CANADA PROFILE (2000) described the biotechnology industry in Canada as both a thriving and growing sector of the Canadian economy. As of 1997, there were nearly 300 firms, about a quarter of which were publicly traded. These firms are located throughout Canada, but most are

found in Quebec, Ontario and British Columbia. Three-quarters of the firms concentrate their efforts in the areas of health or agri-food.

As of 1997, the industry generated about C\$1 billion in sales, C\$400 million in exports and 10,000 jobs. Expenditures on research and development were found to be approximately \$600 million.

The importance of the industry is observed in a number of ways. First, biotechnology can be seen as a science that can lead to an improvement in the quality of life by providing new medicines, new tools for health surveillance and diagnosis, new foods, and solutions to problems related to climate change. Second, biotechnology can be seen as an enabling technology that can improve the quality and volume of products in the agriculture, fisheries and forest industries. Third, the use of biotechnology processes in production or research can be found in such industries as pharmaceuticals, crude petroleum and petroleum refining, mining, and wood, pulp and paper.

OBSERVATIONS

USING PRIMARILY CONTACT CANADA'S 2000 DIRECTORY of biotechnology firms in Canada, the Life Sciences Branch developed a list of about 480 firms as of the spring of 2000. The list contained some duplication because other sources were also used. For the purposes of our study, the list underwent substantial pruning. Duplicates were culled, while suppliers, chief research officers and consultants were removed from the list.

Because data on R&D expenditures existed for 1998, that year was selected as the base year for the empirical study. Therefore, nearly all of the firms created in 1998, those created subsequently and some firms created before were removed from the list because no R&D expenditure data existed for them.

As patent data were also an important element of the database, further pruning was required. Subsidiaries of foreign-based firms were typically removed when patents were found to be assigned to the parent firm. For subsidiaries of Canadian-based companies, decisions were made in each case based on our ability to attribute patents and other key data.

As many of the firms were young, it was recognized that serious problems could arise in trying to construct an accurate patenting history, especially since the element that mattered was patent applications rather than patent grants. In addition to the United States Patent and Trademark Office (USPTO) database, we consulted the Canadian Intellectual Property Office (CIPO) database, we reviewed the firms' public announcements, press clippings, annual reports and mid-year reports for any information related to patents, changes to organization, or information related to other measures that we intended to use. For a patent to be taken into account, the firm had to be an assignee although we took note of inventors and used boolean searches to try to find other matches.

Where company names were known to have changed over time, we undertook separate searches for each known company name. Dates related to the application and to the granting of the patent were noted. When CIP0 data were used, the application date taken was the date of application to the USPTO if it was available; otherwise, we used the Canadian application date. In cases where patent applications were filed with both agencies, the information provided in both applications was compared to ascertain as best as possible whether there was duplication.

While we are primarily interested in studying dedicated biotechnology firms, candidates did not have to be wholly biotechnology based, but we removed firms when it seemed clear that the patenting activity was not mostly in the area of biotechnology.

Finally, incomplete records were removed. Given that about three-quarters of the firms are privately owned, it was very difficult to pick up missing elements. There were two elements that led to most of the removals at this stage: R&D expenditures and data on alliances.

In sum, records that were removed were typically for relatively small, young and privately-owned firms.

VARIABLES

THERE ARE FOUR ENDOGENOUS and eight exogenous variables in the specified models. These variables are as follows.

First, we used expenditures on R&D per employee in 1998, measured in tens of thousands of dollars. The use of average rather than total expenditures is due to concerns about the presence of heteroscedasticity.

For patents, we used the total number of known patent applications (TOTPAT). Hall and Ham (1999) were able to use annual patent counts. Only 5 of the 72 firms they surveyed had no known patents through 1996, and the fifth most prolific patenting firm in their population, Micron Technology, was known to possess 698 patents. This number comfortably exceeds the total number of known applications for the biotechnology industry in Canada as of 1998, the base year for our study. The use of total applications reflects scale concerns.

We used three variables related to alliances. We used a count of all known alliances (ALL). We also introduced two (assumed exogenous) dummy variables that flag alliances with partners and suggest that funds may have been part of the deal. To this end, we employed dummy variables for alliances with financial intermediaries (ALLF) and alliances with pharmaceutical and other biotechnology firms (ALLB). Clearly, it is not true that all the alliances under ALLB involve an exchange of funds, but our data did not permit a finer breakdown.

We suspect that both ALL and ALLF underestimate the number of deals made with financial intermediaries.

We included a dummy variable for ownership status that differentiates between publicly-held and privately-owned firms (PRI).

The proxy used for firm size was the total number of employees in the firm (SIZE), as is found frequently in the literature. We also used a count of the firm's staff engaged in R&D (RDSTF), a measure of human capital, to assess the importance of researchers relative to other employees. Our choice of including SIZE over a measure for other staff is a reflection of our preference for the spurious correlation inherent in using SIZE, and RDSTF, a clear subset of the former, over a measure for other staff with numerous zero values for the many small- and medium-sized firms found in our population.

We included the age of the firm as of the base year (AGE98). To eliminate the possibility of obtaining zero values, we added 1 and the measure should be interpreted as the firm then existing age plus one year.

We included three dummy variables to represent areas of specialization. The health variable (HLTH) flags all firms operating in the area of therapeutics, diagnostics or health-unspecified. Firms known to be operating in agriculture, agri-bio or food were counted under an agri-food grouping (AGFD). Finally, we included environment (ENV) as a separate grouping.

MODELS, METHODS AND TESTS

HALL AND HAM (1999) proposed a single equation production function in which they try to explain changes in output, as measured by patent counts per year, by the following variables: expenditures on R&D, size of firm, age of firm, capital intensity, and type of firm (which differentiated between manufacturers and designers of mask works).

For the Canadian biotechnology industry, we are proposing instead a structural model consisting of four equations. In the section below, we introduce each of the four equations.

Production Function for New Economically Valuable Knowledge

We begin with a function specification representing the production of new economically valuable knowledge. We specify this model as follows:

$$(1) \quad \ln R\&D = a_{10} + a_{12} \ln TOTPAT + a_{13} \ln ALL + b_{11} \ln SIZE \\ + b_{12} \ln RDSTF + b_{13} \ln AGE98$$

Cumming and MacIntosh (2000) found patent protection to be a significant factor in promoting R&D. We included total patent applications because

we want to test the hypothesis that patenting does indeed affect the growth of new economically valuable knowledge and investment.

We included a count of alliances to test the hypothesis that alliances lead to the growth of new economically valuable knowledge. Gans, Hsu and Stern (2000) supposed that control over IPRs or association with venture capitalists simply proxy for *high quality*. We treated association with venture capitalists as one of many kinds of alliances and considered the possibility that alliances lead to increased output of economically valuable knowledge. Powell and Koput (1996) found a positive correlation between the level of R&D and the number of alliances. Cumming and MacIntosh (2000) found a marginally significant relationship between strategic alliances and the share of a firm's expenditures that is reported for R&D.

Baldwin, Hanel and Sabourin (2000) suggested that size, measured by the number of employees, can be used as a proxy for both scale effects and differences in the internal abilities of firms. Cohen and Klepper (1996, p. 232) argued that the returns to R&D, and hence R&D itself, tended to increase with firm size. Alternatively, the variable SIZE may proxy the labour input.

To get at the competencies most closely related to R&D and additions to economically valuable knowledge, we included a measure of human capital (RDSTF). We used this variable recognizing that researchers may not all be dedicated to biotechnology. Henderson (1994, p. 104) suggested that firms that take advantage of knowledge created in all parts of the organization are significantly more productive than rivals, so this measure may be a useful predictor.

Since most biotechnology firms in Canada are relatively young and/or small, we did not include physical capital in the specification of the production function. Furthermore, a measure of capital is not expected to be a particularly helpful indicator for this exercise given that our output is technology/knowledge rather than actual products. Nevertheless, we included the age of the firm as of 1998 in our model recognizing that firms can become more capital intensive with age and developments in the product life cycle.

Equation (1) is a production function. The specified form of the model is a Cobb-Douglas production function, which Tong and Frame (1994, p. 138) noted is commonly used in economic studies to examine the relationship between inputs and outputs. We obtained the natural logarithms of the variables of equation (1) and we then applied the ordinary least squares (OLS) method.

One outstanding issue remains with regard to the production of economically valuable knowledge. It concerns the ownership status and requires an extended specification of the production function to include a dummy variable allowing for differentiation between publicly-held and privately-owned firms.

$$(2) \quad \ln R\&D = a_{10} + a_{12} \ln TOTPAT + a_{13} \ln ALL + a_{14} \ln PRI \\ + b_{11} \ln SIZE + b_{12} \ln RDSTF + b_{13} \ln AGE98$$

Levin et al. (1987, p. 797) wondered whether the exclusion from their sample of firms that offered no publicly-traded securities may have biased their findings. A statistically significant coefficient for the dummy variable (PRI), which indicates whether a firm is publicly held or privately owned as of 1998, will suggest that the findings are affected at least for the biotechnology industry in Canada.

Model for Patenting

The specified model for patent applications is as follows:

$$(3) \quad \ln \text{TOTPAT} = a_{20} + a_{21} \ln \text{R\&D} + a_{23} \ln \text{ALL} + a_{24} \ln \text{PRI} + b_{21} \ln \text{SIZE} + b_{23} \ln \text{AGE98} + b_{24} \ln \text{HLTH} + b_{27} \ln \text{ALLF} + b_{28} \ln \text{ALLB}$$

Joly and DeLooze (1999, p. 184) pointed out that patents play two roles for biotechnology firms. They serve as a base both for the development of new products and for further inventions. Thus, it can be argued that while patenting precedes R&D it may also result from it. Niosi (2000, p. 13) cited a number of studies suggesting that the growth of a firm is dependent upon R&D. Hall and Ham (1999) included R&D as a determinant of patenting, noting that the latter has traditionally been found to be the most important determinant of patent production. Fleischer (1999, p. 108) included the natural logarithm of R&D in a (natural log of) patents model and observed a statistically significant relationship between the two variables. We included R&D expenditures per employee as a determinant.

Firms engage in alliances at different times in the development of new products and processes. Therefore, it is difficult to say that most alliances either post-date or pre-date patent applications. We included the number of alliances in this equation to check empirically for a relationship showing that alliances substantially contribute to patenting activity.

We argued earlier that liquidity concerns are frequently an important motive leading young or small firms to apply for patents. We included indicators of alliances with financial intermediaries and with pharmaceutical and other biotechnology firms to test this hypothesis. However, we do not have ideal data to measure this effect. The number of alliances with financial intermediaries understates the effect because these arrangements are not always seen as alliances. The interpretation of the indicator for alliances with pharmaceutical and other biotechnology firms cannot be limited to liquidity concerns because these alliances often happen for other reasons.

We included ownership status in the equation to test the hypothesis that public firms are more likely to patent. Again, the direction of causality is unclear. It can be argued that firms more heavily engaged in patenting/signalling

are more likely to be publicly held and this hypothesis will be addressed later in the study.

We included both size and age in the equation. Brouwer and Kleinknecht (1999, p. 622) found that larger firms have a higher probability to seek patent protection. This effect is hard to predict, however. Small, young firms are more likely to seek patents for their value as a signal of quality in order to obtain funding, while larger firms are more likely to patent in order to collect rents. Hall and Ham (1999) included both variables in their patenting model and found that, controlling for their much larger size, older firms are less likely to patent. Other things being equal, we anticipate a similar outcome. However, it should be noted that there could be collinearity problems associated with the inclusion of firm size, age and ownership status as there is an age element to these other determinants.

McMahon and McVean (2001) found that Canadian biotechnology firms operating in the health area were more likely to engage in patenting while environmental firms were less likely to do so. We included HLTH in the model expecting to obtain a positive and significant result.

As was the case for the R&D equation, we treated equation (3) as a production function. We thus took the natural logarithms of the variables (excluding the dummies) and then applied the OLS method.

Model for Alliances

We specify the model for alliances as follows:

$$(4) \quad ALL = a_{30} + a_{32}TOTPAT + a_{34}PRI + b_{31}SIZE + b_{32}RDSTF \\ + b_{33}AGE98 + b_{34}HLTH + b_{36}ENV$$

Powell and Brantley (1992, p. 379) anticipated that several determinants influenced the number of alliances. They suggested that larger firms, as measured by the number of employees, should enter into more alliances than small firms. McMahon and McVean (2001) noted that all large surveyed biotechnology firms in Canada engaged in alliances, with the proportion reaching 83 percent for mid-size and very small firms, and 71 percent for small firms. The firm size variable is included in our model.

Barley, Freeman and Hybels (1992, pp. 329-330) pointed out the importance of the age of the firm as a determinant of alliance activity. One of their explanations was that publicly-held firms are required in the United States to report certain types of alliances, but not privately-owned firms. Consequently, the information on alliances for publicly-held firms may be more complete. Their second explanation was that publicly-held firms tended to be older and had more resources and greater visibility. This argument was seconded by Powell

and Brantley (1992, p. 380). Potential suitors may consider publicly-held biotechnology firms to be more attractive and less risky partners for a strategic alliance. McMahon and McVean (2001) found that many top executives of biotechnology firms in Canada postponed alliances in the hope that their bargaining position would improve, or until they were forced to engage into alliances by investors. These arguments suggest that both firm age and (public) ownership status should be included in the proposed model.

Powell and Brantley (1992) also found that firms involved in therapeutics and diagnostics have a greater number of ties. McMahon and McVean (2001) observed a similar trend among Canadian biotechnology firms, with all firms in the health area reporting alliance activity and the proportion reaching 80 percent for agri-food firms and 67 percent for other firms. We looked at the possible inclusion of dummy variables for health and environment in the model to represent firms that are relatively more and less active in networking.

Smith-Doerr, Owen-Smith, Koput and Powell (1999, p. 396) noted that patents may serve as a form of publicity toward potential collaborators. Hence, the patent applications variable was included in the model.

A proxy for human capital, the number of researchers, was also included. This variable may detect the effect of a firm's research staff on networking.

The proxy for alliances is a straight count. While the number can potentially be quite large, there are in fact many zero and single-digit values. Hall and Ham (1999) have used maximum likelihood for the Poisson distribution to address this concern. Although we recognized that such a procedure may be more suitable, we applied the OLS method.

For the logistic analysis of acquisitions and minority equity positions, Hoang (1997) considered firm age, firm size, therapeutics, number of patents, and dummy variables for foreign-based firms and subsidiaries among potential determinants. The results from six models showed that only the intercept was significant in all cases. Firm age and firm size were never statistically significant, while the number of patents was significant only in the first model. The dummy variables for foreign-based firms and subsidiaries were significant in three of the six models. The results from a second set of logistic models were only slightly more encouraging: the number of patents was significant at the 1-percent confidence level in one model, while firm age and an index of survival (current assets to R&D expenses) were significant in three models.

Powell and Brantley (1992) performed a regression analysis on the number and types of agreements or ties. All of their models displayed a very good linear fit although the regressions on the percentage distribution of ties were somewhat weaker. For total agreements, public ownership was found to be statistically significant at the 1-percent level. The number of employees, product mix (as opposed to therapeutics alone) and region were also highly significant.

Barley, Freeman and Hybels (1992) looked at the organizational determinants of alliances and found that the degree of dedication to biotechnology and public ownership were statistically significant determinants. They worked with 466 observations and their models had R^2 values of 0.29 and 0.18, respectively.

Based on these experiences, one might reasonably expect that public ownership would come out as an important determinant of alliances, that age and patent applications might show up as important determinants, and that the linear fit of the models would not be particularly strong.

Model for Ownership Status

The specified form of the equation for ownership status is as follows:

$$(5) \quad PRI = a_{40} + a_{41}R\&D + a_{42}TOTPAT + a_{43}ALL + b_{41}SIZE + b_{43}AGE98 + b_{44}HLTH + b_{45}AGFD$$

Pagano, Panetta and Zingales (1995) found that the second most important determinant of the decision to go public is the size of the firm. In fact, they pointed to arguments by Chemmanur and Fulghieri (1994) suggesting that the probability of going public should be negatively correlated with the age or size of the firm. However, they obtained a positive correlation when using the log of the lagged value of a firm's revenues. We fully expect a positive correlation because as firms grow and get older, they become better known to investors. For this reason, we expect a positive correlation with age but AGE98 refers to the age of the firm as of the base year, 1998, and does not refer to the year when the firm went public.

Although we are unable to include many of the variables employed by Pagano, Panetta and Zingales (1995), it is important to note that they included two measures of a firm's financing needs, investment and growth, in an attempt to focus on liquidity issues. We included R&D expenditures per employee in the equation, expecting to find a positive correlation that would suggest that liquidity issues increase the probability of a firm going public.

Individually and together, three variables — TOTPAT, ALL and R&D — attempt to isolate the importance of signals to the market concerning the value of the firm. Hence, although we have no specific proxy for the market-to-book ratio at which firms in an industry trade, these variables may serve as a useful substitute for the variable found by Pagano, Panetta and Zingales (1995) to be the most important predictor of a firm going public.

McMahon and McVean (2001) noted that 57 percent of Canadian biotechnology firms operate in the health area and 25 percent operate in the agri-food area. We wanted to ensure that the coefficient estimates for the other variables were conditioned on the areas in which firms operated and, therefore, we included HLTH and AGFD in the equation.

The Reduced Form

The general linear model consists of the four equations described earlier in this section. Simultaneous systems have been used for this purpose before. Baldwin, Hanel and Sabourin (2000) postulated a two-equation model. One equation mapped the determinants of patents and the other equation explored the determinants of innovations. Expenditures on R&D were treated as exogenous.

Crépon, Duguet and Mairesse (1998, p. 3) were also concerned about the endogeneity of innovative input and output, suggesting that R&D was endogenous in the innovation equation and that patents were endogenous in their productivity equation. Their model differed in a very important way from the conceptual model shown in Griliches (1990, p. 1671). The former suggests that innovations/patents, a function of knowledge capital, directly affect productivity, whereas the latter suggests that additions to economically valuable knowledge are the catalyst for patents and other desirable benefits from invention (perhaps improved productivity), but there is no explicit connection between patents and the desirable benefits arising from invention.

This particular aspect of the Pakes-Griliches model is a characteristic of the reduced form equation. There is no explicit representation of patents. For our model, the output measure is R&D expenditures per employee in 1998 while the predictors are firm size, number of researchers, firm age, dummy variables for areas of firm activity (health, agri-food, and environment) and dummy variables for alliances with financial intermediaries and pharmaceutical and other biotechnology firms.

Although we show the four equations as a system of equations, our intention is to analyze the individual equations rather than the reduced form.

EMPIRICAL FINDINGS

THEORETICAL CONSIDERATIONS underlying the decisions to apply the OLS method to the log-log version of the equation for R&D expenditures per employee in 1998 and of the equation for total patent applications have been noted earlier. Berry and Taggart (1998) referred to a strong evolutionary effect through which firms demonstrate a high degree of informality and flexibility in the early stages R&D expenditures in terms of both technology and business strategy. We thus applied the OLS method to the alliances equation in recognition of the fact that the majority of Canadian biotechnology firms would not be at a stage where formalization of strategies was an issue. We applied a logit regression to the ownership status equation to account for the fact that the dependent variable is binary.

Pakes and Griliches (1984) used a variant of the Box-Cox procedure to choose the form of the dependent variable and found that the log of patents

was clearly preferable over the absolute number of patents in their data set. We looked at the results of these tests including variables on both sides of the equation but excluding dummies. The transformation suggested by the data for the expenditures equation lay between logarithmic and square root. The transformation suggested by the data for the patent applications equation lay between linear and the square of the variables.

SUMMARY STATISTICS (FROM INDUSTRY CANADA'S DATABASE)

THERE WERE 218 BIOTECHNOLOGY FIRMS in the base year (1998) for which we have complete records. Of these, 104 firms (48 percent) are known to have applied for at least one patent. We also know that 180 firms (83 percent) were involved in at least one alliance. We found that only 57 firms (26 percent) were publicly held.

Table 1 provides descriptive statistics for the 218 Canadian biotechnology firms contained in the database. The mean number of patent applications over the entire history of the firm is 2.46.

TABLE 1				
DESCRIPTIVE STATISTICS FOR THE 218 CANADIAN BIOTECHNOLOGY FIRMS INCLUDED IN THE DATABASE IN 1998				
VARIABLE N=218	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
Total Patent Applications	2.46	7.28	0	81
R&D Expenditures per Employee (1998: in \$10K)	5.48	6.73	0	40
Number of Alliances	3.18	3.40	0	28
Number of Employees	94.47	345.85	1	4,000
Number of R&D Staff	14.41	26.58	0	300
Age as of 1998 (1999 minus year of establishment)	14.22	14.58	1	76
Dummy for Ownership Status	0.26	0.44	0	1
Dummy for Firm Active in Health	0.57	0.50	0	1
Dummy for Firm Active in Agri-food	0.43	0.50	0	1
Dummy for Firm Active in Environment	0.22	0.42	0	1
Dummy for Alliances with Financial Intermediaries	0.06	0.23	0	1
Dummy for Alliances with Pharmaceutical or Other Biotech Firms	0.56	0.59	0	1
Sources: USPTO and CIPO databases; Contact Canada, <i>Canadian Biotechnology Directory</i> , 2001, 2000, 1999, 1998, 1997, 1996 and 1994/95 editions.				

Average R&D expenditures, expressed in tens of thousands of dollars, amounted to 5.48. That is, average expenditures on R&D in 1998 by the 218 biotechnology firms in the database were \$54,800. On average, these firms were involved in 3.18 alliances. They reported an average of 94.47 employees and an average of 14.41 staff engaged in R&D. Average firm age is 14.22 years that is the firm is in its 14.22th year as of 1998, calculated as 1999 minus the year of establishment, to eliminate the possibility of zero values for this variable.

As can be seen from Table 1, there were zero values for many variables. There were 38 firms with no known alliances. Three firms reported no R&D staff and nine firms reported no expenditures on R&D. We did not omit these observations despite obvious inconsistencies.

Averages for dummy variables considered in the modelling are also presented in Table 1. They show that the probability that a firm reported to be active in health is 0.57 (therapeutics, diagnostics or simply health), compared to 0.43 for agri-food (agri-bio, agriculture or food — aquaculture was not included), and 0.22 for environment. These were not interpreted as areas of specialization so firms could report activity in any or all of these areas. We also had data on other areas of biotechnology such as genomics, forestry, aquaculture and bioinformatics, but the numbers were too small to warrant inclusion as separate entities; moreover, grouping them, while solving the scale problem, would have introduced difficulties in interpretation.

EQUATION FOR R&D EXPENDITURES PER EMPLOYEE

WE APPLIED THE OLS METHOD TO EQUATION (1) to test a number of hypotheses related to increases in economically valuable knowledge as measured by R&D expenditures per employee in 1998. The results are presented in Table 2. We used equation (1) because it was set up to reflect the modified Pakes-Griliches production function employed by Hall and Ham (1999). Other things being equal, we found some statistical support for the hypothesis that patent applications help to create new economically valuable knowledge. Given the fact that the industry was relatively young in 1998 and the result obtained by Cumming and MacIntosh (2000), we could have expected a stronger relationship. Nevertheless, a stronger relationship is more likely to be found among U.S.-based patenting firms where the influence of the USPTO and the CAFC is most directly felt.

The relationship between alliances and the creation of new knowledge was found to be statistically insignificant. In contrast to the finding of Cumming and MacIntosh (2000), alliances do not appear to affect directly the creation of economically valuable knowledge in any way.

TABLE 2		
REGRESSION RESULTS FOR THE PRODUCTION OF NEW ECONOMICALLY VALUABLE KNOWLEDGE		
NATURAL LOG OF R&D EXPENDITURES PER EMPLOYEE IN 1998 (IN \$10K)	ESTIMATED COEFFICIENT (STANDARD ERROR)	ESTIMATED COEFFICIENT (STANDARD ERROR)
Equation	1 (218 observations)	2 (218 observations)
Natural Log of Total Patent Applications	0.08* (0.04)	0.04 (0.04)
Natural Log of Alliances	-0.04 (0.05)	-0.05 (0.05)
Dummy For Ownership Status	—	1.20** (0.48)
Natural Log of Number of Employees	-0.56*** (0.17)	-0.62*** (0.17)
Natural Log of Number of R&D Staff	0.49*** (0.13)	0.46*** (0.13)
Natural Log of Age as of 1998	0.04 (0.26)	0.00 (0.26)
Constant	1.46** (0.68)	1.36** (0.68)
Adjusted R ²	0.09	0.11
F	5.38	5.62
Notes: For estimates of regression coefficients: * Statistically significant at the 10-percent confidence level. ** Statistically significant at the 5-percent confidence level. *** Statistically significant at the 1-percent confidence level.		

The estimated coefficient for R&D staff is highly significant. It is hardly surprising to find that human capital plays a critical role in the creation of new economically valuable knowledge especially since many of these firms are comprised largely of scientists.

The role of the variable representing the number of employees becomes somewhat ambiguous as R&D staff is accounted for in the equation. In effect, this variable may account less for the firm's manpower in general and more for the residual staff. Since many biotechnology firms start as spin-offs from university research, the residual may be related to time.

The estimated coefficient for firm size is negative and highly significant. Given that R&D staff is directly responsible for the creation of new valuable knowledge, it is hardly surprising that the addition of employees who do not work on R&D is negatively related to the variable studied. Furthermore, as noted earlier, the size variable has an element of the passage of time. Accordingly, a negative coefficient can be expected.

This formulation of the model does not allow us to test the Cohen and Klepper (1996) theory that R&D itself tends to increase with firm size. In fact,

the findings point to the importance of differentiating between human capital and other staff employed by the firm.

Finally, we found firm age to be a poor predictor of the creation of new economically valuable knowledge. It is possible that the division of R&D expenditures by the number of employees seriously weakens the likelihood of finding such a relationship.

To test the effect of ownership status on the creation of new economically valuable knowledge, we reran equation (1) with the dummy variable for ownership status included in the specification. The dummy variable was given a value of one when the biotechnology firm was known to be publicly held.

As can be seen from the results for equation (2) in Table 2, there is a statistically significant relationship between ownership status and increments to economically valuable knowledge. We found that higher levels of new knowledge were associated with publicly-held biotechnology firms in Canada.

It is also clear that ownership status, age in 1998 and patent applications are correlated. The effect is most evident in the weakened relationship between patent applications and increments in economically valuable knowledge.

MODEL FOR PATENT APPLICATIONS

THE REGRESSION RESULTS are presented in Table 3. For the 218 Canadian biotechnology firms, we do not find a statistically significant relationship between R&D expenditures per employee and patent applications. This result holds whether or not we control for ownership status (as shown). It is possible that there really is no such relationship. It is also possible that the results are affected by the fact that many patent applications remain in the USPTO inventory, and the undercount reduces the likelihood of observing this relationship.

We were also unable to find empirical support for the hypothesis that alliances promote patenting activity. The problem could again be related to the fact that patent applications are undercounted.

We found a statistically significant and positive relationship between ownership status and total patent applications. Publicly-held firms appear to be more likely to have a patenting history.

Firm size was found to be highly and positively related to patent applications. We also observed a statistically significant negative relationship between patent applications and the age of the firm in 1998. Hall and Ham (1999) obtained similar results for the U.S. semiconductor chip industry, while Brouwer and Kleinknecht (1999) found that propensity to patent varied with firm size.

TABLE 3**REGRESSION RESULTS FOR TOTAL PATENT APPLICATIONS**

PATENT APPLICATIONS	ESTIMATED COEFFICIENT (STANDARD ERROR)
Natural Log of R&D Expenditures per Employee in 1998 (in \$10K)	0.08 (0.10)
Natural Log of Alliances	0.01 (0.09)
Dummy For Ownership Status	2.58*** (0.75)
Natural Log of Number of Employees	1.20*** (0.23)
Natural Log of Age as of 1998	-1.21*** (0.39)
Dummy For Firm Active in Health	3.08*** (0.67)
Dummy For Alliances with Financial Intermediaries	1.20 (1.26)
Dummy For Alliances with Pharmaceutical or Other Biotech Firms	-1.28* (0.71)
Constant	-7.17*** (1.20)
Adjusted R ²	0.34
F	15.01
Notes: For estimates of regression coefficients: * Statistically significant at the 10-percent confidence level. ** Statistically significant at the 5-percent confidence level. *** Statistically significant at the 1-percent confidence level.	

We observed a strong positive relationship between patent applications and firm activity in the health area, adding further support to the finding of McMahon and McVean (2001) in their study of Canadian biotechnology firms.

Finally, we hoped to be able to test for the impact of liquidity concerns on the patenting behaviour of biotechnology firms in Canada. The results were not encouraging. Although there was a positive relationship between patent applications and alliances with financial intermediaries, it is too weak to conclude that there is empirical support. We did find a weak significant relationship between alliances with pharmaceutical and other biotechnology firms. However, the relationship is negative, suggesting that biotechnology firms who participate in alliances with these types of partners are less likely to patent.

ANALYZING ALLIANCES

THE REGRESSION RESULTS FOR ALLIANCES are found in Table 4. The linear fit, at 0.28, is comparable to that obtained by Barley, Freeman and Hybels (1992).

The results from our models pretty much mirror what is found in the literature. Public ownership was not quite statistically significant at the 10-percent

TABLE 4**REGRESSION RESULTS FOR ALLIANCES**

ALLIANCES	ESTIMATED COEFFICIENT (STANDARD ERROR)
Total Patent Applications	-0.02 (0.03)
Ownership Status	0.82 (0.51)
Number of Employees	0.00 (0.00)
Number of R&D Staff	0.06*** (0.01)
Age of Firm as of 1998	-0.04** (0.02)
Dummy for Firm Active in Health	-0.07 (0.51)
Dummy for Firm Active in Environment	-0.58 (0.54)
Constant	2.82*** (0.51)
Adjusted R ²	0.28
F	12.87
Notes: For estimates of regression coefficients: * Statistically significant at the 10-percent confidence level. ** Statistically significant at the 5-percent confidence level. *** Statistically significant at the 1-percent confidence level.	

confidence level, but the relationship was stronger in the absence of a firm size variable. Powell and Brantley (1992) suggested that public firms would be more likely to use both the knowledge gathering and the symbolic importance associated with external ties to provide appropriate signals to the relevant financial community.

Firm age was statistically significant at the 1-percent level. The sign of the coefficient deserves some discussion. As for Hoang (1997) and Powell and Brantley (1992), the estimated coefficient for age reported in Table 4 was negative. Powell and Brantley (1992) anticipated that older firms would have acquired knowledge about the ins and outs of networking and thus be more likely to engage in further agreements than younger firms. This suggests that they were expecting the sign of the estimated coefficient to be positive.

They also expected the sign of the coefficient for their size variable to be positive as larger firms should possess more ties than smaller firms. They do not explain this position but it might be suggested that alliances arise from the increased needs of growing firms. We found no such relationship involving the firm size variable. However, the relationship between the number of R&D staff and patent applications is highly significant.

We included indicator variables for firms active in health and environment expecting to find that firms active in the health area would be more likely and firms active in environment less likely to participate in alliances. We were unable to obtain empirical support in either case.

Our results suggest that publicly-held and younger biotechnology firms are more likely to participate in alliances. They also show that the measure of human capital is a better determinant of alliance activity for Canadian biotechnology firms.

EQUATION FOR OWNERSHIP STATUS

THE RESULTS OF THE LOGIT REGRESSION for ownership status are presented in Table 5. The relative importance of ownership status in explaining the other variables under study only emphasizes the need to understand its determinants.

TABLE 5	
ESTIMATION RESULTS FOR OWNERSHIP STATUS	
OWNERSHIP STATUS (LOGIT)¹	ESTIMATED COEFFICIENT (STANDARD ERROR)
R&D Expenditures per Employee in 1998 (in \$10K)	0.11 *** (0.03)
Total Patent Applications	0.18 *** (0.07)
Number of Alliances	0.16 ** (0.07)
Number of Employees	0.002 ** (0.001)
Age of Firm as of 1998	0.03 * (0.02)
Dummy for Firm Active in Health	1.27 ** (0.54)
Dummy for Firm Active in Agri-food	-0.69 (0.45)
Constant	-3.92 *** (0.71)
McFadden Adjusted R ²	0.30
Likelihood Ratio Test (7 degrees of freedom)	79.64
Number of Right Predictions	180
Notes: Estimation using probit results yielded slightly different coefficient estimates. With regard to statistical significance, results were very similar except that age was significant at the 5-percent rather than the 10-percent level.	
* Statistically significant at the 10-percent confidence level.	
** Statistically significant at the 5-percent confidence level.	
*** Statistically significant at the 1-percent confidence level.	

We found that the probability of going public is positively and significantly related to increments in economically valuable knowledge, patent applications, alliance activity, firm size and age. We also found that firms active in health were more likely to have gone public, while firms active in agri-food were less likely although this last finding was not quite significant at the 10-percent confidence level.

We thus found statistical support for the Pagano, Panetta and Zingales (1995) argument that firm size is an important determinant of ownership status. More importantly, we found empirical support for the proposition that a firm's use of value-enhancing activities, such as applying for patents, creating new economically valuable knowledge and engaging in alliances, is associated with public ownership.

A CLOSER LOOK AT PUBLICLY-HELD BIOTECHNOLOGY FIRMS

MANY STUDIES, SUCH AS THOSE BY LEVIN ET AL. (1987) and Hall and Ham (1999) have focussed on publicly-held firms. In fact, the former expressed concern that the study of public firms alone could lead to biased findings. Our database, which consists of both publicly-held and privately-owned firms, allows us to examine these concerns empirically.

Specifically, we have already tested the impact of ownership status on increments to economically valuable knowledge, patent applications and alliance activity. The regression results seem to suggest that there are statistical differences between publicly-held and privately-owned biotechnology firms in Canada. We shall now study the data in greater detail by examining the summary statistics and results of regressions for publicly-held Canadian biotechnology firms.

Table 6 presents summary statistics for the 57 publicly-held and 161 privately-owned biotechnology firms. In the database, 21 percent of publicly-held firms reported no patent applications while 63 percent of privately-owned firms had no known patent applications. The mean values for total patent applications reflect this disparity. Publicly-held firms were found to have an average of 6.63 patent applications, while privately-owned firms were found to have on average just under one patent application.

Publicly-held firms were found to have an average of 4.68 alliances while their privately-owned counterparts reported an average of 2.65 alliances. Publicly-held firms were larger on average (215.40 employees against 51.66) and had more staff engaged in R&D (28.16 researchers against 9.55). They were, on average, more likely to be active in the health area while privately-owned firms were more likely to be active in agri-food and environment.

TABLE 6
SUMMARY STATISTICS FOR 57 PUBLIC AND 161 PRIVATE FIRMS

VARIABLE	MEAN: PUBLIC (N=57)	MEAN: PRIVATE (N=161)
Total Patent Applications	6.63 (13.03)	0.98 (2.02)
R&D Expenditures per Employee in 1998 (in \$10K)	5.41 (8.27)	0.78 (1.08)
Number of Alliances	4.68 (4.72)	2.65 (2.61)
Number of Employees	215.40 (633.39)	51.66 (121.46)
Number of R&D Staff	28.16 (46.25)	9.55 (10.87)
Age as of 1998	13.95 (15.34)	14.31 (14.35)
Dummy for Firm Active in Health	0.81 (0.40)	0.48 (0.50)
Dummy for Firm Active in Agri-food	0.23 (0.42)	0.50 (0.50)
Dummy for Firm Active in Environment	0.09 (0.29)	0.27 (0.44)
Dummy for Alliances with Financial Intermediaries	0.04 (0.19)	0.06 (0.24)
Dummy for Alliances with Pharmaceutical or Other Biotech Firms	0.74 (0.44)	0.50 (0.50)

It is also interesting to note that ownership status does not appear to be related to the age of the firm as of 1998. Public firms were found to be less than half a year younger on average than private firms.

Finally, nearly three-quarters of public firms were found to be involved with pharmaceutical or other biotechnology firms while one half of privately-owned firms were so involved.

Table 7 presents regression results for two models run on the 57 public biotechnology firms. All of the models reported in the table are log-linear. The results are shown for the model of increments to economically valuable knowledge, then for total patent applications. The former model is essentially unchanged from that applied to the 218 observations except, of course, for the omission of the ownership status variable. For the estimation of the patent applications equation, we removed ownership status and the variables identifying alliance partners. The latter were removed because it is presumed that the act of going public has addressed the underlying liquidity issue.²¹

Looking first at the results for the R&D expenditures per employee equation, we found that the relationship between patent applications and the study variable was no longer statistically significant. Patent applications are not as important to firms that are publicly held as they were found to be for the

TABLE 7		
REGRESSION RESULTS FOR THE 57 PUBLICLY-HELD BIOTECHNOLOGY FIRMS: NEW KNOWLEDGE AND TOTAL PATENT APPLICATIONS		
VARIABLE (N=57)	R&D EXPENDITURES PER EMPLOYEE ESTIMATED COEFFICIENT (STANDARD ERROR)	TOTAL PATENT APPLICATIONS ESTIMATED COEFFICIENT (STANDARD ERROR)
Natural Log of R&D Expenditures per Employee in 1998 (in \$10K)	—	0.28 (0.18)
Natural Log of Total Patent Applications	0.11 (0.07)	—
Natural Log of Alliances	-0.06 (0.10)	-0.31** (0.14)
Natural Log of Number of Employees	-0.77** (0.33)	1.63*** (0.35)
Natural Log of Number of R&D Staff	0.72** (0.36)	—
Natural Log of Age as of 1998	-0.03 (0.51)	-0.78 (0.68)
Dummy for Firm Active in Health	—	8.52*** (1.26)
Constant	2.59** (1.00)	-12.67*** (2.26)
Adjusted R ²	0.16	0.57
F	3.06	15.84
Notes: For estimates of regression coefficients: * Statistically significant at the 10-percent confidence level. ** Statistically significant at the 5-percent confidence level. *** Statistically significant at the 1-percent confidence level.		

population at large. One of the explanations for this phenomenon could be that upon going public, a firm's liquidity concerns have been addressed. Although the test is indirect, we could conclude that liquidity concerns do exert some influence before we control for public ownership.

We were unable to find a statistically significant relationship between the number of alliances and increments to economically valuable knowledge for the 57 publicly-held firms in our database. Alliances do not appear to have any direct bearing in this regard.

The results for the size and human capital proxy variables were found to be similar to those obtained for the entire population, although the statistical significance was slightly weaker. In both cases, we found human capital to be an important determinant of the growth in new economically valuable knowledge. This result is hardly surprising and we were fortunate to be able to include such a variable in our analysis.

Finally, we included age as of 1998 in our model. We were unable to find any relationship between age and increments to economically valuable knowledge for either publicly-held firms or the population as a whole.

The results of the regression on total patent applications for the 57 publicly-held firms are also presented in Table 7. The relationship between R&D expenditures per employee and patent applications was stronger but still not statistically significant at the 10-percent confidence level.

A more striking result occurs for alliances, where we found that the estimated coefficient was negative and statistically significant. The outcome suggests that for the 57 publicly-held biotechnology firms, alliances appear to be treated as substitutes for patenting. This is certainly not the situation for the population as a whole.

We found that size is again an important predictor of patenting although the impact of age was greatly reduced. We also observed that firms active in the health area were more likely to apply for patents.

Table 8 presents the results of the regression on alliances. For the population as a whole, it appeared to be appropriate to apply the OLS method to the untransformed variables. Berry and Taggart (1998) noted that, as firms developed, formality increased significantly and the firm took on a powerful

TABLE 8	
REGRESSION RESULTS FOR ALLIANCES (57 PUBLIC FIRMS)	
VARIABLE (N=57)	ESTIMATED COEFFICIENT (STANDARD ERROR)
Natural Log of Total Patent Applications	-0.34** (0.13)
Natural Log of Number of Employees	0.61 (0.45)
Natural Log of Number of R&D Staff	0.66 (0.45)
Natural Log of Age as of 1998	-0.52 (0.66)
Dummy for Firm Active in Health	4.46*** (1.52)
Dummy for Firm Active in Environment	-1.72 (1.46)
Constant	-6.34** (2.50)
Adjusted R ²	0.20
F	3.39
Notes: For estimates of regression coefficients: * Statistically significant at the 10-percent confidence level. ** Statistically significant at the 5-percent confidence level. *** Statistically significant at the 1-percent confidence level.	

market orientation. For the purpose of analyzing alliances, we assumed that a greater degree of formality could be associated with the fact that the firm has gone public. Therefore, we applied the OLS method in this case to the natural logarithms of the variables because these firms were believed to be formally working toward the creation of alliances.

We found that the results changed considerably when the functional form was assumed to be log-linear. When the regression was run on the natural log of the variables on both sides of the equation, we found that patent applications were negatively and significantly related to the number of alliances. We also found the health area to be a statistically significant determinant of alliances, but the effects of the number of employees and the number of R&D staff were not significant. We were also unable to establish a significant relationship between activity in the environment area and alliances.

A CLOSER LOOK AT THE 161 PRIVATELY-OWNED FIRMS

TABLE 6 PRESENTS SUMMARY STATISTICS for the 161 privately-owned biotechnology firms in the database. Slightly more than five-eighths of these firms have no known patent applications. It is difficult to pursue a model-type approach to data analysis when more than half of the observations show a zero value for a key variable. Private firms were found to have applied about once for a patent and to have participated in an average of 2.65 alliances.

We ran contingency table tests for a small number of key hypotheses. We checked to determine whether private biotechnology firms with at least one patent were more likely to be involved in alliances than those with no patenting history but there was no statistical support for this hypothesis. We also checked to determine whether biotechnology firms listing agri-food as an active business area were more likely to be patenting and again there was no statistical support for this hypothesis.

Other test results were more promising. Private biotechnology firms known to be active in the health area were more likely to have applied for at least one patent. The likelihood that a private biotechnology firm applied for at least one patent was found to increase with size although the break seems to occur most clearly at 10 employees. Finally, there was statistical support for the hypothesis that firms were more likely to apply for at least one patent with increased spending on R&D although the difference becomes clearest when \$1 million is used as the threshold for comparisons.

SUMMARY AND CONCLUSIONS

THE LITERATURE SINCE LEVIN ET AL. (1987) has focussed on the fact that the primary benefit of patenting is that it helps firms appropriate rents. In this context, the estimation of production functions based on Pakes and Griliches (1984) has been predicated on the assumption that the best measure of innovation or of increases in economically valuable knowledge is an annual patent count. Stoneman (1983) suggested that patent counts be treated as determinants rather than dependent variables, but most of the evidence in support of the conceptual argument is recent. There remains the issue that the lack of success of economists in attempting to establish a link between patenting activity levels and innovation may be due to the fact that patent counts have been used as an output measure and R&D expenditures as a key determinant. The application of the Pakes-Griliches (1984) conceptual model, as illustrated in the Path Analysis Diagram, is inconsistent with the aim of patents, which is to protect investment. The influence of patents, and thus patent policy, on innovation and economic growth is indirect at best.

The ideal way of testing these arguments would be to examine the growth of patent-using industries in the United States since, with the creation of the CAFC and the recent relaxation of patenting standards to accommodate developments in new technologies (software, higher life forms, and business methods), the associated benefits would be felt primarily by U.S.-based businesses that use patents, though the general thrust can be tested in any event.

Accordingly, we developed a model that allows us to test the hypothesis that patent activity, as represented by applications for new patents, influences the creation of new economically valuable knowledge, as measured by the amount of money that firms spent on R&D per employee in 1998. We tested this hypothesis using data for the biotechnology industry in Canada and found that there was indeed a statistically significant relationship. We conclude from this finding that patenting activity levels may indeed serve as a leading indicator of economic growth. However, it must be recognized that because the effect is felt indirectly through investment, other economic factors linked to investment need to be factored into the equation. Jaffe (2000) suggested that patents are only one of many determinants. We are suggesting here that at least some of these other determinants are investment-related.

Although this finding is based on an analysis of data on Canada's biotechnology industry, it can be argued that the effect will be much greater for U.S.-based businesses that use patent applications to attract investors. The record of support demonstrated by the CAFC for patents issued in the United States, combined with the stance of the USPTO on patenting new technologies, has

nurtured an environment in which investors have very actively supported U.S.-based, patent-using firms.

The situation of Canadian-based biotechnology firms is complicated by the fact that they are subject to Canadian fiscal and monetary measures while they seek patents in the United States. With regard to competitiveness, it can be suggested that, other things being equal (which they are not), biotechnology firms in Canada are at a competitive disadvantage with respect to their U.S. counterparts. Canadian biotechnology firms have company in this regard. Susannah Rodgers (2001) cited an Ernst & Young report that found that the European biotechnology sector was still very much behind that of the United States, which was *flooded* with capital.

We had reason to expect a significant relationship between alliances and patent applications. Such a relationship was suggested in the study of biotechnology firms in Canada by McMahon and McVean (2001). Hoang (1997) found statistical support for this relationship. Brouwer and Kleinknecht (1999) noted that the propensity to patent was significantly higher among R&D collaborators. However, for the 218 biotechnology firms in our database, we were unable to find statistical support for the hypothesis that patent applications may lead to alliances. We were also unable to find statistical support for the hypothesis that alliances lead to greater patenting activity.

An important finding is that R&D expenditures per employee are not a significant determinant of patent applications. For many of these biotechnology firms, it might be argued that the filing of applications pre-dates much of the actual R&D. This finding is thus not surprising. Nevertheless, it may also be true that total expenditures per employee over the period associated with the development of the patent application would be a better measure.

Levin et al. (1987) expressed concern about the fact that the results of analyses of public firms may not be representative of all firms. Our database of Canadian biotechnology firms includes 57 publicly-held and 161 privately-owned firms. We looked at those concerns in two ways. First, we included ownership as a determinant of alliances, patent applications and then increments to economically valuable knowledge as measured by R&D expenditures per employee. We found that ownership status is a statistically significant determinant of total patent applications and per employee expenditures on R&D. It is also nearly significant as a determinant of alliances. These results suggest that we have found empirical evidence in support of the concerns raised by Levin et al.

In an attempt to determine where the biases may lie, we then ran the regressions for the 57 publicly-held firms. The most striking finding is that alliances and patent applications appear to be substitutes for each other. Regardless of the direction of causality, we found a negative and statistically significant relationship between the number of alliances and total patent applications. This finding suggests that publicly-held biotechnology firms are willing

to trade off alliances for patent applications (or the reverse). We found no such relationship when looking at the population as a whole. As such, these two findings appear to support the Berry-Taggart (1998) conclusion that there is an evolutionary effect wherein firms demonstrate an early degree of informality and flexibility where technology and business strategy are concerned. The act of going public appears to be associated with a greater degree of formality where strategic decisions about patenting and collaboration are concerned.

We looked at the relationship between per employee R&D expenditures and patent applications for the 57 publicly-held firms and again failed to find a statistically significant relationship although it is stronger than the test result for the entire population when ownership status is included as a determinant.

We looked at the determinants of ownership status and found many indicators of public ownership, including the firm's R&D spending per employee, its patent applications and its collaborative efforts. Although public ownership is not necessarily a panacea for biotechnology firms in Canada, the results suggest that patenting activity is helpful in this regard.

It is worth noting that the inclusion of the ownership status effect in the per employee R&D expenditures equation weakened the impact of patent applications on investment. It was suggested earlier that liquidity concerns may lead firms to apply for patents. Results from the per employee R&D expenditures equation suggest that patenting helps a firm obtain investment in the short term, as well as in the longer term when it attempts to go public, as revealed by the results of the ownership status equation.

At the outset, we put forward the idea that, in addition to appropriability concerns, liquidity concerns are important when considering the relationship between patenting and increments to economically valuable knowledge in relatively young industries comprised mainly of small- and medium-sized firms. Our data did not permit ideal testing of this hypothesis.

However, the data allowed us to include a proxy variable for human capital. Our results demonstrated the value of knowledge workers both for the production of new economically valuable knowledge and for the creation of alliances among the 218 biotechnology firms.

The above analysis is subject to the typical caveats of studies looking at patent applications. Primarily, they pertain to the reality that patent application counts are biased downward. In part, this is due to the absence of record on patent applications to the USPTO that are eventually not granted, and to the fact that there are many applications still in the USPTO pipeline, as we are barely two and a half years past the study's base year. Better data on the impact of financial intermediaries would also serve to improve the above analysis.

ENDNOTES

- 1 See Jaffe (2000), who suggests that “robust conclusions regarding the empirical consequences for technological innovation in patent policy are few because [...] patents are only one of many determinants [...] so even significant changes in patent policy may have only limited effects.”
- 2 See Capes (1992), Wagner (1998) or Morrow (1994).
- 3 See Eisenberg (1987) and Morrow (1994).
- 4 See Merges (1999, pp. 577-78) and Raskind (1999).
- 5 See Hall and Ham (1999), who show how high-technology firms *trade* patents.
- 6 See Kortum and Lerner (1998) and Lerner and Merges (1998).
- 7 See Currier (2000, p. 339), who suggests that a patent is a type of academic publication.
- 8 Kortum and Lerner (1999) did suggest some of this in an alternative hypothesis.
- 9 Hall, Griliches and Hausman (1986) reiterate this point. Cumming and MacIntosh (2000) employed a questionnaire designed to direct causality from hypothesized variables, such as the importance of patent protection and strategic alliances, to R&D expenditures. They also tested and rejected the possibility of significant endogeneity effects.
- 10 It must be realized that respondents may not wish to divulge any information on patent applications that have not been made public.
- 11 It should be noted that Griliches (1979, p. 94) recognized that it was not easy to establish causality.
- 12 See Feldman (1999, pp. 3, 8).
- 13 According to Mackaay (1992, p. 48), these characteristics are non-exclusion, which means that if the goods are available to one person, no one else can be excluded from their use; and non-rivalry in consumption which means that use by one person does not preclude use by another. Free riding tends to result because it is so expensive to prevent use. Congestion may arise with goods or services that are not completely non-rival.
- 14 See Griliches (1992, p. S31) and Griliches (1979, p. 94).
- 15 See Griliches (1990, pp. 1671, 1702).
- 16 See Lanjouw, Pakes and Putnam (1998, p. 406).
- 17 See Griliches, Hall and Pakes (1991, p. 184).
- 18 See Lanjouw, Pakes and Putnam (1998, p. 406).
- 19 See Lanjouw, Pakes and Putnam (1998, p. 406), Brouwer and Kleinknecht (1999, p. 615) and Licht and Zoz, (2000, p. 310); the latter looked at it from the vantage point of small firms.
- 20 They surveyed 46 biotechnology firms in Canada and conducted interviews with over 30 of the chief executive officers.
- 21 Although we recognize that the decision to *go public* reflects appropriability and governance issues as well.

ACKNOWLEDGMENTS

HELPFUL COMMENTS by Wesley Cohen and Jonathan Putnam and past discussions with Gilles McDougall, Sandra Charles and Julie Tran are gratefully acknowledged. The author also acknowledges the assistance of Dominique Cusson in the preparation of the database. The views expressed belong to the author and do not necessarily reflect those of any organization with which he is affiliated.

BIBLIOGRAPHY

- Archibugi, Daniele. 1992. "Patenting as an Indicator of Technological Innovation: A Review." *Science and Public Policy* 19, 6 (December): 357-368.
- Audretsch, David B., and Paula E. Stephan. 1996. "Company-Scientist Locational Links: The Case of Biotechnology." *American Economic Review* 86, 3: 641-652.
- Baldwin, John. 1997. *Innovation and Intellectual Property*. Ottawa: Statistics Canada. Catalogue No. 88-515-XPE.
- Baldwin, John, Petr Hanel and David Sabourin. 2000. *Determinants of Innovative Activity in Canadian Manufacturing Firms: The Role of Intellectual Property Rights*. Ottawa: Statistics Canada (Analytical Studies Branch) (March). Research Paper No. 11F0019MIE2000122.
- Barley, Stephen R., John Freeman and Ralph C. Hybels. 1992. "Strategic Alliances in Commercial Biotechnology." In *Networks and Organizations: Structure, Form and Action*. Edited by Nitin Nohria and Robert G. Eccles, pp. 311-347.
- Barré, Rémi, and Françoise Laville. 1996. "The Patent Count as a Measure of Technological Activity." In *INSEE Studies in Economics and Statistics*. Edited by INSEE, pp. 31-41.
- Berry, Maureen M.J., and James H. Taggart. 1998. "Combining Technology and Corporate Strategy in Small High Tech Firms." *Research Policy* 26, 7-8: 883-896.
- Bollinger, Lynn, Katherine Hope and James M. Utterback. 1983. "A Review of Literature and Hypotheses on New Technology-based Firms." *Research Policy* 12: 1-14.
- Brouwer, Erik, and Alfred Kleinknecht. 1999. "Innovative Output and a Firm's Propensity to Patent. An Exploration of CIS Micro Data." *Research Policy* 28, 6 (August): 615-624.
- Capes, Nelson R. 1992. "Current Status of Patent Protection for Computer Software." *Journal of the Patent and Trademark Office Society* 74: 5-25.
- Chemmanur, Thomas, and Paolo Fulghieri. 1994. "Information Production, Private Equity Financing, and the Going Public Decision." Columbia University. Mimeo.
- Cohen, Wesley M., and Steven Klepper. 1996. "Firm Size and the Nature of Innovation within Industries: The Case of Process and Product R&D." *Review of Economics and Statistics* 78, 2 (May): 232-243.

- Cohen, Wesley M., Richard R. Nelson and John P. Walsh. 2000. *Protecting Their Intellectual Assets: Appropriability Conditions and Why US Manufacturing Firms Patent (Or Not)*. NBER Working Paper No. 7552 (February).
- Colombo, Massimo G., and Paolo Garrone. 1996. "Technological Cooperative Agreements and Firms' R&D Intensity. A Note on Causality Relations." *Research Policy* 25, 6: 923-932.
- Contact Canada. 2000. *Canadian Biotechnology 2000 Directory*. Georgetown (Ont.).
- Craig, Stephen G. 1987. "The Impact of Congestion on Local Public Good Production." *Journal of Public Economics* 32: 331-353.
- Crépon, Bruno, Emmanuel Duguet and Jacques Mairesse. 1998. *Research, Innovation, and Productivity: An Econometric Analysis at the Firm Level*. NBER Working Paper No. 6696 (August).
- Cullen, W.C., and M.D. Dibner. 1993. "Strategic Alliances in Biotechnology: Imperatives for the 1990s." *International Journal of Technology Management* (Special Edition on the Management of Technology): 110-119.
- Cumming, Douglas J., and Jeffrey G. MacIntosh. 2000. "The Determinants of R&D Expenditures: A Study of the Canadian Biotechnology Industry." *Review of Industrial Organization* 17, 4 (December): 357-370.
- Currier, T. Andrew. 2000. "To Publish or to Patent, That is the Question." *Canadian Intellectual Property Review* 16, 2: 337-350.
- Dodgson, Mark. 1992. "Strategy and Technological Learning: An Interdisciplinary Microstudy." In *Technological Change and Company Strategies: Economic and Sociological Perspectives*. Edited by Rod Coombs, Paolo Saviotti and Vivien Walsh, pp. 136-163.
- Dunner, D.R. 1988. *Annual Report*. Special Committee on CAFC, American Bar Association, Section on Patent, Trademark and Copyright Law, pp. 314-325.
- Eisenberg, Rebecca S. 1987. "Proprietary Rights and the Norms of Science in Biotechnology Research." *The Yale Law Journal* 97, 2 (December): 177-231.
- Enviro-nics. 2000. "Canadian Biotechnology Community's Practices, Attitudes and Opinions Regarding the Research Exemption and Methods of Medical Treatment Exemption in Canadian Patent Law." (December). Draft Report.
- Feldman, Maryann P. 1994. "Knowledge Complementarity and Innovation." *Small Business Economics* 6: 363-372.
- . 1999. "The New Economics of Innovation, Spillovers and Agglomeration: A Review of Empirical Studies." *Economics of Innovation and New Technology* 8: 5-25.
- Fleischer, Manfred. 1999. "Innovation, Patenting, and Performance." *Économie appliquée* 52, 2: 95-119.
- Gans, Joshua S., David H. Hsu and Scott Stern. 2000. *When Does Start-up Innovation Spur the Gale of Creative Destruction?* NBER Working Paper No. 7851 (August).
- Garland, Steven B., and Jeremy E. Want. 1999. "The Canadian Patent System: An Appropriate Balance Between the Rights of the Public and the Patentee." *Canadian Intellectual Property Review* 16, 1 (September): 43-64.
- Gompers, Paul A., and Joshua Lerner. 1999. *The Venture Capital Cycle*. Cambridge (Mass.): The MIT Press.

- Grenzmann, Christoph, and Siegfried Greif. 1996. "Relationship Between R&D Input and Output." In *Innovation, Patents and Technological Strategies*. Edited by the OECD, pp. 71-88.
- Griliches, Zvi. 1979. "Issues in Assessing the Contribution of Research and Development to Productivity Growth." *Bell Journal of Economics* 10, 1: 92-116.
- . 1990. "Patent Statistics as Economic Indicators: A Survey." *Journal of Economic Literature* 28 (December): 1661-1707.
- . 1992. "The Search for R&D Spillovers." *Scandinavian Journal of Economics*. Supplement 94, 1: S29-S47.
- Griliches, Zvi, Bronwyn H. Hall and Ariel Pakes. 1991. "R&D, Patents and Market Value Revisited: Is There a Second (Technological Opportunity) Factor?" *Economics of Innovation and New Technology* 1: 183-201.
- Griliches, Zvi, Ariel Pakes and Bronwyn H. Hall. 1987. "The Value of Patents as Indicators of Inventive Activity." In *Economic Policy and Technological Performance*. Edited by Partha Dasgupta and Paul Stoneman, pp. 97-124.
- Hall, Bronwyn H., Zvi Griliches and Jerry A. Hausman. 1986. "Patents and R&D: Is There a Lag?" *International Economic Review* 27, 2 (June): 265-283.
- Hall, Bronwyn H., and Rose Marie Ham. 1999. *The Patent Paradox Revisited: Determinants of Patenting in the US Semiconductor Industry, 1980-94*. NBER Working Paper No. 7062 (March).
- Henderson, Rebecca. 1994. "Managing Innovation in the Information Age." *Harvard Business Review* (January-February): 100-105.
- Hoang, Ha. 1997. "The Consequences of Network Participation for Acquisition and Alliance Activity in the Biotechnology Industry." In *Academy of Management Proceedings* 97. Edited by Lloyd N. Dosier and J. Bernard Keys. Academy of Management, pp. 267-271.
- Industry Canada. 2000. *Economic Profile of the Canadian Biotechnology Sector*. Unpublished report prepared for the Life Sciences Branch.
- Jaffe, Adam B. 1989. "Real Effects of Academic Research." *American Economic Review*, 79, 5: 957-970.
- . 2000. "The US Patent System in Transition: Policy Innovation and the Innovation Process." *Research Policy* 29: 531-557.
- Joly, Pierre-Benoit, and Marie-Angèle DeLooze. 1999. "Copropriété de brevets et coopération en R&D: une analyse dans les biotechnologies." *Économie appliquée* 52, 2: 183-197.
- Kingston, William. 1999. "New Approaches to Innovation Protection." *Économie appliquée* 52, 2: 221-236.
- Klofsten, Magnus, and Asa Lindholm Dahlstrand. 2000. "Financing Technology-based New Ventures: Credibility and Value Creation." In *Technology-based Firms at the Turn of the Century*. Edited by Wim During, Ray Oakey and Michelle Kipling, pp. 127-142.
- Kondo, Masayuki. 1999. "R&D Dynamics of Creating Patents in the Japanese Industry." *Research Policy* 28, 6 (August): 587-600.
- Kortum, Samuel, and Joshua Lerner. 1998. *Does Venture Capital Spur Innovation?* NBER Working Paper No. 6846 (December).

- . 1999. "What is Behind the Recent Surge in Patenting?" *Research Policy* 28, 1: 1-22.
- Lanjouw, Jean O., Ariel Pakes and Jonathan Putnam. 1998. "How to Count Patents and Value Intellectual Property: The Uses of Patent Renewal and Application Data." *The Journal of Industrial Economics* 46, 4 (December): 405-432.
- Lerner, Joshua, and Robert P. Merges. 1998. "The Control of Technology Alliances: An Empirical Analysis of the Biotechnology Industry." *The Journal of Industrial Economics* 46, 2 (June): 125-156.
- Levin, Richard C., Alvin K. Klevorick, Richard R. Nelson and Sidney G. Winter. 1987. "Appropriating the Returns from Industrial Research and Development," *Brookings Papers on Economic Activity* 3: 783-820.
- Licht, Georg, and Konrad Zoz. 2000. "Patents and R&D: An Econometric Investigation Using Applications for German, European and US Patents by German Companies." In *The Economics and Econometrics of Innovation*. Edited by David Encaoua, Bronwyn H. Hall, François Laisney and Jacques Mairesse, pp. 307-338.
- MacDonald, Stuart, and Bernard Lefang. 1997. "Innovation and the Patent Attorney." *Prometheus* 15, 3: 329-343.
- Mackaay, Ejan. 1992. "An Economic View of Information Law." In *Information Law: Towards the 21st Century*. Edited by Willem F. Korthals Altes, Egbert J. Dommering, P. Bernt Hugenholtz and Jan J.C. Kabel. Deventer, pp. 43-65.
- Mazzoleni, Roberto, and Richard R. Nelson. 1998. "The Benefits and Costs of Strong Patent Protection: A Contribution to the Current Debate." *Research Policy* 27: 273-284.
- McMahon, Eileen M., and Shonagh M. McVean. 2001. *Canadian Biotech and Intellectual Property Report 2000*. Donahue, Ernst & Young.
- Merges, Robert P. 1999. "As Many as Six Impossible Patents before Breakfast: Property Rights for Business Concepts and Patent System Reform." *Berkeley Technology Law Journal* 14: 577-615.
- Merz, Jon F., and Nicholas M. Pace. 1994. "Trends in Patent Litigation: The Apparent Influence of Strengthened Patents Attributable to the Court of Appeals for the Federal Circuit." *Journal of the Patent and Trademark Office Society* (August): 579-590.
- Morrow, Joy D. 1994. "Patentable Subject Matter: Emerging Technologies." In *Patent Law of Canada*. Edited by Gordon F. Henderson, Howard P. Knopf, John R. Rudolph, David Watson, James D. Kokonis and Donald M. McRae, pp. 23-40.
- Mowery, David C., Joanne E. Oxley and Brian S. Silverman. 1998. "Technological Overlap and Interfirm Cooperation: Implications for the Resource-based View of the Firm." *Research Policy* 27, 5 (September): 507-523.
- Niosi, Jorge. 2000. *Explaining Rapid Growth in Canadian Biotechnology Firms*. Ottawa: Statistics Canada (Science, Innovation and Electronic Information Division). Catalogue No. 88F0017MIE200008 (August).
- Pagano, Marco, Fabio Panetta and Luigi Zingales. 1995. *Why Do Companies Go Public? An Empirical Analysis*. NBER Working Paper No. 5367 (November).
- Pakes, Ariel, and Zvi Griliches. 1984. "Patents and R&D at the Firm Level: A First Look." In *R&D, Patents and Productivity*. Edited by Zvi Griliches, pp. 55-72.

- Powell, Walter W., and Peter Brantley. 1992. "Competitive Cooperation in Biotechnology: Learning Through Networks?" In *Networks and Organizations: Structure, Form and Action*. Edited by Nitin Nohria and Robert G. Eccles, pp. 366-394.
- Powell, Walter W., and Kenneth W. Koput. 1996. "Interorganizational Collaboration and the Locus of Innovation." *Administrative Science Quarterly* 41, 1: 116-145.
- Raskind, Leo J. 1999. "The State Street Bank Decision: The Bad Business of Unlimited Patents for Methods of Doing Business." *Fordham Intellectual Property, Media and Entertainment Law Journal* 10: 61.
- Rodgers, Susannah. 2001. "Ernst & Young Say Europe's Biotechs Held Back by Red Tape." *Dow Jones International News* (April 25).
- Scherer, Frederic M., and Sandy Weisburst. 1995. "Economic Effects of Strengthening Pharmaceutical Patent Protection in Italy." *International Review of Industrial Property and Copyright Law* 26, 6: 1009-1024.
- Smith-Doerr, Laurel, Jason Owen-Smith, Kenneth W. Koput and Walter W. Powell. 1999. "Networks and Knowledge Production: Collaboration and Patenting in Biotechnology." In *Corporate and Social Capital*. Edited by R. Leenders and S. Gabbay, Norwell (Mass.): Kluwer Academic Publishers, pp. 390-408.
- Stoneman, Paul. 1983. "Patents and R&D: Searching for a Lag Structure – Comment." *Proceedings of the Conference on Quantitative Studies of Research and Development in Industry*. Paris: ENSAE.
- Tong, Xuesong, and J. Davidson Frame. 1994. "Measuring National Technological Performance with Patent Claims Data." *Research Policy* 23: 133-141.
- Wagner, Allen B. 1998. "Patenting Computer Science: Are Computer Instruction Writings Patentable?" *John Marshall Journal of Computer and Information Law* 17: 5-23.
- Woiceshyn, Jaana, and Diana Hartel. 1996. "Strategies and Performance of Canadian Biotechnology Firms: An Empirical Investigation." *Technovation* 16, 5: 231-243.
- Zucker, Lynne G., and Michael R. Darby. 1996. "Star Scientists and Institutional Transformation: Patterns of Invention and Innovation in the Formation of the Biotechnology Industry." *Proceedings of the National Academy of Sciences, USA* 93 (November): 12709-12716.

OTHER REFERENCES

- Barton, John H. 1995. "Patent Scope in Biotechnology." *International Review of Industrial Property and Copyright Law* 26, 5: 605-618.
- Cockburn, Iain M., and Rebecca M. Henderson. 1998. "Absorptive Capacity, Coauthoring Behavior, and the Organization of Research in Drug Discovery." *The Journal of Industrial Economics* 66, 2 (June): 157-182.
- Cohen, Wesley M., and Daniel A. Levinthal. 1990. "Absorptive Capacity: A New Perspective on Learning and Innovation." *Administrative Science Quarterly* (March): 128.

- Cumming, Douglas J., and Jeffrey G. MacIntosh. 2003. "The Extent of Venture Capital Exits: Evidence from Canada and the United States." In *Venture Capital Contracting and the Valuation of High-Tech Firms*. Edited by J. McCahery and L.D.R. Renneboog. Oxford and New York: Oxford University Press.
- del Canto, Jesús Galende, and Isabel Suarez Gonzalez. 1999. "A Resource-based Analysis of the Factors Determining a Firm's R&D Activities." *Research Policy* 28, 8 (November): 891-905.
- Duguet, Emmanuel, and Isabelle Kabla. 2000. "Appropriation Strategy and the Motivations to Use the Patent System: An Econometric Analysis at the Firm Level in French Manufacturing." In *The Economics and Econometrics of Innovation*. Edited by David Encaoua, Bronwyn H. Hall, François Laisney and Jacques Mairesse. Kluwer Academic Publishers, pp. 267-305.
- Feldman, Maryann P., and David B. Audretsch. 1999. "Innovation in Cities: Science-Based Diversity, Specialization and Localized Competition." *SINOA* 6 (February).
- Frank, Richard G., and Mark S. Kamlet. 1986. "Quality, Quantity and Total Expenditures on Publicly Provided Goods: The Case of Public Mental Hospitals." *Journal of Public Economics* 29: 295-316.
- Guellec, Dominique, and Bruno van Pottelsberghe de la Potterie. 2000. "Applications, Grants and the Value of Patents." *Economic Letters* 69: 109-114.
- Gulati, Ranjay. 1998. "Alliances and Networks." *Strategic Management Journal* 19: 293-317.
- Hall, Bronwyn H., Albert N. Link and John T. Scott. 2001. "Barriers Inhibiting Industry from Partnering with Universities: Evidence from the Advanced Technology Program." *Journal of Technology Transfer* 26, 1-2 (January): 87-98.
- Harmon, R.L. 1991. *Patents and the Federal Circuit*. Washington (D.C.): Bureau of National Affairs.
- Hirsch, Werner Z. 1973. *Urban Economic Analysis*. Toronto: McGraw-Hill Book Company.
- Iwasaka, Ryan M.T. 2000. "From Chakrabarty to Chimeras: The Growing Need for Evolutionary Biology in Patent Law." *The Yale Law Journal* 109: 1505-1534.
- Jaffe, Adam B. 1989. "Characterizing the 'Technological Position' of Firms, with Application to Quantifying Technological Opportunity and Research Spillovers." *Research Policy* 18: 87-97.
- Jorda, Karl F. 1999. "Information and Knowledge Protected as Intellectual Property: Role in Economic, Social, Cultural and Technological Development." Presented at WIPO-UNITAR Academy, New York (August).
- Kamien, Morton I., and Nancy L. Schwartz. 1975. "Market Structure and Innovation: A Survey." *Journal of Economic Literature* 13, 1: 1-37.
- Katsh, Salem M., Jack E. Brown and Frederic M. Scherer. 1985. "The Value of Patents and other Legally Protected Commercial Rights: Panel Discussion." *Antitrust Law Journal* 53: 535-553.
- Kingston, William. 2000. "Antibiotics, Invention and Innovation." *Research Policy* 29, 6 (June): 679-710.
- Kortum, Samuel, and Joshua Lerner. 1997. *Stronger Protection or Technological Revolution: What is Behind the Recent Surge in Patenting?* NBER Working Paper No. 6204.

- Lerner, Joshua. 1993. "Innovation and the Structure of High-Technology Industries." In *Research on Technological Innovation, Management and Policy*, vol. 5. Edited by Robert A. Burgelman and Richard S. Rosenbloom, pp. 89-107.
- Long, Clarisa. 1999. "Patents and Innovation in Biotechnology and Genomics." In *Capital for Our Time: The Economic, Legal and Management Challenges of Intellectual Capital*. Edited by Nicholas Imparato, pp. 251-281.
- Malerba, Franco, and Luigi Orsenigo. 1999. "Technological Entry, Exit and Survival: An Empirical Analysis of Patent Data." *Research Policy* 28, 6 (August): 643-660.
- Mansfield, Edwin. 1994. *The Contributions of New Technology to the Economy*. Working Paper. University of Pennsylvania.
- Metcalfe, J. Stan. 2000. "Restless Capitalism, Experimental Economies." In *Technology-based Firms at the Turn of the Century*. Edited by Wim During, Ray Oakey and Michelle Kipling, pp. 4-16.
- Murashige, Kate H. 1997. "Industrial Policy and Biotechnology – Can Intellectual Property Protection Systems Catch up?" *International Journal of Technology Management* 14, 5: 471-484.
- Niosi, Jorge. 1994. "Technological Alliances in Canadian Industry." In *New Technology Policy and Social Innovations in the Firm*. Edited by Jorge Niosi, pp. 75-94.
- Pavitt, K. 1985. "Patent Statistics as Indicators of Innovative Activities: Possibilities and Problems." *Scientometrics* 7, 1-2: 77-99.
- Pisano, Gary P., and Paul Y. Mang. 1993. "Collaborative Product Development and the Market for Know-How: Strategies and Structures in the Biotechnology Industry." In *Research on Technological Innovation, Management and Policy*, vol. 5. Edited by Robert A. Burgelman and Richard S. Rosenbloom, pp. 109-136.
- Schankerman, Mark, and Suzanne Scotchmer. 2000. *Damages and Injunctions in Protecting Proprietary Research Tools*. Working Paper (June).
- Schwab, Robert M., and Ernest M. Zampelli. 1987. "Disentangling the Demand Function from the Production Function for Local Public Services: The Case of Public Safety." *Journal of Public Economics* 33: 245-260.
- Shohet, Simon, and Martha Prevezer. 1996. "UK Biotechnology: Institutional Linkages, Technology Transfer and the Role of Intermediaries." *R&D Management* 26, 3: 283-298.
- Silverman, Alexander E. 1990. "Symposium Report: Intellectual Property Law and the Venture Capital Process." *High Technology Law Journal* 5: 157-192.
- Stephan, Paula, David Audretsch and Richard Hawkins. 2000. "The Knowledge Production Function: Lessons from Biotechnology." *International Journal of Technology Management* 19, 1-2: 165-178.
- Veugelers, Reinhilde, and Bruno Cassiman. 1999. "Make and Buy in Innovation Strategies: Evidence from Belgian Manufacturing Firms." *Research Policy* 28, 1: 63-80.
- Walsh, Vivien, Jorge Niosi and Philippe Mustar. 1995. "Small-firm Formation in Biotechnology: A Comparison of France, Britain and Canada." *Technovation* 15, 5: 303-327.
- Zingales, Luigi. 1995. "Insider Ownership and the Decision to Go Public." *Review of Economic Studies* 62: 425-448.



Stuart J.H. Graham & David C. Mowery
University of California
at Berkeley

7

Intellectual Property Protection in the U.S. Software Industry

INTRODUCTION

THE SOFTWARE INDUSTRY is a knowledge-intensive industry whose output is information, the coded instructions that guide the operations of a computer or a network of computers. Both the inputs and much of the output of this industry consist of intangibles, the prices of which contain considerable Schumpeterian rents. The rewards to innovators in the software industry of the 1980s and 1990s were extraordinary, illustrated by the meteoric rise of William Gates III to control of the largest personal fortune in the world. The modern computer software industry is thus an extreme example of an industry where the returns to innovators' investments, and in many cases market structure, are heavily influenced by the ownership of intellectual property. As such, it is hardly surprising that the legal framework establishing and regulating the ownership of such property has attracted considerable attention and debate.

The *modern* computer software industry of the 21st century differs sharply from the software industry of the 1950s or 1960s, most notably in the growth of mass markets for so-called "packaged" software. These differences are reflected in the central importance of formal intellectual property (IP) protection. The increased importance of formal (IP) rights protection, as well as the evolving economic and legal significance of different instruments for such protection, create significant challenges for U.S. intellectual property rights policy.

Although the computer software industry is global in nature, significant differences remain among the software industries and the associated intellectual property regimes of industrial economies. The United States, Japan and Western Europe differ in the extent to which domestic consumption and production of software are dominated by packaged software. As a result, domestic

lobbying for the creation or modification of legal regimes covering this relatively new form of intellectual property has contributed to differences in the level and characteristics of intellectual property rights for computer software among major industrial economies. The recent controversies over business methods patents and the response of both the U.S. Congress and U.S. Patent and Trademark Office (USPTO) to these controversies (see below) are only the latest example of this endogenous character of national intellectual property rights regimes.

For example, intellectual property protection for software in Japan has been relatively weak, which is compatible with a domestic software industry that has been dominated historically by the production of custom software (Merges, 1996). Although intellectual property protection for software has been strengthened somewhat in Japan during the past decade, both the letter and the enforcement of this protection remain weaker than in the United States. In contrast, the Western European software industry has improved its performance in packaged software. The European Union has adopted stronger formal protection (and enforcement) policies for software than Japan, while exempting some forms of *reverse engineering* of protected software programs from legal challenges. The resulting policy has been more lenient in its treatment of this practice than U.S. policy (Merges, 1996).

The endogenous character of national and regional intellectual property rights regimes is hardly surprising. Analyses of their evolution and effects on industry must adopt a more nuanced and complex view of causes and effects. Among other things, this endogeneity means that the historical evolution of industries and national innovation systems is a path-dependent process.

THE HISTORICAL DEVELOPMENT OF THE COMPUTER SOFTWARE INDUSTRY

THE GROWTH OF THE GLOBAL COMPUTER SOFTWARE INDUSTRY has been marked by at least four distinct eras spanning the 1945-2001 period. During the early years of the first era (1945-65), covering the development and early commercialization of the computer, software as it is currently known did not exist. Even after the development of the concept of a stored program, software was largely custom-developed for individual computers. During the 1950s, however, the commercialization and widespread adoption of *standard* computer architectures supported the emergence of software that could operate on more than one type of computer or in more than one computer installation. In the United States, the development of the IBM 650, followed by the even more dominant IBM 360, provided a large market for standard operating systems and application programs. The emergence of a large installed base of a single

mainframe architecture occurred first, and to the greatest extent, in that country. During this period, however, most of the software for early mainframe computers was produced by their manufacturers and users.

During the second era (1965-78), independent software vendors (ISVs) began to appear. During the late 1960s, producers of mainframe computers *unbundled* their software product offerings from their hardware products, separating the pricing and distribution of hardware and software. This development provided opportunities for entry by independent producers of standard and custom operating systems, as well as independent suppliers of applications software for mainframes. Unbundling occurred first in the United States and has progressed further in that country and in Western Europe than in Japan.

Although independent suppliers of software began to enter in significant numbers in the early 1970s, computer manufacturers and users remained important sources of both custom and standard software in Japan, Western Europe, and the United States during this period. Some computer *service bureaus* that had provided users with operating services and programming solutions began to unbundle their services from their software, providing yet another cohort of entrants into the market for independent development and sale of software. Sophisticated users of computer systems, and especially mainframe computers, also created solutions for their applications and operating system needs. A number of leading suppliers of traded software in Japan, Western Europe and the United States were founded by computer specialists formerly employed by major mainframe users.

During the third era (1978-93), the development and diffusion of the desktop computer produced explosive growth in the traded software industry. Once again, the United States was the *first mover* in this transformation, and the U.S. domestic market became the largest single outlet for packaged software. Rapid adoption of the desktop computer in the United States supported the early emergence of a few *dominant* designs in desktop computer architecture, creating the first mass market for packaged software. The independent vendors that entered the desktop software industry in the United States were largely new to the industry. Few of the major suppliers of desktop software came from the ranks of the leading independent producers of mainframe and minicomputer software, and mainframe and minicomputer ISVs are still minor players in desktop software.

Rapid diffusion of low-cost desktop computer hardware, combined with the emergence of a few dominant designs for this architecture, eroded vertical integration between hardware and software producers and opened up opportunities for ISVs. The declining cost of computing technology has continually expanded the array of potential applications for computers; many of these applications rely on software solutions. A growing installed base of ever-cheaper computers has been an important source of dynamism and entry into the

traded software industry, because the expansion of market niches in applications has outrun the ability of established computer manufacturers and major producers of packaged software to supply them.¹

The packaged computer software industry now has a cost structure that resembles that of the publishing and entertainment industries much more than that of custom software — the returns on a *hit* product are enormous while production costs are low. As in these industries also, the growth of a mass market for software has elevated the importance of formal intellectual property rights. However, a key contrast between software and the publishing and entertainment industries is the importance of product standards and consumption externalities in the software market. In the mass software market, users often resist switching among operating systems or even well-established applications because of the high costs of learning new skills, as well as concerns over the availability of an abundant library of applications software that complements an operating system. These switching costs typically are higher for less-skilled users who dominate mass markets for software, and promote the development of *bandwagons* that create de facto product standards. As the widespread adoption of desktop computers created a mass market for software during the 1980s, these de facto product standards in hardware and software became even more important for the commercial fortunes of software producers than in the 1960s and 1970s.

The fourth era in the development of the software industry (1994-present) has been dominated by the growth of networking among desktop computers, both within enterprises through local area networks linked to a server and among millions of users through the Internet. Networking has created opportunities for the emergence of new software market segments (for example, the operating system software currently installed in desktop computers may reside on a network or a server), the advent of new dominant designs, and potentially, the erosion of currently dominant software firms' positions. Some rapidly-growing network applications, such as the World Wide Web, use a code (HTML) that operates on all platforms rather than being *locked into* a single hardware architecture. Like the previous eras of this industry's development, the growth of network users and applications has been faster in the United States than in other industrial economies, and U.S. firms have maintained dominant positions in these markets (see Mowery and Simcoe, 2002).

How has the growth of the Internet changed the economics of intellectual property protection in the software industry? At least three different effects are apparent at this early date in the Internet's development. First, the widespread diffusion of the Internet has created new channels for low-cost distribution and marketing of packaged software, reducing barriers to entry into the packaged software industry that are based on the dominance of established distribution

channels by large packaged software firms. In this respect, the Internet expands the possibilities for rapid penetration of markets by a *hit* packaged software product (in the jargon of the software industry, a “killer application”), which enhances the economic importance of protection for these types of intellectual property. The Internet is also a key factor behind the growth of patents for business methods, many of which concern tools or routines employed by on-line marketers of goods and services. Although they frequently are embodied in software, these business methods need not be sold directly to end users, but instead may support the delivery to end users of on-line services or products. Nevertheless, there is abundant evidence to the casual observer of the importance and economic returns to Internet-based *hits* that may rely on unique methods for supporting the delivery of such products and services.

But the Internet has also provided new impetus to the diffusion and rapid growth of a very different type of software, *open-source* software. Although so-called “shareware” has been an important form of software in all of the eras of the software industry described above, the Internet’s ability to support both rapid, low-cost distribution of new software and (crucially) the centralized collection and incorporation into that software of improvements from users has made possible such widely used operating systems as Linux and Apache (see Kuan, 1999; and Lerner and Tirole, 2000). The Internet has thus increased the returns to inventors of patented software, while at the same time supporting the growth of open-source software.

THE EVOLUTION OF INTELLECTUAL PROPERTY RIGHTS POLICY AND PRACTICE IN THE U.S. SOFTWARE INDUSTRY

THIS STUDY IS PRIMARILY CONCERNED with intellectual property rights in software that combine the grant of a limited monopoly in exchange for an element of disclosure or public use. As such, it is most appropriate to examine in detail copyright and patent protection, particularly because software has been brought underneath the umbrella of each of these regimes in distinct and interesting ways over the last several decades. In the near future, however, the use by software innovators of legal protections in the areas of trade secret,² misappropriation,³ trade-marks,⁴ and even the *Semiconductor Chip Protection Act*⁵ will remain important.

COPYRIGHT

COPYRIGHT PROTECTION FOR SOFTWARE INNOVATIONS was singled out by policymakers during the 1970s as the preferred means for protecting software-related intellectual property (Menell, 1989). In its 1979 report, the National Commission on New Technological Uses of Copyrighted Works (CONTU),

charged with making recommendations to the U.S. Congress on software protection, chose copyright as the most appropriate form of protection for computer software (CONTU, 1979). Because copyright protection adheres to an author-innovator with relative ease and has a long life — now 100 years for works created for hire — the Commission determined that copyright was the preferred type of intellectual property protection for software. Congress adopted the Commission's position when it wrote "computer program" into the *Copyright Act* in 1980.⁶

The federal judiciary's application of copyright to software in the aftermath of the CONTU initially promised strong protection for inventors. Over time, however, the courts' interpretation of copyright as applied to software has yielded a narrower form of protection. *Apple Computer, Inc. v. Franklin Computer Corp.*⁷ is an early and important case of copyright litigation over packaged software. Although the federal judiciary had long held that copyright protects only *expression* in works,⁸ the Court in *Apple Computer* argued that Apple's specific code was protected by its copyright. The Court concluded that efforts by a follower firm to use the copyright holder's code for purposes of achieving compatibility with the original software were inconsequential to the determination of whether infringement had occurred. This decision strengthened copyright protection considerably, making it possible for one firm's copyrighted software to block the innovative efforts of others. Subsequent decisions — the so-called *look and feel* cases — extended traditional copyright protection of *expression* to such non-literal elements of software as structure, sequence and organization.⁹

The sweeping interpretation of copyright protection in the *Apple Computer* case was narrowed and weakened considerably in the outcome of a series of copyright infringement cases brought by Lotus Development. Lotus successfully sued Paperback Software International over the latter's alleged imitation of the look and feel of Lotus's spreadsheet software in a case that was decided in favour of Lotus in 1990. Lotus then sued Borland International over the alleged infringement by Borland's *Quattro* software of the look and feel of Lotus's 1-2-3 spreadsheet software in a case that lasted for six years, producing four opinions in federal district court and appeals to both the Court of Appeals and the U.S. Supreme Court. The district court found that Borland had infringed Lotus's 1-2-3 spreadsheet software. Borland rewrote its software to achieve partial compatibility with elements of Lotus's software, but this modification also was met with infringement findings by the district court and a permanent injunction banning its sale.¹⁰

The Court of Appeals ultimately reversed some of the district court's conclusions, arguing that *second-movers* in the software industry must be allowed to emulate and build on certain of the innovator's code and methods.¹¹ The decision of the Court of Appeals was affirmed in 1996 by the U.S. Supreme Court in a 4-4 decision.¹² The *Borland* decision weakened the strong protection for

software inventions provided by *Apple Computer v. Franklin Computer*, and along with other decisions affirming the strength of software patents, may have contributed to an increased reliance on patents by some U.S. software firms in the 1990s.¹³

PATENTS

IN CONTRAST TO COPYRIGHT, federal court decisions during the past decade have consistently broadened and strengthened the economic value of software patents. Although some early cases during the 1970s supported the initial stance of the USPTO in stating that software algorithms were not patentable,¹⁴ judicial opinions have shifted since then to support the use of patents for software (Samuelson, 1990).¹⁵ In the *Diamond v. Diehr*¹⁶ and *Diamond v. Bradley*¹⁷ cases, both decided in 1981, the Supreme Court announced a liberal rule that permitted the patenting of software algorithms. Both the courts and the USPTO have supported this policy, strengthening patent protection for software (Merges, 1996). A vivid example of the effects of this stronger patent regime is the 1994 court decision that found Microsoft guilty of patent infringement and awarded \$120 million in damages to Stac Electronics, the plaintiff. The damages awarded were hardly a crippling blow to Microsoft, but the firm's infringing product had to be withdrawn from the market temporarily, compounding the financial and commercial consequences of the court's decision (Merges, 1996).

As the USPTO adopted a more favourable posture toward applications for software patents, the ability of patent examiners to identify *novelty* in an area of technology in which patents historically have not been issued to cover major innovations was criticized well before the surge of business methods software patent applications in 1998 and 1999. The celebrated multimedia patent issued by the USPTO to Compton's Newmedia in 1993 is one example of the difficulties associated with a lack of patent-based prior art. On November 15, 1993, Compton's Newmedia announced that it had won a *fundamental* patent for its multimedia software that rapidly fetched images and sound.¹⁸ The patent was quite broad, covering

a database search system that retrieves multimedia information in a flexible, user-friendly system. The search system uses a multimedia database consisting of text, picture, audio and animated data. That database is searched through multiple graphical and textual entry paths.¹⁹

Compton's President Stanley Frank suggested that the firm did not want to slow the growth of the multimedia industry, but simply "want[ed] the public to recognize Compton's Newmedia as the pioneer in this industry, promote a standard that can be used by every developer, and be compensated for the

investments we have made.” Armed with this patent, Compton’s traveled to Comdex, the computer industry trade show, to detail its licensing terms to competitors, which involved payment of a 1-percent royalty for a non-exclusive licence.²⁰

Compton’s appearance at Comdex launched a political controversy that culminated in an unusual event — the USPTO reconsidered and invalidated Compton’s patent. On December 17, 1993, the USPTO announced that it was re-examining its award of the patent to Compton’s Newmedia because, in the words of Commissioner Lehman, “this patent caused a great deal of angst in the industry.”²¹ On March 28, 1994, the USPTO released a preliminary statement declaring that “[a]ll claims in Compton’s multimedia patent issued in August 1993 have been rejected on the grounds that they lack ‘novelty’ or are obvious in view of prior art.”²² This declaration was confirmed by the USPTO in November of 1994.²³

Patents in *Business Methods*

Recent federal judicial decisions have continued to support the rights of patent holders and have expanded the definition of *software* subject to protection by patent. On August 23, 1998, the Court of Appeals for the Federal Circuit (CAFC) validated a business methods software patent in *State Street Bank v. Signature Financial Group*.²⁴ In 1993, Signature was awarded a patent for its data-processing system used in financial transactions, but controversy kept it bottled up in the courts until the 1998 ruling by the CAFC, the highest federal court specialized in patent appeals.²⁵ In ruling that the software was patentable, the court announced that

the transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, formula, or calculation, because it produces ‘a useful, concrete, and tangible result.’²⁶

This sweeping language supports recent software patenting guidelines by the USPTO that have expanded the definition of patentable software subject matter. A patent attorney suggested that the language used in this opinion was so sweeping as to allow Newton to receive a patent for the calculus.²⁷

Since the *State Street* decision, business methods patenting has expanded rapidly, especially for Internet-based transactions and marketing techniques. USPTO Commissioner Dickinson noted in March 2000 that the number of patent applications for such techniques expanded from 1,275 in fiscal 1998 to 2,600 in fiscal 1999, resulting in the issuance of 600 business methods patents in 1999. Although the doubling in business methods patent applications is

noteworthy, issued patents in this class accounted for less than 0.5 percent of all issued patents in 1999.²⁸ Several firms have filed patent applications for *one-click* Internet ordering techniques, and Amazon.com, an Internet vendor of books and other products, has threatened to sue other Internet firms for allegedly infringing its patent on one-click order methods. Priceline.com, another Internet marketing firm, has sued Microsoft over the latter's alleged infringement of its patented *reverse auctions*, which allow buyers to name a price for a good and sellers to respond.

As in the case of Compton's patent, the proliferation of Internet-based business methods patents was facilitated by a lack of patent-based prior art available for review by USPTO examiners.²⁹ Tim Berners-Lee, developer of the HTML software code that is widely used for the creation of websites, argues that some of the Internet business methods patents "combine well-known techniques in an apparently arbitrary way, like patenting 'going shopping in a yellow car on a Thursday.'" (Waldmeir and Kehoe, 1999).

Political reactions to the surge in business methods patents and the controversy surrounding their validity were swift and involved both the U.S. Congress and the USPTO. In late 1999, the Congress passed the *American Inventor Protection Act* (AIPA). This statute was originally drafted in order to revise the U.S. patent system to make it consistent with the World Trade Organization (WTO) agreements that concluded the Uruguay Round of trade negotiations, but additional provisions were added specifically to address the business methods patent controversy. One important provision of the AIPA that was incorporated to conform to WTO requirements stipulated the publication of most U.S. patent applications within 18 months after their submission to the USPTO. This publication requirement should make it easier for a would-be inventor to verify that he or she is not infringing pending patents. A second provision of the AIPA, which was inserted in response to the business methods patenting controversy, created a *first-to-invent* defence against infringement claims. Defendants who can show that they were practicing the relevant method or art one year or more prior to the filing of the patent application are protected against infringement suits. This provision also should reduce the exposure of inventors to infringement suits based on their use of long-established, non-patented prior art.

Administrative responses to the business methods controversy included the USPTO's Business Methods Patent Initiative, unveiled in the spring of 2000. This initiative included several provisions:

1. Hiring more than 500 new patent examiners specialized in software, computer and business methods applications.

2. Tripling the number of examiners assigned to examine applications in Class 705, the primary locus of business methods patenting activity.
3. Expanding the number of non-patent prior art databases to which these examiners have access.
4. Requiring that non-patent and foreign prior art be searched systematically for all applications in Class 705.
5. Requiring examination of all applications in Class 705 by a second examiner in addition to the primary examiner to whom the application was assigned.

This administrative initiative will raise the level of scrutiny devoted to business methods patent applications and is likely to reduce the fraction of applications in this class that result in the issuance of a patent.

Nevertheless, the economic significance and validity of U.S. business methods patents will be determined ultimately through litigation. The *re-examination* procedure instituted in 1980 allows interested parties to request that an issued patent be re-examined by the USPTO, but it bears little resemblance to the more elaborate *opposition* process of the European Patent Office (EPO) and a number of European countries. In the United States, parties requesting a re-examination do not participate directly in the proceeding, which takes place on an *ex parte* basis, and the evidence considered during the re-examination is limited.³⁰ By contrast, the formal processes of most European countries allow the opposing parties to introduce evidence and present arguments as part of the proceedings. According to Merges (1999), the EPO opposition processes result in the invalidation of roughly one-third of the opposed patents, while the U.S. re-examination process invalidates only 12 percent of the patents for which a re-examination is requested.

Our recent research in the USPTO records of re-examination proceedings indicates that more than 40 percent of all re-examinations during 1980-99 were requested by the patent owner.³¹ Moreover, nearly 14 percent of the more than 3,000 re-examinations that we analyzed involved adding claims, and almost 7 percent of these proceedings resulted in both the addition and deletion of patent claims. While a full cancellation of the patent is likely in a third of all opposition proceedings, under the re-examination system a full cancellation of all claims occurs in less than 10 percent of the cases. Clearly, the re-examination procedure is very different from patent oppositions found in the European Patent Office and other European national patent systems.

Although litigation provides rigorous scrutiny of patent claims and validity, it is a very costly tool for maintaining patent *quality* — the cost of a *typical*

infringement suit is estimated to run between \$1 million and \$3 million. Moreover, litigation involves a lengthy process (one estimate suggests that the duration of the *average* patent suit in district court is 31 months),³² meaning that the validity of key *foundational* patents in software or business methods — those on which subsequent inventors may rely (and for which they are either paying royalties or risking costly infringement penalties) — may take years to establish. In rapidly-evolving fields like software, such delays raise the prospect of high uncertainty, high transaction costs and impediments to the innovation process.

The non-litigation avenues to establish the validity of business methods patents in the United States are thus limited and the ultimate effectiveness of the Congressional and administrative initiatives described above cannot yet be ascertained. Nonetheless, it may be that the global nature of markets in which business methods patents are applied, especially those whose operation rely on the Internet, may limit the proliferation of *junk patents*. Given the footloose nature of the Internet (an Internet enterprise can be established virtually anywhere in the world where there is a reasonably well-developed infrastructure), the value of Internet-based business methods patents may well rest on a global recognition of their validity. At present, most European patent systems do not recognize the validity of business methods patents that do not have a *technical effect* (Hart, Holmes and Reid, 1999). The precise meaning of this distinction is subject to considerable debate and interpretation, suggesting that at least some, but by no means all, business methods patents issued in the United States will be upheld as valid in Europe. Therefore, the value of many U.S. business methods patents may be limited, although much uncertainty remains about their validity in foreign jurisdictions.

Indeed, the broader question of patent quality requires some reinterpretation in light of the fact that most valuable patents are the subject of an application in more than one region of the global economy. As such, the effects of the limited *quality-control* mechanisms of the U.S. system on patenting of genuinely important or valuable inventions may be less pronounced than occasionally suggested. The relatively loose quality control system of the United States may allow some *free riding* on the more rigorous scrutiny afforded in other jurisdictions where inventors feel that patent protection is essential. The interaction among the different standards and scope of patent protection applied in the various industrial economies, and the economic significance of patents in global industries remain important topics for future research.

PATENTING TRENDS IN THE U.S. SOFTWARE INDUSTRY

IN THIS SECTION, THE LIMITED DATA ON SOFTWARE PATENTS in the United States during the 1980s and 1990s are examined. As with most other elements of the software industry, definitional issues loom large — what is a

software patent? Moreover, rapid growth in the number of software-related USPTO patents creates severe problems for longitudinal analysis — we wish to examine changes in software patenting, rather than changes that may reflect a reclassification of patents from the “all other” to the “software-related” categories. Lacking a clear a priori definition of “software-related” patent classes, we focused on the following 11 main groups of the International Patent Classification (IPC):³³

G06F Electric Digital Data Processing:

- 3/ Input arrangements for transferring data to be processed into a form capable of being handled by the computer.
- 5/ Methods or arrangements for data conversion without changing the order or content of the data handled.
- 7/ Methods or arrangements for processing data by operating upon the order or content of the data handled.
- 9/ Arrangements for programme control.
- 11/ Error detection; Error correction; Monitoring.
- 12/ Accessing, addressing or allocating within memory systems or architectures.
- 13/ Interconnection of, or transfer of information or other signals between, memories, input/output devices or central processing units.
- 15/ Digital computers in general.

G06K Recognition of Data; Presentation of Data; Record Carriers; Handling Record Carriers

- 9/ Methods or arrangements for reading or recognizing printed or written characters or for recognizing patterns.
- 15/ Arrangements for producing a permanent visual presentation of the output data.

H04L Electric Communication Technique

- 9/ Arrangements for secret or secure communication.

These main groups were identified by examining overall patenting activity during 1984-95 by the six largest U.S. producers of personal computer (PC) software, based on their calendar 1995 revenues.³⁴ These firms were granted 156 patents over the period (Table 1), and more than 58 percent of those patents fell into the 11 IPC groups. Those groups account for a higher share of the patents of the six firms during the same period (72.8 percent) when we exclude unclassified design patents and IPC groups created after 1984 (for example, the main group G06F 17/ came into existence in 1990). These groups account for a

similar share of the overall patenting activity of the largest specialized producers of computer software (any type of software, not just PC software) based on global software revenues for 1995.³⁵ Patenting activity in the eleven main IPC groups accounts for 58.2 percent of overall patenting in this second set of firms during 1984-95, and when we consider only patents that were neither unclassified nor assigned to late-appearing groups, patenting in the eleven main groups rises to 71.2 percent of overall patenting activity for the second set of firms. These patent classes thus appear to capture a substantial share of the patenting activity of both PC and non-PC software producers, and their content and coverage were relatively stable throughout the 1984-97 period.

Since they existed throughout the 1984-97 period, these patent classes provide a useful basis for examining time trends in U.S. software patenting. Note that they do not cover all software patents. We believe that trends in these classes are representative of overall software patenting activity, particularly since they include the areas where patenting appears to have grown rapidly during 1980-2001. The data in Figure 1 indicate that the share of all U.S. patents accounted for by patents classified in these IPC groups more than doubled during 1987-97, rising from 1.7 percent in 1984 to 3.8 percent in 1997. Moreover, growth in this share appears to accelerate after 1991. The evidence on patenting by the largest U.S. packaged software firms presented below provides some corroborative evidence of acceleration in the growth of overall software patenting in the 1990s, perhaps in response to the more expansive

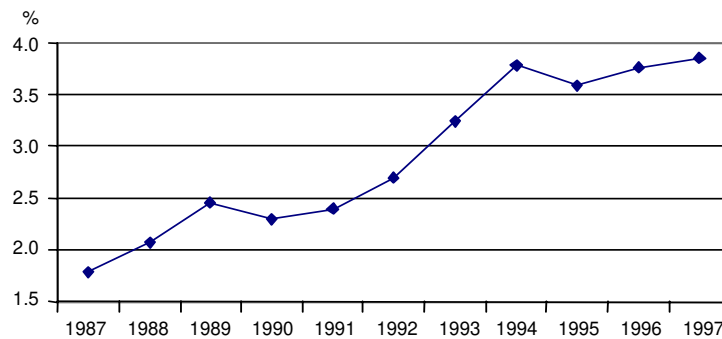
TABLE 1

PATENTS ISSUED DURING 1984-95 TO THE TOP SIX SOFTWARE FIRMS
IN THE 1995 *SOFTLETTER* 100 RANKING
(N=156)

INTERNATIONAL PATENT CLASS	PATENT COUNT	SHARE OF ALL FIRM PATENTS (%)	CUMULATIVE TOTAL (%)
G06F 15/	30	19.2	19.2
G06F 9/	20	12.8	32.0
G06F 13/	10	6.4	38.4
G06F 3/	9	5.8	44.2
G06F 11/	6	3.8	48.0
G06K 9/	5	3.2	51.2
G06F 12/	3	1.9	53.1
G06K 15/	3	1.9	55.0
H04L 9/	3	1.9	56.9
G06F 5/	1	0.6	57.5
G06F 7/	1	0.6	58.1

FIGURE 1

PACKAGED SOFTWARE PATENTS AS A SHARE OF ALL PATENTS, 1987-97



judicial treatment of the breadth and strength of patents in the early 1990s.

PATENTS ISSUED TO PACKAGED SOFTWARE FIRMS FROM 1987 TO 1997

WE NOW TURN TO A DETAILED EXAMINATION of the patenting behaviour of large U.S. software firms during the 1980s and 1990s. The discussion centers on the patenting behaviour of U.S. packaged software firms (based on revenues) drawn from the annual lists of the 100 leading U.S. packaged software firms compiled for 1985, 1990, 1995 and 1997 by *Softletter*, a trade newsletter.³⁶ We focus on packaged software producers because their share of industry output has grown rapidly since 1980, and because we noted earlier that packaged software is the product area where the importance of intellectual property protection appears to have increased considerably. These firms are also among the few U.S. firms whose publicly-reported research and development (R&D) spending can be treated, for analytic purposes, as devoted largely to software R&D, in contrast to highly diversified firms like IBM that produce electronic systems as well as software.

Our discussion of the patenting behaviour of U.S. software firms focuses on three issues:

1. How has the propensity to patent of these firms, measured as the ratio of patents to constant-dollar R&D spending, changed during the past decade?
2. Do we observe significant differences in the patenting propensities of incumbents (firms founded before 1985) and entrants (firms founded after 1985) in the U.S. packaged software industry?

3. How has the importance of these firms' software patents (measured by the proportion of citations to these firms' patents in the four classes defined above, to citations to all patents in these classes) changed during the same period?

We use slightly different samples of U.S. packaged software firms to examine each of these questions, because of the need for both R&D spending and patent data at the firm level to analyze patent propensities. Immediately below (Figures 2 and 3), we present firm-level data on patenting propensities for the nine and eight (Figure 3 excludes Borland/Inprise) largest U.S.-based packaged software firms — all publicly traded firms that report annual R&D spending. Firm-level patenting trends for a larger number of firms become almost unintelligible when presented in a single graph, and we thus supplement firm-level data with data on trends in overall patenting propensity for the 15 largest U.S.-based packaged software firms in Figures 4 and 5.

In subsequent figures, we summarize data on the patenting propensities of the 15 largest U.S.-based packaged software firms founded before and after 1985 (a total of 30 firms), by way of addressing the second question listed above. However, the third question requires only firm-level patent data, which enables us to draw on a larger sample of software firms.

Figures 2 and 3 display trends in firm-specific patenting propensities (based on a 3-year moving average) during 1988-96 for the nine and eight largest U.S. PC software firms (as identified in the 1997 *Softletter* ranking of the top 100 packaged software firms — Figure 2 includes, and Figure 3 excludes Borland/Inprise³⁷) with significant patenting activity in 1997. The data, based on the IPC main classes discussed above, present a mixed picture. Microsoft, by far the largest of these firms, displays an upward trend (increasing by roughly fourfold) in its post-1991 patenting propensity. Novell, Symantec, Wall Data and Borland also exhibit increases in patenting propensity during the 1990s. Interestingly, the 1996 patents/R&D spending ratio is highest for Borland, a packaged software firm with extensive experience in intellectual property litigation. Another firm with hard-won experience in the consequences of unfavourable intellectual property decisions, Microsoft, was also among the most intensive users of patents by 1997.

FIGURE 2

FIRM-LEVEL PATENT PROPENSITY, 3-YEAR MOVING AVERAGE, 1988-96

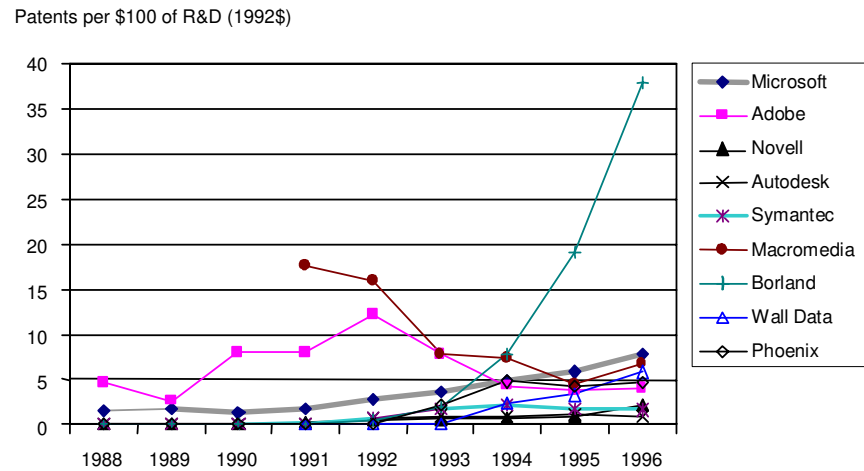


FIGURE 3

FIRM-LEVEL PATENT PROPENSITY, 3-YEAR MOVING AVERAGE, 1988-96

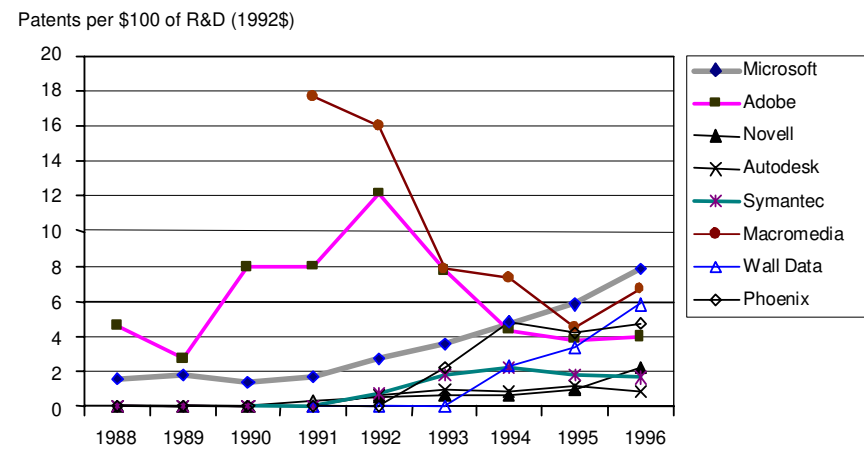


FIGURE 4

PATENT PROPENSITY, TOP 15 U.S. PACKAGED SOFTWARE FIRMS (IN 1997),
3-YEAR MOVING AVERAGE, 1988-96

Patents per \$100 of R&D (1992\$)

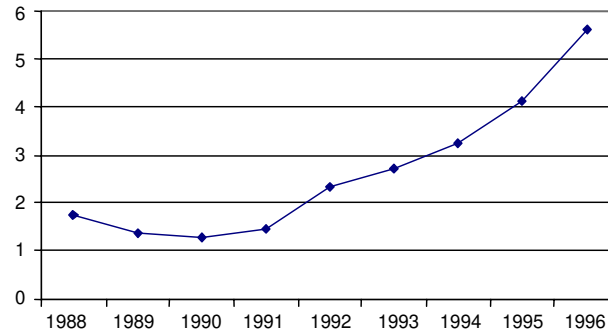
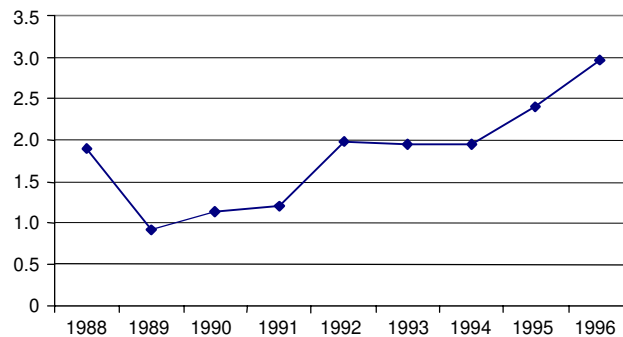


FIGURE 5

PATENT PROPENSITY, TOP 15 U.S. PACKAGED SOFTWARE FIRMS (IN 1997),
3-YEAR MOVING AVERAGE, 1988-96
(EXCLUDING MICROSOFT)

Patents per \$100 of R&D (1992\$)



This evidence is hardly definitive, but it suggests that the judicial decisions of the early 1990s on copyright and patent protection for software may have influenced the patenting behaviour of at least some large U.S. packaged software firms. Not only did two leading defendants in patent infringement

suits (Borland and Microsoft) increase their patenting intensity during this period, but several other firms not directly involved in these cases also did.

Patent propensities for the largest U.S. software firms as a group also grew during the 1987-97 period. Figures 4 and 5 show trends in the aggregate patents/R&D spending ratio over 1988-96 for the 15 U.S. PC software firms listed by *Sofialetter* among the top 100 firms for which data are available throughout the period (again, a 3-year moving average is used).³⁸ Figure 4 displays an unweighted average, and Figure 5 a weighted average (by R&D spending, which weights Microsoft heavily) of the patents/R&D spending ratios of these 15 firms. The weighted average exhibits a significant upward trend, reflecting Microsoft's behaviour. Nonetheless, even when Microsoft is excluded from the data presented in Figure 4 (Figure 5), a modest increase in patent propensities is still apparent. Thus, there is some evidence of an increase in the aggregate patenting propensities of leading U.S. PC software firms (as of 1997) during 1988-96, although the size of the increase is heavily affected by the behaviour of the largest firm (Table 2 presents data on Microsoft's patenting and R&D spending during 1986-97, revealing the firm's large share of total R&D investment by the 10 largest packaged software firms during this period).

TABLE 2

MICROSOFT R&D AND PATENTING ACTIVITY, 1986-97

	R&D (1992\$M)	PATENTS	SHARE OF TOP-10 R&D
1986	24.9	1	0.535709
1987	45.0	0	0.523173
1988	79.8	1	0.555825
1989	121.4	2	0.532544
1990	191.6	3	0.560819
1991	240.8	2	0.538292
1992	352.2	8	0.547642
1993	458.4	19	0.563369
1994	581.6	26	0.489477
1995	802.9	52	0.504766
1996	1311.7	103	0.610868
1997	1733.8	206	0.611822

As noted earlier, the data on patent propensities are restricted to firms reporting annual R&D spending. A slightly different but more comprehensive assessment of patenting by packaged software firms considers the share of overall software patenting accounted for during 1987-97 by the patents assigned to the 100 largest U.S. packaged software firms (based on the 1997 *Softletter* ranking). This share has increased sharply since 1987, rising from 0.06 percent of all software patents in 1988 to nearly 3.25 percent in 1997 (Figure 6). Moreover, the trend is unchanged when Microsoft is excluded from the ranks of the top 100 U.S. software firms (Figure 7), although the magnitude of the share increase is much smaller (from less than 0.1 percent in 1987 to slightly more than 0.7 percent in 1997). In both cases, the increase in large-firm patenting activity is most pronounced during the 1990s. The largest U.S. software firms have increased their patenting activity relative to other software firms and now account for a larger share of overall software patenting in the U.S. economy.

Is increased patenting by large U.S. packaged software firms a result of entry by firms that are especially active patenters? We lack a clear basis for separating our group of large U.S. packaged software firms into incumbents and entrants, but on a visual examination of the data on these firms' founding dates, we chose 1985 to split incumbents from entrants within the top 100 firms in 1997 (48 of these firms were founded before 1985). Figure 8 displays trends over 1990-97 in the weighted-average patenting propensities of the 15 largest incumbents and the 15 largest entrants (based on the 1997 *Softletter* ranking), defined as above (our sample size and the length of the time series are limited by the need to have a balanced panel of publicly traded firms, so as to

FIGURE 6

PACKAGED SOFTWARE PATENTS AS A SHARE OF ALL SOFTWARE PATENTS,
1987-97

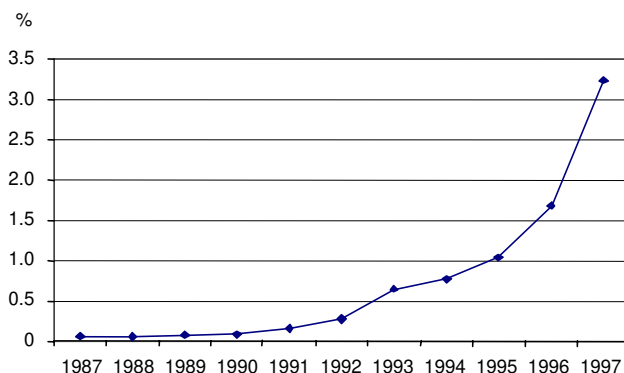
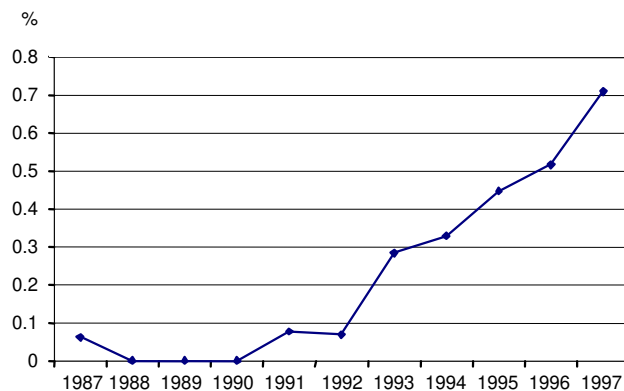


FIGURE 7

PACKAGED SOFTWARE PATENTS (EXCLUDING MICROSOFT) AS A SHARE OF ALL SOFTWARE PATENTS, 1987-97

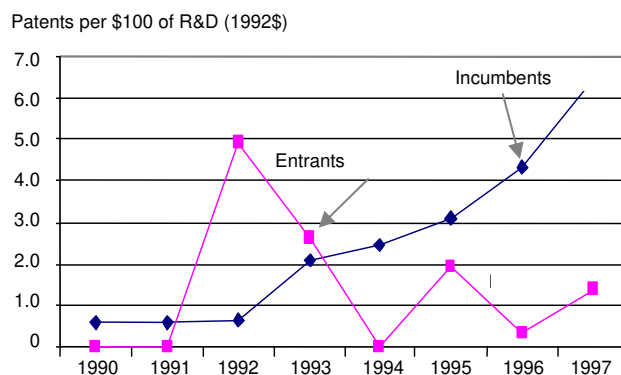


enable us to compute the patent propensity measure). There is almost no time trend in the patenting propensities of entrants (indeed, they show a sharp decline during 1992-94), but incumbents exhibit a steady increase in their patenting propensity. Moreover, this difference is unaffected by excluding Microsoft.

The conclusion that older firms are more intensive patenters is consistent with recent work by Sorensen and Stuart (1999), who find that patenting activity increases with the age of the firm in the semiconductor and

FIGURE 8

PATENT PROPENSITIES OF INCUMBENTS AND ENTRANTS, 1990-97



biotechnology industries. Increased patenting by more mature firms may reflect a payoff from the larger knowledge stock created by a longer stream of R&D investments. But this finding seems to conflict with the conclusion of Kortum and Lerner (1999) that the increased overall rate of patenting in the United States during 1985-96 reflects more intensive patenting by smaller, younger firms.

Increased patenting by large packaged software firms appears to track the trends in federal court decisions, such as *Stac Electronics*, which were followed by increases in large firms' patent propensities. It is possible that software patents are being used by these firms for strategic purposes, such as cross-licensing or blocking of other firms' innovations, as well as to protect their intellectual property (Hall and Ziedonis, 2001; Cohen, Nelson and Walsh, 1998).³⁹ Further research on this issue is needed.

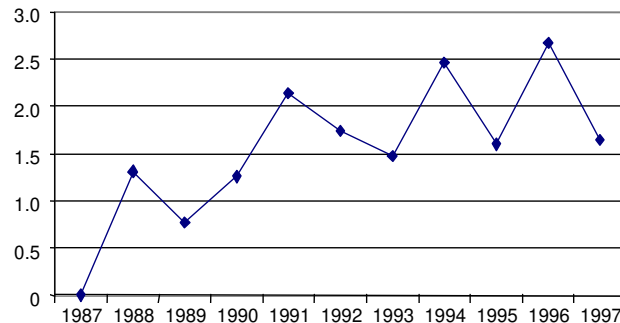
A closely related issue concerns the *quality* of software patents issued to these firms, relative to all patents in our software classes, during this recent period of rapid growth in patenting activity. As noted earlier, the growing use of patents for the protection of intellectual property in the software industry raises unusual challenges. The examination of patents at the USPTO for novelty, utility, and non-obviousness relies heavily on the study of patent-based prior art. Has the lack of patent-based prior art resulted in USPTO examiners approving the issue of trivial, *junk* software patents to leading software firms, as critics (Aharonian, 1993) have argued?

In order to examine trends in the quality of recent industrial software patents, we analyzed the frequency of citations to the software patents of the top 100 packaged software firms, relative to citations to all software patents (defined as above). Because of the requirement for inventors to cite prior art and the need for examiners to supplement these citations to prior art, the number of citations received by a patent serves as a crude measure of its technological importance. Moreover, recent empirical work (Trajtenberg, 1990) has found that heavily cited patents also have greater economic value.

Our measure of the relative importance of patents compares the citation rates of patents issued to the *Sofletter* top 100 firms (in 1997) during the three years following patent issue, with the citation rates of all software patents issued in that year during the three years following the year of issue. Relatively important patents will have citation ratios greater than one, while relatively unimportant patents will have citation ratios of less than one. We compute the ratio of citation rates for these firms' patents to those for all software patents for a period of two years after the date of issue. This patent citation measure is not sensitive to the truncation of the time period during which more recently issued patents can be cited, since it compares the citation rates of patents within the same cohort. Our citation measure also omits self-citations by the firm assigned the patent.

FIGURE 9

CITATIONS TO TOP 100 PACKAGED SOFTWARE FIRMS' PATENTS,
ALL SOFTWARE PATENT CITATIONS, 1987-97



We computed this measure of patent *importance* for patents issued during 1987-97 to the 100 largest U.S. software firms in 1997 (Figure 9). The measure displays a modest upward trend over much of the 1985-95 period, suggesting that the patents issued to the *Softletter* top 100 software firms were cited more heavily than were all software patents. Moreover, through 1996 these firms' patents were being cited with growing intensity, relative to all software patents. However, the data in Figure 9 must be interpreted with caution, since it is possible that the importance of all software patents dropped precipitously during this period — we are able to compare only the importance of software patents issued to the *Softletter* top 100 firms with the importance of software patents issued to all inventors. We also cannot compare the importance of these software patents with that of non-software patents — instead, these indicators shed light only on the relative importance of software patents (as defined earlier) assigned to large software specialists. Nonetheless, these trends indicate that the relative importance of patents issued to large specialized producers of PC software — firms that have intensified their patenting activity during the 1990s — has not deteriorated during this recent period of significant growth in their software patenting.

SOFTWARE PATENTING BY ELECTRONICS FIRMS

AN IMPORTANT CHARACTERISTIC OF SOFTWARE is its status as a general purpose technology, one with applications over a broad array of products. Among other things, this characteristic of software means that many firms that are not

specialized producers and vendors of software rely heavily on software to incorporate new features into their products. In addition, of course, a great deal of software is produced by users of advanced computing and electronics technologies, many of whom are manufacturers of electronic systems products. Finally, major producers of mainframe and minicomputer products retain an important role as producers and vendors of software (indeed, IBM's revenues from software sales alone exceeded the corporate revenues of the largest specialized software firm, Microsoft, until 1997). For all of these reasons, we wished to examine trends in software patenting activity (defining software patents as above) for each of the following producers of electronic systems and devices: IBM, Intel, Hewlett-Packard, Motorola and National Semiconductor. We also analyze combined patenting data for a larger group of electronic systems producers, one that included all of the firms above as well as NEC, Digital Equipment Corporation, Compaq, Hitachi, Fujitsu, Texas Instruments and Toshiba. Because of space constraints, we present data only for the combined 12-firm sample.

Our relatively restrictive definition of software patents, as well as our reliance on data from specialized producers of packaged software to develop this definition, mean that our data on the patenting activity of these firms assuredly understate their software-related patenting. We almost certainly omit significant patenting activity in the embedded software (software incorporated directly into a product and whose operation is typically not controlled by the user) included in such products as microprocessor chips or measurement instruments. Nevertheless, since patenting of packaged software appears to have grown faster than for most other product areas, we believe that these data are of interest. We lack data on these firms' software-related R&D, which means that an analysis of the software patent propensity of these firms is infeasible. Instead, we focus our discussion on two issues: (1) How has software patenting grown, if at all, relative to overall corporate patenting? and (2) How has these firms' software patenting grown, if at all, as a share of overall software patenting, defined as above?

Figures 10 and 11 display trends during 1987-97 in software patenting as a share of overall corporate patenting, and corporate software patents as a share of all software patents for a group of electronic systems firms (IBM, NEC, DEC, Compaq, Hitachi, Fujitsu, National Semiconductor, TI, HP, Rockwell International, Intel and Toshiba). Figure 10 depicts the share of software patents (as defined above) in the total patenting activity of these firms during the 1987-97 period, revealing a modest increase from less than 15 percent to more than 20 percent of total patenting by these firms. In some firms, such as National Semiconductor, software patents increased from less than 5 percent of corporate patenting in 1987 to roughly 20 percent in 1997. The 1980s and 1990s were a period of rapid growth in overall patenting by major U.S. semiconductor manufacturers. The increase in the share of software patents at a major

FIGURE 10

SOFTWARE PATENTS AS A SHARE OF TOTAL PATENTS, 12 ELECTRONICS FIRMS
(IBM, NEC, DEC, COMPAQ, HITACHI, FUJITSU, NATIONAL SEMICONDUCTOR,
TI, HP, ROCKWELL INTERNATIONAL, INTEL AND TOSHIBA), 1987-97

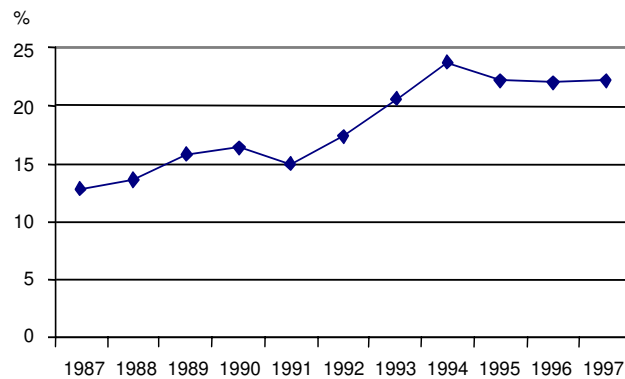
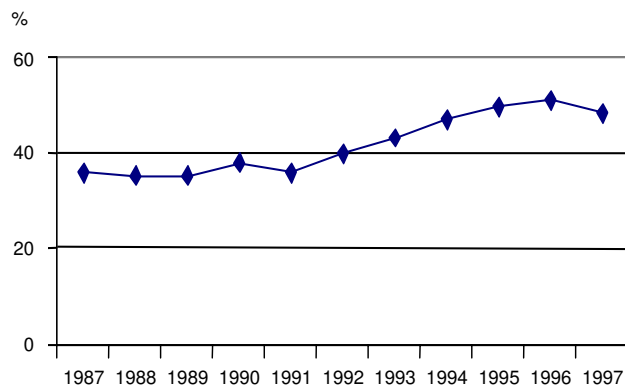


FIGURE 11

ELECTRONIC SYSTEMS FIRMS' SHARE OF ALL SOFTWARE PATENTS (IBM, NEC,
DEC, COMPAQ, HITACHI, FUJITSU, NATIONAL SEMICONDUCTOR, TI, HP,
ROCKWELL INTERNATIONAL, INTEL AND TOSHIBA), 1987-97



semiconductor firm such as National Semiconductor thus represents very strong growth, since the total number of corporate patents also grew rapidly during the same period. At IBM, a major producer and seller of software throughout the period, software patents grew from slightly more than

20 percent of total corporate patenting to almost 35 percent between 1987 and 1997.

Nevertheless, there is little evidence that these large diversified producers of electronic systems and devices expanded their share of overall software patenting during 1984-97. As Figure 11 shows, the combined software patenting activity of this group of firms grew from approximately 40 percent in 1984 to slightly less than 50 percent in 1997. Consistent with the data discussed elsewhere in this study (notably, in Figures 2 to 7), the major increases in software patenting (based on our definition) are found among specialized packaged-software firms.

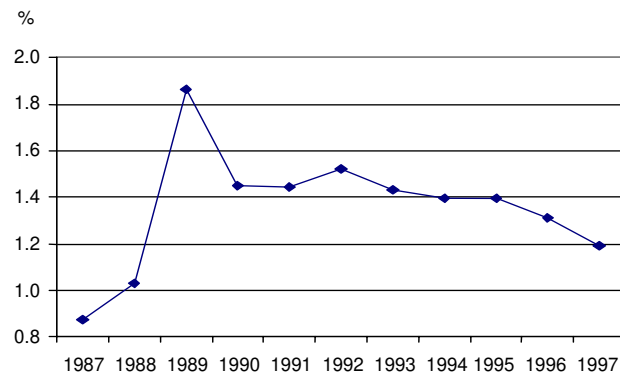
UNIVERSITY SOFTWARE PATENTS

U.S. UNIVERSITIES HAVE LONG PLAYED A PROMINENT ROLE in the innovative activities of the U.S. software industry (Steinmueller, 1996; Mowery, 1999). Surprisingly, however, in view of the significant increase in their patenting activity in other fields (like biomedical technologies), U.S. universities have accounted for a small share of overall software patenting (defined as patents in the four classes described earlier) throughout the 1984-97 period. As Figure 12 shows, university patents have never accounted for even 2 percent of the annual flow of software patents issued in the United States, less than the 3.6 percent share of overall patents accounted for by U.S. universities in the late 1990s (Mowery and Sampat, 2001). Although the share of university patenting grew during the 1984-88 period, and remained higher during the 1990s (at 1.0-1.5 percent) than during the earlier period, the 1990s witnessed a slight decline in the share of software patents accounted for by universities.

We obtained additional information on the role of universities in software patenting from the data on faculty invention disclosures, patents and licences for Stanford University and Columbia University. Since Stanford University began its patenting and licensing program in 1970, its data cover the 1970-92 period, while those for Columbia University cover only the period 1981-92 (the data and discussion are drawn from Mowery, Nelson, Sampat and Ziedonis, 2001). The overall patenting propensity of U.S. universities has increased dramatically since 1970, as Henderson, Jaffe and Trajtenberg (1998) and Mowery et al. (2001) have noted — the number of patents issued to U.S. universities and colleges more than doubled between 1979 and 1984, more than doubled again between 1984 and 1989, and doubled yet again between 1989 and 1997 (Table 3). This increase in academic patenting activity is attributable to the *Bayh-Dole Act* of 1980, as well as to the rapid growth in academic research in biomedical technologies, which has yielded a number of scientific advances of great commercial interest.

FIGURE 12

UNIVERSITY SOFTWARE PATENTS AS A SHARE OF ALL SOFTWARE PATENTS,
1987-97



Although both Stanford and Columbia were active software licensors, they patented very few software inventions through at least the 1980s. Virtually all of the software inventions licensed by Columbia University are protected by copyright rather than by patents. Software licences account for well over 50 percent of Columbia licensing agreements after 1988; however, the majority of these licences (420 of a total of 648), are associated with one software invention.⁴⁰

TABLE 3

UTILITY PATENTS ISSUED TO U.S. UNIVERSITIES AND
COLLEGES, 1969-97 (YEAR OF ISSUE)

YEAR	NUMBER OF PATENTS
1969	188
1974	249
1979	264
1984	551
1989	1,228
1994	1,780
1997	2,436

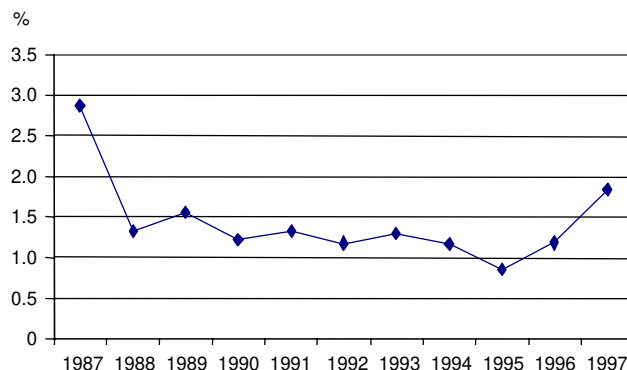
Source: United States Patent and Trademark Office, 1998.

Like the Columbia University data, Stanford's invention disclosures include a number of software inventions, which account for 10-15 percent of annual disclosures. As was the case at Columbia during the 1980s, most of these inventions were not patented and thus cannot be traced through annual patent counts. The importance of software disclosures in Stanford's licensing activity has grown over time. Only 2 of the 41 inventions disclosed during 1974-79 (less than 5 percent) and licensed within eight years of their disclosure were software inventions, but this fraction increased to more than 20 percent in the 1984-88 period. Many of these software inventions (for example, the WYLBUR operating system) were licensed on a non-exclusive basis to academic institutions through Stanford's Software Distribution Center during the 1980s. The majority of these licences involved a small, one-time payment (e.g. \$1,000) by the licensee institution.⁴¹ Partly because of the large number of such site licences, the coverage by our data of Stanford University's software licensing agreements is incomplete and our estimate of the share of all Stanford licensing agreements accounted for by software is less accurate. Nonetheless, like Columbia University, a significant portion of Stanford's licensed inventions (at least 10-20 percent of annual licensing agreements, and a smaller share of gross revenues) cover non-patented inventions.

We analyze trends in the importance of university software patents using the same measure as the one employed in our examination of patents issued to U.S. software firms (Figure 13). In some contrast to the patents issued to the *Softletter* top 100 firms, which increase in importance relative to all software patents, the importance of university software patents displays little or no trend over the 1987-97 period. The value of the importance ratio drops from a peak of nearly 3.0 in

FIGURE 13

UNIVERSITY SOFTWARE PATENT CITATIONS AS A SHARE OF ALL SOFTWARE PATENT CITATIONS, 1987-97



1987 to a level slightly above 1.0, where it remained through 1996, increasing to nearly 2.0 by 1997.

This brief descriptive analysis of university software patenting presents an interesting contrast to the earlier discussion of industry software patenting. We lack the necessary data on research funding to compute any statistics on the patent propensity of U.S. universities; but the *Bayh-Dole Act* appears to have raised U.S. universities' propensity to patent faculty inventions in all fields, not just in software (see Mowery et al., 2001). Nonetheless, there is little evidence of increased reliance by universities on patents to protect their software-related intellectual property during the 1980-97 period, in contrast to software firms. Moreover, the apparently lower level of patenting of software inventions did not prevent U.S. universities from licensing these inventions (albeit on a non-exclusive basis for relatively modest fixed fees), suggesting that copyright protection may suffice to support markets for technology in software.

THE RELATIONSHIP BETWEEN PATENTING AND COPYRIGHT IN SOFTWARE-RELATED INTELLECTUAL PROPERTY

AS NOTED EARLIER, both copyright and patent protection have been extensively employed in software-related intellectual property and some of the current controversies over software patents have clear precedents in debates over the advisability of using copyright. Indeed, one of the first scholarly analyses of methods for protecting software-embodied intellectual property, that of Menell (1989), argued that patent protection of software was preferable because of the higher standards and more stringent reviews of prior art required for the issuance of patents.

Along with other scholars, Lemley and O'Brien (1997) assert that the "primary means of legal protection for computer software has shifted from copyright to patent...", but little direct evidence has been adduced to support the contention that software inventors have shifted from copyright to patent. Rather than a shift in the preferred instrument for protection of intellectual property throughout this very large and heterogeneous industry, it is equally plausible that the fastest-growing segments of the industry have been those relying on patents for protecting their intellectual property. Have computer software firms switched from copyright to patents as the preferred means of protection of their intellectual property? What are the characteristics of firms that have switched to patenting from copyright protection? What are the implications of any such move? In this section, we examine new data on software copyright registrations in a preliminary analysis of the changing relationship between copyright and patent protection for software.

COPYRIGHT DATA

OUR DATA ON COPYRIGHTING OF COMPUTER PROGRAMS by packaged software firms are drawn from the United States Library of Congress (LOC) collection of registered U.S. copyrights. The LOC has data on all materials⁴² registered for copyright with the United States Copyright Office since 1978. Each record includes the identity of the entity requesting registration of a copyright, a unique registration number and the media type. Three dates are recorded for each registration: the date of creation of the work; its date of publication; and its date of registration for copyright. As of January 2001, the LOC copyright database included over 13 million records.

Using *Softletter's* list of the largest packaged software firms in 1997, we searched these LOC records for uniquely numbered copyrights registered upon computer programs. Computer software can be designated as such by the author on the copyright registration form, and the copyright office assigns an internal computer program code to the relevant pieces of intellectual property. We rely upon this latter internal code when defining a registered computer program copyright.

Although copyright provides some protection for a piece of written software regardless of whether it is registered with the Copyright Office,⁴³ there are additional incentives to pursue registration of a copyright. The registration procedure is quick and inexpensive, and the legal strength of the resulting protection is greater for a registered copyright.⁴⁴ Registration within five years of original publication gives the copyright a presumption of validity under law.⁴⁵ Infringement actions cannot be brought before the courts until a copyright is registered.⁴⁶ The holder of a registered copyright is entitled to the recovery of attorney fees and statutorily defined damages, including those for wilful infringement, only for the period after registration. Usually, the owner cannot collect these damages for the period between the publication of the work and the registration of a copyright, but the law offers an incentive for registering *early*: damages are available from the date of publication *only* if the owner registers the copyright within three months of publication of the work.⁴⁷

Faced with these incentives, we believe that rational actors in a crowded commercial space will register intellectual property protections on their software soon after its creation. We therefore use data on registered copyrights to analyze trends in the use of copyright to protect software-related intellectual property. This means that we are examining trends in firms' use of copyrights for which some positive action and (modest) expenditure are required on the part of the inventor, rather than simply counting the number of copyrights that are created more or less automatically with the development of a new piece of software. Although all software arguably is copyrighted at the moment of its

creation, all software does not receive a registered copyright. And only registered copyrights provide a basis for filing a suit against an alleged infringer.

COPYRIGHT PROPENSITIES AMONG THE LEADING U.S. PACKAGED SOFTWARE FIRMS BETWEEN 1987 AND 1997

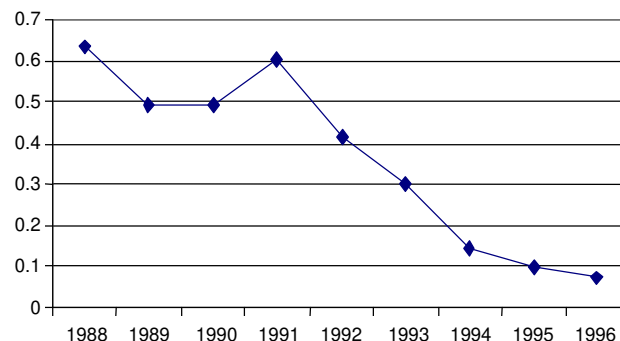
AS IN OUR ANALYSIS OF SOFTWARE PATENTING among the largest U.S. packaged software firms, we restrict our sample to firms for which R&D spending data are available, enabling us to compute copyright propensities for these firms. The analysis also resembles the examination of patenting propensities in that we lack good data on propensities by disaggregated software product classes. Nonetheless, the data provide a basis for comparing packaged software firms' use of these two forms of intellectual property protection.

Figure 14 presents the weighted 3-year moving average of copyright propensity for the same 15 large packaged software firms for which patent propensity data were plotted in Figures 4 and 5. The data tend to support the Lemley and O'Brien (1997) assertion that copyright protection has been supplanted by the use of patents in software, at least among these leading producers of packaged software. In data not displayed here because of space limitations, the copyright propensities of Novell, Microsoft and Adobe all show declines in the number of copyrights registered per million of (constant-dollar) R&D spending during 1985-98. In particular, Novell and Microsoft exhibit sharply contrasting trends in patents/R&D spending and copyrights/R&D spending; both firms show increases over this period in their propensity to patent and a downward

FIGURE 14

**COPYRIGHT PROPENSITY OF THE 15 LARGEST PACKAGED SOFTWARE FIRMS
(IN 1997), 3-YEAR MOVING AVERAGE, 1988-96**

Registered Copyrights per \$100 of R&D (1992\$)



trend in their propensity to copyright their intellectual property. Adobe, which exhibited little or no consistent time trend in its patent propensity, also shows a downward trend in its copyright propensity. A comparison of the copyright behaviour of incumbent and entrant firms among the *Softletter* top 100 (defined as above) also yields little indication of contrasting behaviour among the two groups in their copyright propensities. Both incumbents and entrants decreased their use of copyright, relative to R&D spending, as a means to protect their intellectual property during the 1980s and 1990s.

This preliminary analysis of packaged software firms' use of copyright to protect software-related intellectual property suggests that patents have indeed replaced copyright during 1988-96. As noted earlier, this shift from copyright to patent protection was once seen as an important step to raise the threshold for protection of software-related intellectual property, and it is ironic that the increased use of patents by software firms has been accompanied by a chorus of concerns over *junk* patents. Junk patents may indeed be a problem (although our limited evidence on citations does not support this claim for large packaged software firms' patents), but the problem might have been much more severe had firms continued to rely heavily on copyright in preference to patents.

Why have firms shifted from copyright to patent protection? As noted earlier in our discussion of the evolution of the intellectual property regime for software, the treatment of copyright by the U.S. federal judiciary has changed over time to weaken somewhat the sweeping rights originally claimed by copyright holders. This shift in judicial opinion may reflect the absence of a specialized appeals court that would support copyright holder rights as vigorously as the Court of Appeals for the Federal Circuit has done for patent holders. Certainly, software patents have enjoyed a more supportive judicial climate during the past decade than copyright. In addition, patents may better support the types of defensive intellectual property strategies that Hall and Ziedonis (2001) describe for the semiconductor industry — the cross-licensing of portfolios of patents may be less difficult than similar transactions in copyrighted material.⁴⁸ The use of software patents to support markets in intellectual property and/or as a complement to defensive intellectual property strategies remains an important issue for future research. Nonetheless, to the extent that transactions in intellectual property are facilitated by reliance on patent rather than on copyright, and to the extent that the (admittedly limited) quality controls imposed by the USPTO on the issuance of patents enforce a higher average quality level among software patents than is the case of copyrighted material, the shift from copyright to patent protection may well be a desirable development.

CONCLUSION

THE U.S. AND GLOBAL COMPUTER SOFTWARE INDUSTRIES have been transformed during the past 20 years as a result of the explosive diffusion of the microcomputer and the development of the Internet. No longer are the business activities and revenues of leading firms dominated by sales of products that incorporate high levels of user-specific customization. Instead, the dominant firms in the U.S. software industry, enterprises that account for a leading global market share as well, rely on sales of standard products to mass markets. Accordingly, formal instruments for intellectual property protection have assumed much greater importance, despite their hazy and evolving legal status. In the United States, which can be broadly described as an economy characterized in recent years by relatively strong protection of intellectual property rights, copyright protection for software-related intellectual property has been supplemented by patent protection, and the boundaries of both forms of intellectual property protection have been extended substantially. The culmination of this broadening of patent protection for software was the 1998 *State Street Bank* decision, which extended patent protection into the previously unexplored area of business methods. The rapid growth in this class of patenting since *State Street* presages increased litigation over validity and infringement.

The U.S. judicial and legislative arenas have substantially strengthened the rights of owners of intellectual property in a number of industries since 1980, including computer software. The strong protection of intellectual property provided in the United States is followed by Western Europe, where the European Commission has applied a somewhat more lenient treatment to reverse engineering of software for purposes of complementary invention, and by Japan where, historically, protection of software-related intellectual property has been relatively weak (See Merges, 1996). These contrasting regional or national systems of intellectual property policy have evolved in parallel with the software industries in each area. Indeed, the furor over the Compton's multimedia patent, as well as the more recent controversy over business methods patents, provides additional evidence of the influence of industry-led political action on the decisions of the USPTO. It is hardly a coincidence, therefore, that the United States provides the strongest formal protection of intellectual property rights and has the strongest global firms in the packaged software market. Although the characteristics of each economy's intellectual property rights policy has influenced the development of its software industry, the reverse is also true. In other words, the relationship between the development of the domestic software industries and the intellectual property rights regimes of the United States, Western Europe and Japan is best characterized as one of *co-evolution*, involving mutual causation and influence (Nelson, 1994).

The discussion in the previous section suggests that a number of relatively large firms in the U.S. PC software industry are shifting toward a more patent-intensive approach for the protection of their intellectual property, as the largest firms increase their propensity to patent. Moreover, the evidence of increased patenting is strongest for older (and, in most cases, larger) firms in the U.S. software industry. We observe no tendency for entrants to seek patent protection more intensively than incumbent firms. On its face, this evidence of more intensive use of formal intellectual property protection by established firms could be taken to mean that these firms are using software patents to erect barriers to entry. However, we have no evidence to suggest that entry has been curtailed by these policies, and much more information is needed on entry, profitability and the long-term evolution of the industry's structure before such a conclusion is warranted. The limited evidence on the *importance* of patents obtained by the largest U.S. software firms does not support a characterization of these patents as *junk* patents, by comparison with overall software patents. Taken as a whole, however, the data suggest some shift in the underlying competitive dynamics of the U.S. software industry, as major firms seek to develop much larger patent portfolios. Moreover, large packaged software firms appear to be substituting patent for copyright protection, based on a comparison of trends in patent and copyright propensities.

Although computer software as a product of inventive effort is nearly 50 years old, the application of intellectual property rights to these products is relatively recent. Although patents were originally viewed by some experts as preferable to the extensive reliance on copyright for protection of software-related intellectual property (Menell, 1989) because of the higher threshold for patent protection, the expanded use of patents to protect software-related intellectual property has also sparked controversy. Software patents in particular raise unusual challenges for the U.S. patent system, which relies on inventors and patent examiners for searches of prior art, rather than allowing for interested parties to challenge patents before their issue in a formal pre-grant opposition process. Because of the historical lack of software patents, a primary source of software-related prior art scarcely exists, which contributes to the issuance of patents (such as the multimedia patent discussed above) of potentially sweeping breadth and limited validity. As the multimedia patent example suggests, there are few cases thus far of such broad patents being issued and upheld by either the USPTO or the courts. But the general problem is nonetheless serious — how can searches of prior inventions be undertaken in a technology where patents have only recently become common?

The slow pace of issuance of patents on (allegedly) new software *art* creates still other problems — some industry experts argue that software developers may become aware of a related patent only after they have completed the development of a new product.⁴⁹ Innovation in software is generally a cumulative

activity, and individual software products frequently build on components from other products. The requirement for publication of patent applications after 18 months should reduce somewhat the severity of this problem. The liberalized *prior use* defence embodied in the AIPA could also reduce the incidence of litigation over infringement. Nevertheless, given the rapid pace of innovation in this industry and the very short lives of most products, even these policy changes cannot eliminate the risk that a software invention may be subject to infringement suits because of its reliance on a piece of prior art that subsequently receives patent protection. In this context, extensive reliance on patents, combined with their slow issuance and the lack of reliable prior art searches, could paralyze commercial innovation in the software industry and/or provoke a flood of litigation.

It is important to distinguish problems associated with the transition to a new, patent-based regime of intellectual property protection for software from the very different problems associated with a steady state characterized by greater reliance on patents. Many of the problems associated with a lack of prior art that can be searched by patent examiners should dissipate as software patenting grows and this body of prior art expands. The costs of this transition will be high, because of the reliance on litigation to establish the validity of the growing body of prior art, but the mechanisms and incentives to effect this transition are readily apparent. Alternative mechanisms, such as a modified form of pre-grant opposition, might facilitate this and other shifts to patent-based systems for protecting intellectual property in new technologies at a lower cost than litigation — with its attendant costs, inefficiencies and unintended consequences. Given the desirability of mechanisms other than litigation to guarantee the quality and validity of patents in this and other new technologies, the existing re-examination process may merit review and reform.

The computer software industry provides a fascinating *laboratory* to observe the transition from a relatively open intellectual property regime to one in which formal protection, especially through patents, figures prominently. The cross-national differences in domestic patent systems, combined with cross-national differences in the structure of domestic software industries and software markets, provides additional rich material for comparative studies of the interaction of intellectual property systems, innovation and industrial development. Current research, including this study, has scarcely scratched the surface of this fertile subject.

ENDNOTES

- 1 Bresnahan and Greenstein (1996) point out that a similar erosion of multi-product economies of scope appears to have occurred among computer hardware manufacturers with the introduction of the microcomputer.
- 2 A trade secret is formally some information used in a business which, when secret, gives one an advantage over competitors. The secret must be both novel and valuable. *Metallurgical Industries Inc. v. Fourtek Inc.*, 790 F.2d 1195 (1986).
- 3 Collectors of valuable information can prevent competitors from using the information. *International News Service v. Associated Press*, 248 U.S. 215 (1911).
- 4 Protects names, words, and symbols used to identify or distinguish goods and to identify the producer. *Zatrains, Inc. v. Oak Grove Smokehouse, Inc.*, 698 F.2d 786 (5th Cir., 1983).
- 5 Protection is available for software embodied in semiconductor chips — so-called mask works. *E.F. Johnson v. Uniden Corp. of America*, 653 F. Supp. 1485 (D. Minn. 1985).
- 6 Copyright Act, 17 U.S.C. §§ 101, 117 (as amended 1980). For a more complete discussion, see Menell, 1989.
- 7 *Apple Computer, Inc. v. Franklin Computer Corp.*, 714 F.2d 1240 (3rd Cir. 1983).
- 8 Historically, a major distinction in the copyright law has been that ideas are not protected, only expressions are. *Baker v. Selden*, 101 U.S. 99 (1879).
- 9 *Computer Associates Int'l v. Altai Inc.*, 982 F.2d 693 (2d Cir. 1992); *Whelan Associates v. Jaslow Dental Laboratory*, 797 F.2d 1222 (3rd Cir. 1986).
- 10 *Lotus Development Corp. v. Borland Int'l Inc.*, 788 F. Supp. 78 (D. Mass. 1992) (finding Quattro a virtual copy of Lotus's menu structure); *Lotus Development Corp. v. Borland Int'l Inc.*, 799 F. Supp. 203 (D. Mass. 1992); *Lotus Development Corp. v. Borland Int'l Inc.*, 831 F. Supp. 202 (D. Mass. 1993); *Lotus Development Corp. v. Borland Int'l Inc.*, 831 F. Supp. 223 (D. Mass. 1993).
- 11 *Lotus Development Corp. v. Borland Int'l Inc.*, 49 F.3d 807 (1st Cir. 1995).
- 12 116 S. Ct. 804 (1996).
- 13 Interestingly and ironically, in light of subsequent controversies over the role of software patents, Menell's influential 1989 analysis of intellectual property protection of software, written in the wake of the strong judicial interpretation of copyright embodied in *Apple Computer, Inc. v. Franklin Computer Corp.*, argued that patents had significant advantages over copyright as a means for protecting computer applications software: "The patent system's threshold requirements for protection — novelty, utility, and non-obviousness — are better tailored than the copyright standard to rewarding only those innovations that would not be forthcoming without protection." (p. 47). As we note below (see also Merges, 1999), the debate over software patents centers on precisely these issues — is the United States Patent and Trademark Office able to apply these requirements with sufficient rigour to prevent the issue of low-quality patents?
- 14 *Gottschalk v. Benson*, 409 U.S. 63 (1972).
- 15 Samuelson (1990) argues that the Patent and Trademark Office was at odds with the Court of Customs and Patent Appeals (CCPA) throughout the 1970s over

- the patentability of software and concludes that the CCPA's views in favour of patentability ultimately triumphed.
- 16 *Diamond v. Diehr*, 450 U.S. 175 (1981).
 - 17 *Diamond v. Bradley*, 450 U.S. 381 (1981).
 - 18 See Peltz, 1993. Compton's had actually been awarded the patent on August 31, numbered 5,241,671, and titled "Multimedia Search Systems Using a Plurality of Entry Path Means Which Indicate Interrelatedness of Information." See Markoff, 1993.
 - 19 Abstract, United States Patent Number 5,241,671, August 31, 1993.
 - 20 See Abate, 1993.
 - 21 See Markoff, 1993.
 - 22 See Riordan, 1994.
 - 23 See Orenstein, 1994.
 - 24 *State Street Bank v. Signature Financial Group*, 149 F.3d 1368 (CAFC, 1998).
 - 25 See Riordan, 1998. There was a significant movement in the programming community to oppose patenting of software on all grounds. See Samuelson (1990) for arguments, and Stallman and The League for Programming Freedom (1990).
 - 26 *State Street Bank v. Signature Financial Group*, 149 F.3d 1368 (CAFC, 1998).
 - 27 See National Public Radio, 1998.
 - 28 These data count only applications and issued patents in U.S. patent class 705 ("Data Processing: Financial, Business Practice, Management or Cost/Price Determination") as "business methods" patents. Depending on one's definition of this elusive concept, the number of applications and issued patents could in fact be substantially greater.
 - 29 "Now we're dealing with a much broader universe of 'prior art,' says J.T. Westermeier, a Washington (D.C.) Internet attorney with the law firm of Piper and Marbury, pointing out that many allegedly novel Internet business methods may already have been in use at universities or elsewhere." (Waldmeir and Kehoe, 1999).
 - 30 Merges (1999) argues that such re-examination requests have increased during the 1990s. But the data presented in his study (p. 577), which cover re-examination requests in all patent classes, indicate that the number of requests remains quite low and has grown rather slowly. The USPTO reported 243 requests for re-examination of issued patents in 1989, and 376 such requests in 1997. But the number of re-examination requests grew most sharply between 1989 and 1992 (when 392 requests were reported by the USPTO), and the 1997 figure is well below the 418 requests reported for 1996. Regardless of the rate of growth, the small number of such requests is striking, given the number of patents issued in these years. Further research is needed on the factors influencing the filing and effects of such re-examination requests.
 - 31 Patent holder motives for requesting re-examinations are unclear, but patents that are not invalidated in the re-examination process are accorded a higher presumption of validity in judicial proceedings. In at least some cases, the outcomes of the proceedings suggest that patent holders may have sought to narrow claims made in their patents, something that could result in both the addition and deletion of claims.

- 32 See Magrab, 1993.
- 33 The IPC is a hierarchical classification system consisting of sections, classes, subclasses and groups (main groups and subgroups). The IPC divides all technological fields into sections (designated by a capital letter), each section into classes (designated by a two-digit number), and each class into subclasses (designated by a capital letter). For example, "G 06 F" represents Section G, class 06, subclass F. Each subclass is in turn broken down into subdivisions called "groups" (which are either main groups or subgroups, although the former "main group" is of immediate concern in this study). Main group symbols consist of the subclass symbol followed by a 1- to 3-digit number and an oblique stroke (for example, G 06 F 3/).
- 34 As reported in the *Softletter 100* (1996), this group includes Microsoft, Novell, Adobe Systems, Autodesk, Intuit and Symantec. We chose to focus our analysis on the patents assigned to specialized, publicly-traded software firms, because the computation of a software patent *propensity* measure (software patents deflated by R&D spending) is meaningful only for firms reporting R&D spending which can be assumed to be devoted, for the most part, to software development. As a result, our definition of software classes is somewhat narrower than that of Kortum and Lerner (1999), although these authors also found that the fraction of overall U.S. patenting accounted for by software patents increased during the 1985-91 period.
- 35 As reported by *Software Magazine*, reprinted in E. and K. Juliussen (eds.), *The 8th Annual Computer Industry Almanac* (1996), including Microsoft, Computer Associates, Oracle, Novell, Sybase and Adobe Systems.
- 36 We are grateful to *Softletter* for permission to use these data. The *Softletter* data cover only PC software firms, rather than the specialized producers of computer software of any type that formed the basis of our original patent sampling strategy.
- 37 Borland/Inprise is excluded from Figure 3 in order to *decompress* the scaling of the figure and facilitate the clearer depiction of trends in the patenting propensities of the other seven large packaged software firms.
- 38 The firms in the *Softletter* rankings for which data (over 1986-97) are available from the Compustat Database and SEC reports include Microsoft, Adobe Systems, Novell, Autodesk, Symantec, The Learning Company, Activision, Borland, Phoenix Technologies, Quarterdeck, Micrografx, Caere, IMSI, Timberline Software, and Software Publishing.
- 39 According to Walsh (1995), Oracle Corporation, a major producer of database software "...has embarked on an aggressive program to secure patents for its software products — primarily to protect itself against potential infringement claims, in the face of a sharp increase in recent years in the number of software patents issued by the PTO." (p. 1; cited in Merges, 1997, p. 129).
- 40 In addition, and similarly to the situation at Stanford University (see below), more than 300 of the 420 licences for this software invention are academic licences.
- 41 Some indication of the relative magnitude of licensing revenues from these *site licences*, which for some years were administered by Stanford University's Office of Technology Licensing (OTL) Software Distribution Center, is given by the following data cited in the 1988-89 report of the OTL, which separated software licensing revenues into those derived from "direct software distribution through OTL's Software Distribution Center (\$453,581 from 515 use licences), and from royalties

paid by commercial distributors (\$420,000 from 40 distribution licences to software firms, computer companies and publishers).” (*Office of Technology Licensing Twentieth Annual Report*, 2/13/90, p. 4). Unfortunately, we have been unable thus far to consistently separate software licences between these two distribution channels.

- 42 Including books, maps, sound recordings, computer files, dramatic works, toys, games, jewellery, technical drawings, photographs, multimedia kits, sculptural works, textiles, motion pictures, and choreography, among others.
- 43 The 1976 *Copyright Act*, in accord with the international Berne Convention, gives copyright protection to authors regardless of registration status.
- 44 As of March 2001, registration required a two page filing and fees totalling \$US30 .
- 45 *Copyright Act*, 17 U.S.C.A. §410 (2000).
- 46 *Copyright Act*, 17 U.S.C.A. §411 (2000).
- 47 *Copyright Act*, 17 U.S.C.A. §412, 504, 505 (2000).
- 48 It is possible that software firms are choosing not to register copyrights because such early registration no longer is necessary to support litigation against alleged infringers, a possibility that would indicate greater judicial deference to copyright. This possibility seems unlikely, however, in view of the more circumscribed role accorded to copyright by the federal bench since the late 1980s. As Lemley and O’Brien note in their discussion, “...in each of the three main computer software copyright issues, the courts have cut back the scope of protection rather dramatically in the past five years.” (1997, p. 280).
- 49 Dan Bricklin, a pioneer in the packaged software industry and developer of the first spreadsheet program, argues that a typical software product may involve literally thousands of patentable processes, which creates enormous hazards for independent or small-firm inventors who may belatedly discover that important components of their newly developed product are in fact patented by others (Merges, 1997, pp. 119-120).

ACKNOWLEDGMENTS

AN EARLIER VERSION OF THIS STUDY was presented at the Industry Canada Conference on Intellectual Property and Innovation in the Knowledge-Based Economy, held May 23-24, 2001, in Toronto, Canada. We are grateful to conference participants and to Professors Jonathan Putnam, Rosemarie Ziedonis and Brian Silverman for comments on the study. We also appreciate assistance with our analysis of patenting data from Arvids Ziedonis. This study draws on research supported by the Andrew Mellon Foundation and the National Research Council.

BIBLIOGRAPHY

- Abate, T. 1993. "Smaller, Faster, Better; Tech Firms Show off their Latest Wonders at Trade Show and Foretell a User-friendly Future." *San Francisco Examiner* (November 21): E:1.
- Aharonian, G. 1993. "Setting the Record Straight on Patents." *Communications of the ACM* 36: 17-18.
- Bresnahan, T., and S. Greenstein. 1996. "The Competitive Crash in Large Scale Commercial Computing." In *The Mosaic of Economic Growth*. Edited by R. Landau, T. Taylor and G. Wright. Stanford, CA: Stanford University Press.
- Cohen, W., R.R. Nelson and J. Walsh. 1998. "Appropriability Conditions and Why Firms Patent and Why They Do Not in the American Manufacturing Sector." Carnegie-Mellon University. Unpublished manuscript.
- CONTU. 1979. National Commission on New Technological Uses of Copyrighted Works. Final Report. Washington, D.C.: USGPO.
- Hall, B.H., and R.M. Ziedonis. 2001. "The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1975-1995." *Rand Journal of Economics* 32,1 (spring): 101-128.
- Hart, R., P. Holmes and J. Reid. 1999. "The Economic Impact of Patentability of Computer Programs: A Report to the European Commission." London: Intellectual Property Institute.
- Henderson, R., A.B. Jaffe and M. Trajtenberg. 1998. "Universities as a Source of Commercial Technology: A Detailed Analysis of University Patenting, 1965-88." *Review of Economics and Statistics*: 119-127.
- Juliussen, E. and K. (eds.) 1996. *The 8th Annual Computer Industry Almanac*. New York: Computer Industry Almanac, Inc.
- Kortum, S., and J. Lerner. 1999. "What is Behind the Recent Surge in Patenting?" *Research Policy* 28: 1-28.
- Kuan, J. 1999. "Understanding Open Source Software: A Nonprofit Competitive Threat." Haas School of Business, University of California at Berkeley. Unpublished manuscript.
- Lemley, M.A., and D.W. O'Brien. 1997. "Encouraging Software Reuse." *Stanford Law Review* 49 (February).
- Lerner, J., and J. Tirole. 2000. "The Simple Economics of Open Source." Harvard Business School. Unpublished manuscript.
- Magrab, E. Brendan. 1993. "Patent Validity Determinations of the ITC: Should U.S. District Courts Grant Them Preclusive Effect?" *Journal of the Patent and Trademark Office Society* 75: 125, 127-135.
- Markoff, J. 1993. "Patent Office to Review a Controversial Award." *The New York Times* (December 17): D:2.
- Menell, P. 1989. "An Analysis of the Scope of Copyright Protection for Application Programs." *Stanford Law Review* 41: 1045-1096.

- Merges, R.P. 1996. "A Comparative Look at Intellectual Property Rights and the Software Industry." In *The International Computer Software Industry: A Comparative Study of Industry Evolution and Structure*. Edited by D.C. Mowery. New York: Oxford University Press.
- . 1997. *Patent Law and Policy*. Charlottesville, VA: Michie.
- . 1999. "As Many as Six Impossible Patents Before Breakfast: Property Rights for Business Concepts and Patent System Reform." *Berkeley Technology Law Journal* 14: 578-615.
- Mowery, D.C. 1999. "The Computer Software Industry." In *The Sources of Industrial Leadership*. Edited by D.C. Mowery and R.R. Nelson. New York: Cambridge University Press.
- Mowery, D.C., and B.N. Sampat. 2001. "Patenting and Licensing University Inventions: Lessons from the History of the Research Corporation." New York: Columbia University.
- Mowery, D.C., and T. Simcoe. 2002. "The Internet." In *Technological Innovation and Economic Performance*. Edited by B. Steil, R. Nelson and D. Victor. Princeton, N.J.: Princeton University Press, pp. 229-264.
- Mowery, D.C., R.R. Nelson, B. Sampat and A.A. Ziedonis. 2001. "The Growth of Patenting and Licensing by U.S. Universities: An Assessment of the Effects of the Bayh-Dole Act of 1980." *Research Policy* 30,1 (January): 99-119.
- National Public Radio. 1998. "Patenting Math Formulas." *All Things Considered* (August 11). Transcript No. 98081115-212.
- Nelson, R.R. 1994. "The Co-Evolution of Industries and Institutions." *Industrial and Corporate Change* 3: 47-64.
- Orenstein, S. 1994. "U.S. Rejects Multimedia Patent." *The Recorder* (November 1): 4.
- Peltz, J. 1993. "Compton's Wins Patent Covering Multimedia." *Los Angeles Times* (November 16): D:2.
- Riordan, T. 1994. "Action Was Preliminary On a Disputed Patent." *The New York Times* (March 30): D:7.
- . 1998. "Patents; An Appeals Court Says a Mathematical Formula can be Patented, if it is a Moneymaker." *The New York Times* (August 3): D:2.
- Samuelson, P. 1990. "Benson Revisited: The Case Against Patent Protection for Algorithms and Other Computer Program-Related Inventions." *Emory Law Journal* 39: 1025-1122.
- Softletter. 1986. "The 1986 Softletter 100." *Softletter Trends and Strategies in Software Publishing* 3: 1-8.
- . 1991. "The 1991 Softletter 100." *Softletter Trends and Strategies in Software Publishing* 8: 1-24.
- . 1996. "The 1996 Softletter 100." *Softletter Trends and Strategies in Software Publishing* 12: 1-24.
- . 1998. "The 1998 Softletter 100." *Softletter Trends and Strategies in Software Publishing* 14: 1-24.
- Sorensen, J.B., and T. Stuart. 1999. "Aging, Obsolescence and Organizational Innovation." University of Chicago (April). Unpublished manuscript.
- Stallman, R., and The League for Programming Freedom. 1990. "Against Software Patents" (October 24). Unpublished manuscript.

- Steinmueller, W.E. 1996. "The U.S. Software Industry: An Analysis and Interpretive History." In *The International Computer Software Industry: A Comparative Study of Industry Evolution and Structure*. Edited by D.C. Mowery. New York: Oxford University Press.
- Trajtenberg, M. 1990. "A Penny for Your Quotes: Patent Citations and the Value of Innovations." *The Rand Journal of Economics* 21: 172-187.
- Waldmeir, P., and L. Kehoe. 1999. "E-commerce Companies Sue to Protect Patents: Intellectual Rights Given Legal Test." *Financial Times* (October 25): 16.
- Walsh, M. 1995. "Bowing to Reality, Software Maker Begins Building a Patent Portfolio." *The Recorder* (Aug. 17): 1.

OTHER REFERENCES

- Baba, Y., S. Takai and Y. Mizuta. 1996. "The User-Driven Evolution of the Japanese Software Industry: The Case of Customized Software for Mainframes." In *The International Computer Software Industry: A Comparative Study of Industry Evolution and Structure*. Edited by D.C. Mowery. New York: Oxford University Press.
- Campbell-Kelly, M. 1995. "Development and Structure of the International Software Industry, 1950-90." *Business and Economic History* 24: 73-110.
- Cohen, W., R.R. Nelson and J. Walsh. 2000. *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)*. NBER Working Paper No. 7552. Cambridge, MA: National Bureau of Economic Research.
- Cottrell, T. 1995. "Strategy and Survival in the Microcomputer Software Industry, 1981-86." Haas School of Business, University of California at Berkeley. Unpublished Ph.D. dissertation.
- . 1996. "Standards and the Arrested Development of Japan's Microcomputer Software Industry." In *The International Computer Software Industry: A Comparative Study of Industry Evolution and Structure*. Edited by D.C. Mowery. New York: Oxford University Press.
- Malerba, F., and S. Torrisi. 1996. "The Dynamics of Market Structure and Innovation in the Western European Software Industry." In *The International Computer Software Industry: A Comparative Study of Industry Evolution and Structure*. Edited by D.C. Mowery. New York: Oxford University Press.
- Maier, G., B. Lytle and K. Dithavong. 1999. "Patent Protection Provides Long-term Net Strategy." *National Law Journal* (October 18): B:11.
- Mowery, D.C., and R. Langlois. 1996. "Spinning Off and Spinning On(?): The Federal Government Role in the Development of the U.S. Computer Software Industry." *Research Policy* 25: 947-966.
- Nelson, R.R. (ed.) 1993. *National Innovation Systems*. New York: Oxford University Press.
- U.S. International Trade Commission. 1995. *A Competitive Assessment of the U.S. Computer Software Industry*. Washington, D.C.: U.S. International Trade Commission.



Nancy Gallini
University of Toronto

Jonathan Putnam
University of Toronto

&

Andrew Tepperman
Charles River Associates

8

Intellectual Property Rights and the Propensity to Patent

INTRODUCTION

SINCE 1989, the Canadian *Patent Act* has undergone extensive changes. Among these were: the conversion from a first-to-invent to a first-to-file system; an increase in patent duration from 17 years from the date of issue to 20 years from the date of filing; the adoption of disclosure rules requiring the publication of new applications within 18 months of the filing date; and the elimination of automatic examination of applications. Perhaps the most prominent reform was the repeal of the compulsory licensing system for pharmaceuticals in 1992.

The changes made to Canada's *Patent Act* are representative of a series of sweeping reforms in intellectual property that are taking place throughout the world. From the international arena came the Trade-Related Aspects of Intellectual Property Rights (TRIPs) Agreement that established minimum standards for the protection of intellectual property in all member countries of the World Trade Organization (WTO), as well as trade-related penalties for non-compliance. At the country level, extensive legislative and policy reforms have been implemented in the United States over the past two decades, including the establishment of the Court of Appeals for the Federal Circuit and the extension of patentability to business methods, software and genetic material. The widely-held view is that, on balance, these country-specific reforms and international agreements have strengthened the rights of patent holders.¹

Around the time the Canadian reforms were taking place, the rate of patent applications in Canada from both domestic and foreign innovators began to increase, after having been constant throughout most of the 1970s and 1980s. Figure 1 shows total patent applications filed in Canada, disaggregated

by domestic, U.S., European and Japanese applicants. During the years 1985-92, the average annual growth in patent applications rose to 6.44 percent from 1.37 percent over the previous seven years (Rafiquzzaman and Whewell, 1998). In addition to becoming a desirable destination for foreign patentees, Canada has developed into a fertile source of new products and processes over the past decade, as shown in Figure 2.

As was the case for reforms, the surge in patenting has not been unique to Canada. Patenting activity increased throughout the industrialized world. For example, patenting has been steadily climbing in the United States since the mid-1980s, particularly among domestic inventors who have increased their patenting activity at home and in foreign markets, as shown in Figures 3 and 4.

These facts — world-wide patent reform and an acceleration in patenting activity — have caught the attention of many academics and policymakers. And, the passage of time has provided an opportunity to examine a key question raised by these observations: Could the strengthening of patent rights be credited with the increase in patenting?

A growing literature sheds light on this question. The results from these studies are remarkably consistent in showing weak support, if any, for a causal relationship between the strengthening of patent protection and increased innovation.² However, several studies find evidence of a positive relationship between stronger patents and an increase in the *propensity to patent*, as measured by patenting per unit of research and development (R&D). [For example, see Hall and Ziedonis (2001) and Hicks, Breitzman, Olivastro and Hamilton (2001) for the United States; Rafiquzzaman and Whewell (1998) for Canada; Scherer and Weisburst (1995) for Italy; Arundel and Kabla (1998) for Europe.]

Measuring the impact of policy changes in the United States and the implications of the TRIPs Agreement for less-developed countries has occupied the research agendas of many academics and policymakers. In contrast, only limited attention has been devoted to recent patent reforms in Canada [Rafiquzzaman (1999), Rafiquzzaman and Whewell (1998), Pazderka (1999) and McFetridge (1999)]³. Except for the repeal of compulsory licensing for pharmaceuticals, there is little systematic evidence to show whether the 1989 reforms have led, on balance, to a strengthening or a weakening of patent rights.⁴ While the data available limit our ability to address this issue directly, we are able to provide some new insights on the determinants of patenting in Canada, particularly among foreign inventors, and the relevance of intellectual property rights for the decision to patent.

Total patent applications (or grants) may vary in response to a strengthening of patent rights because inventors have a greater incentive to develop innovations and/or because they patent a greater proportion of their inventions. It is the latter effect — the *propensity to patent* — that we are interested in explaining.

FIGURE 1

PATENT APPLICATIONS IN CANADA BY SOURCE, 1972-97

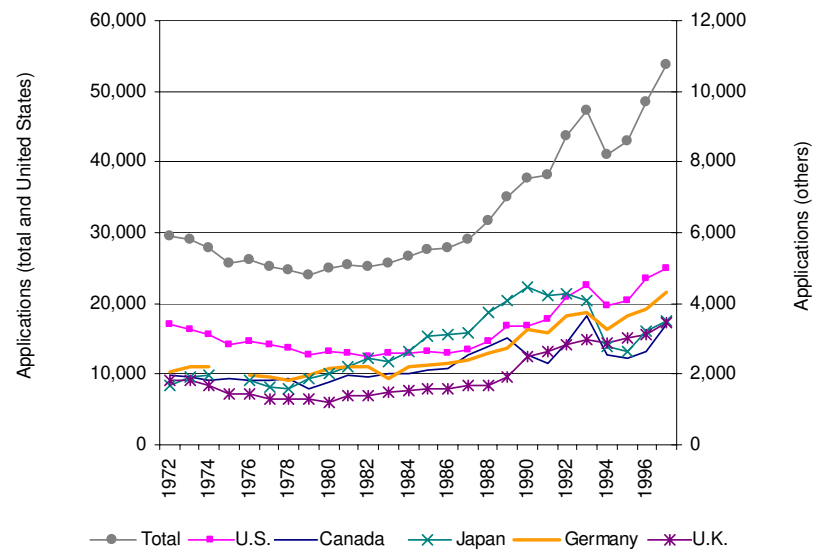


FIGURE 2

PATENT APPLICATIONS BY CANADIAN INVENTORS ABROAD, 1972-97

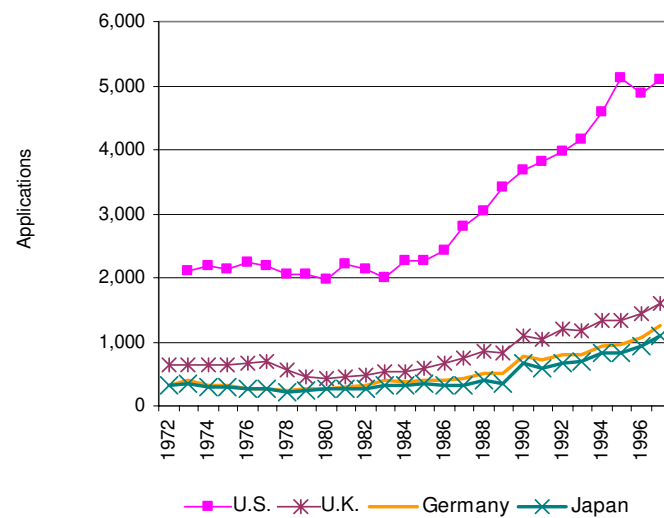


FIGURE 3

PATENT APPLICATIONS IN THE UNITED STATES BY SOURCE, 1972-97

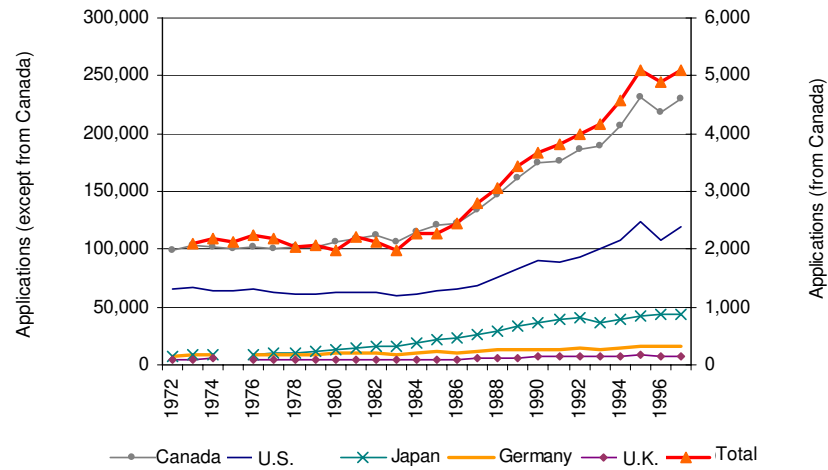
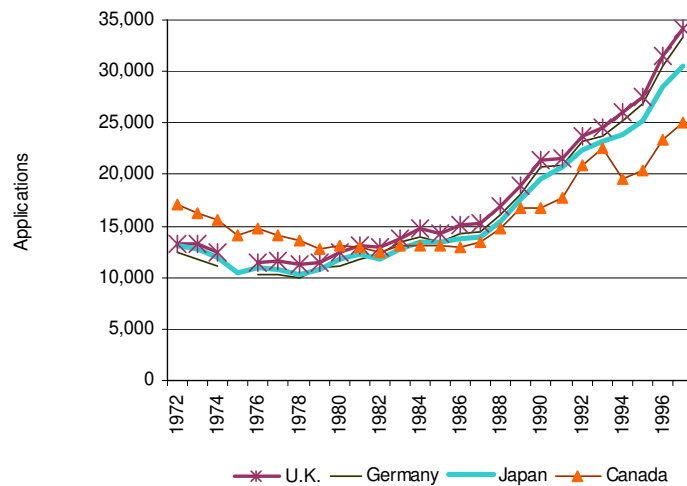


FIGURE 4

PATENT APPLICATIONS BY U.S. INVENTORS ABROAD, 1972-97



Why should we be interested in studying the propensity to patent in Canada? First, an increase in foreign patenting in Canada may simply reflect an increase in innovative activity in the foreign country that *spills over* into Canada, but may have little to do with incentives provided in Canada.⁵ Focusing on the propensity to patent in Canada controls for this possibility. Second, while domestic patenting in Canada has increased significantly over the past decade, foreign patenting still accounts for 90 percent of total applications filed in Canada. Identifying the determinants of foreign patenting may inform policy directed toward attracting new technologies in Canada. Third, as Hall and Ziedonis (2001) suggest, some patenting may be socially wasteful. To determine whether patenting activity occurring in Canada is beneficial or costly requires an analysis of private incentives to patent. More broadly, understanding the determinants of the propensity to patent may guide current policy in Canada and identify whether further reforms are warranted.

We measure the propensity to patent in two ways: (1) the number of patent applications filed in a destination country j from a source country i per million dollars of R&D spent in i (i.e. conditional on i 's R&D input); and (2) the number of patent applications in destination country j from source country i per domestic patent application filed in i (i.e. conditional on i 's R&D output). With these two measures of the propensity to patent, we present two types of analyses. In the first, we estimate a model of the aggregate propensity to patent, in which data are aggregated across all industries for each of 17 countries (both source and destination) observed at four points in time that are distributed before and after the reform of the Canadian patent system.

We find that the quality of patent protection offered by a destination country has a significant impact on the propensity of source country inventors to seek patents in that destination, especially if the destination country has a permissive antitrust policy or high imports from the source country. While performing well overall, the model over-predicts patent propensity for Canada as a destination country in the latter part of the sample. With this lesson from the aggregate analysis, we turn to a more disaggregated approach that attempts to identify differences in patent propensities from major industrial countries across a wide range of industries in Canada. In this analysis, we document changes in the patterns of patent grants across industries and countries prior to and after the patent reforms of 1989.

In the second section, entitled *The Propensity to Patent*, we describe an economic framework from which the two patent propensity measures are derived and review the relevant literature within this framework. In the third section, entitled *Aggregate Analysis*, we present the empirical results from the aggregate analysis and, in the fourth section, entitled *Applying the Model to Canada*, we examine the model's predictions for this country. The disaggregated industry analysis of the propensity to patent in Canada is presented in the

fifth section, entitled *Industry-level Analysis*. The last section concludes and suggests directions for future research.

THE PROPENSITY TO PATENT

IN THIS SECTION WE DEVELOP AN ECONOMIC FRAMEWORK for the propensity to patent, which we estimate in the fourth section, drawing from the analysis of Eaton and Kortum (1996) and Kortum and Lerner (1998).

AN ECONOMIC FRAMEWORK

CONSIDER A SINGLE RESEARCHER IN COUNTRY i , contemplating research on multiple research projects at time t . N_i projects are directed toward patentable inventions; the time subscript is suppressed for convenience.⁶ We assume that research on a patentable project is an independent draw from a distribution $f(q)$, with cumulative distribution $F(q)$ and support $(0, Q)$, that yields a technology of uncertain quality, q . The cost of researching N_i projects is given by $R(N_i)$, where $R'(N_i) > 0$. The researcher faces a two-stage problem. The first stage is the innovation decision in which the number of research projects is chosen; the second stage is the patenting decision in which the researcher decides which of the N_i projects to patent in country i (at home) and in country j (abroad).

We begin in the second stage, after the investment has been made and the research results are known. For simplicity, we assume that all N_i projects yield products or processes that are sold or used in independent and identical markets in each country and, furthermore, that the set of patentable subject matters is the same in both countries.⁷ Suppose that if the technology is patented in country j , the gross return will be $v_p(s_j, x_j, z_{ij})$ per unit of quality q , where s_j represents the level of patent protection in country j ; x_j are features of the economic environment in country j (e.g. market size, imitation costs, etc.); and z_{ij} are features that describe the relationship between the source and destination countries (e.g. bilateral treaties, trade between countries).⁸ If an invention is not patented in country j , the firm earns $v_n(s_j, x_j, z_{ij})$ per unit of quality, which may also depend on s_j , x_j and z_{ij} .⁹ The filing cost of a patent in country j is c_j .¹⁰ Then a firm will patent an innovation with quality q in country j if $q[v_p(s_j, x_j, z_{ij}) - v_n(s_j, x_j, z_{ij})] > c_j$. The quality level that makes the researcher from country i indifferent between patenting and secrecy¹¹ in country j is:

$$(1) \quad q_{ij}^* = c_j / [v_p(s_j, x_j, z_{ij}) - v_n(s_j, x_j, z_{ij})].$$

A parallel decision, made with respect to patenting in the home country, yields a reservation quality level for secrecy, q_{ii}^* .

Next, consider the research investment decision in the first stage. The level of investment will depend on the return that the inventor expects to receive from patenting or secrecy, as outlined above. Without loss of generality, assume that $q_{ii}^* \leq q_{ij}^*$, which implies that if the invention is patented abroad, it will also be patented at home.¹² Then, the researcher maximizes expected profits over N_i , where expected profits are given by:

$$(2) \quad N_i \left\{ \int_0^{q_{ii}^*} q[v_n(s_i, x_i) + v_n(s_j, x_j, z_{ij})]f(q)dq + \int_{q_{ij}^*}^{q_{ii}^*} q[v_p(s_i, x_i) + v_n(s_j, x_j, z_{ij}) - c_i]f(q)dq + \int_{q_{ij}^*}^Q q[v_p(s_i, x_i) + v_p(s_j, x_j, z_{ij}) - c_i - c_j]f(q)dq \right\} - R(N_i).$$

The solution to the maximization problem reveals that the number of profit-maximizing research projects depends on the expected return from patenting which, through the patenting decision, depends on the strength of patent protection, the costs of patenting and other features of the economic environment in *both* countries. That is, the profit-maximizing number of inventions is given by:

$$(3) \quad N_i^* = N(s_i, s_j, c_i, c_j, x_i, x_j, z_{ij}).$$

To complete the model, we denote by ρ_{ij}^* the probability that an invention from country i will be of sufficiently high quality for patenting to be profitable in country j . So $\rho_{ij}^* = \Pr(q > q_{ij}^*)$ or, from (1):

$$(4) \quad \rho_{ij}^* = 1 - F\{c_j/[v_p(s_j, x_j, z_{ij}) - v_n(s_j, x_j, z_{ij})]\} = \rho(s_j, x_j, z_{ij}, c_j).$$

Of course, the above model is a gross simplification of actual R&D processes. Among the apparent criticisms are that innovations are not, in reality, so easily classified as *patentable* or *non-patentable*, and the standards for patentability may not be the same across countries. But, in its simplicity, the determinants of patenting that enter our empirical analysis are easily gleaned. To see this, let P_{ij} be the number of patent applications (grants) in destination country j filed by researchers from source country i . Then, the expected P_{ij} equals the

number of patentable inventions generated in country i , times the probability that an invention generated in country i will be patented in country j . That is,

$$(5) \quad E(P_{ij}) = N_i^* \rho_{ij}^* = N(s_i, s_j, c_i, c_j, x_i, x_j, z_{ij}) \rho(s_j, x_j, z_{ij}, c_j).$$

Equation (5) highlights a direct and an indirect mechanism through which patent policy in a destination country impacts on the total number of patents filed in that country. First, stronger protection in destination country j may increase researchers' incentives to develop more patentable inventions if a higher return from patenting is anticipated (the *innovation effect*). Second, researchers may have a greater incentive to patent rather than keep inventions secret for a given number of patentable inventions in source country i (the *patent propensity effect*). So, if the relationship in equation (5) was estimated by a regression analysis, the coefficient on s_j would reflect *both* the direct (innovation) and indirect (patent) effects of changes in patent strength on the total number of patents.¹³

MEASURING THE PROPENSITY TO PATENT

IN ORDER TO ISOLATE THE IMPACT of intellectual property rights on the propensity to patent, which is our focus, we control for the innovation effect. If our data were disaggregated (by inventor), we could do this by estimating equation (4) directly. Since they are not, but P_{ij} [total patent applications (or grants) from country i , filed in country j] is observable, an alternative approach is to estimate equation (5) by controlling for the innovation effect (N_i^*). As the literature review below reveals, this is typically done by estimating the relationship in equation (5) after substituting a proxy for N_i^* , or by redefining the dependent variable as total patents per patentable innovation, in which case the relevant model becomes:

$$(6) \quad E(P_{ij}/N_i^*) = \rho(s_j, x_j, z_{ij}, c_j).$$

To proxy the total number of patentable inventions, which is unobservable (since inventions kept secret are not observed), a measure of R&D (dollars or number of scientists and engineers) is typically used. This measure of patent propensity — patents filed in country j by country i per million dollars of R&D invested in the source country — is the first of two measures we implement in this study. Since the priority country in which a patent is first filed is typically the source country, then when $i = j$, this *input-based* propensity measure gives the proportion of inventions that are disclosed rather than protected by secrecy.

As an alternative proxy for N_i^* , we use the number of domestic patents filed in country i . So, the second propensity measure can be interpreted as the proportion of inventions already patented in source country i that are also filed in destination country j .¹⁴ In contrast to the first measure, this *output-based* propensity applies only to foreign patenting (since it equals one when $i = j$) and reflects the diffusion, rather than the disclosure, of innovations.

The two propensity measures for Canada as a destination country, disaggregated for four source countries — the United States, Germany, the United Kingdom and Japan — are shown in Figures 5 and 6. Note that the U.S. propensity to patent in Canada in Figure 6 has been steady; the German propensity has been increasing, while Japan's has been steadily falling. A comparison of these results with those for the United States in Figures 7 and 8 suggests considerable variation in patent propensities between destination countries from a particular source, as well as variation among source countries toward a particular destination country.

We attempt to explain this variation with an empirical model based on the above framework. Before describing the specification of the estimated model and its results, we review briefly a subset of studies from the relevant literature.

FIGURE 5

PROPENSITY TO PATENT IN CANADA,
RATIO OF APPLICATIONS IN CANADA TO R&D BY SOURCE COUNTRY, 1974-97

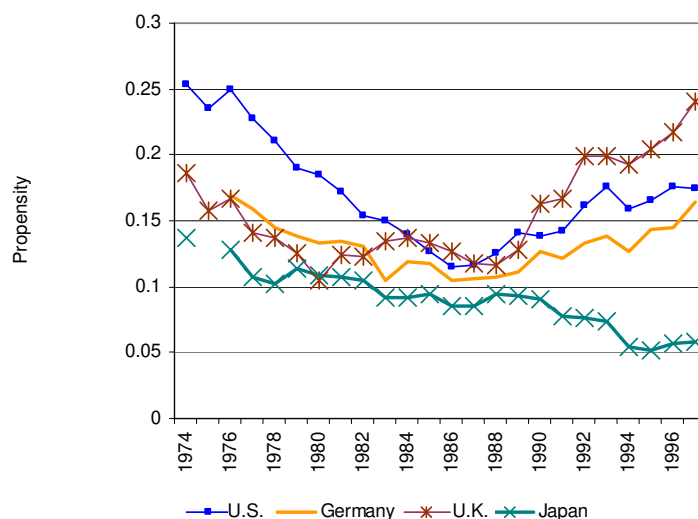


FIGURE 6

PROPENSITY TO PATENT IN CANADA
RATIO OF APPLICATIONS IN CANADA TO SOURCE COUNTRY PATENTS, 1973-97

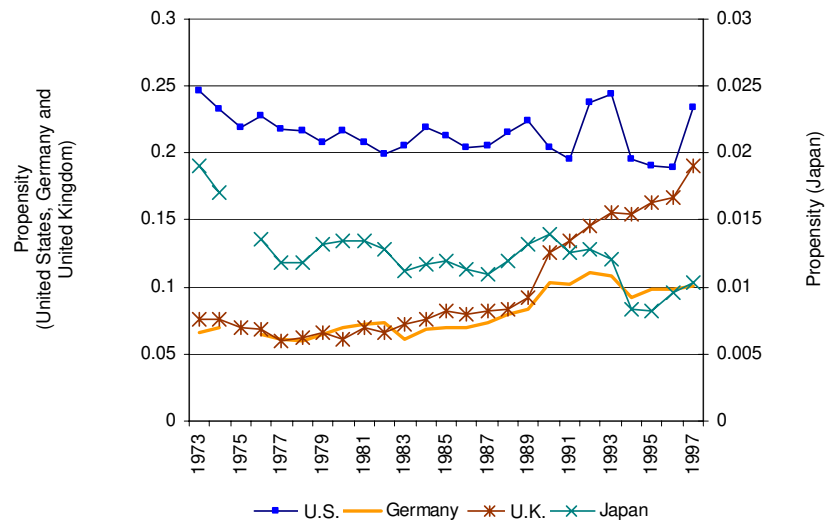


FIGURE 7

PROPENSITY TO PATENT IN THE UNITED STATES,
RATIO OF APPLICATIONS IN THE UNITED STATES TO R&D BY SOURCE, 1974-97

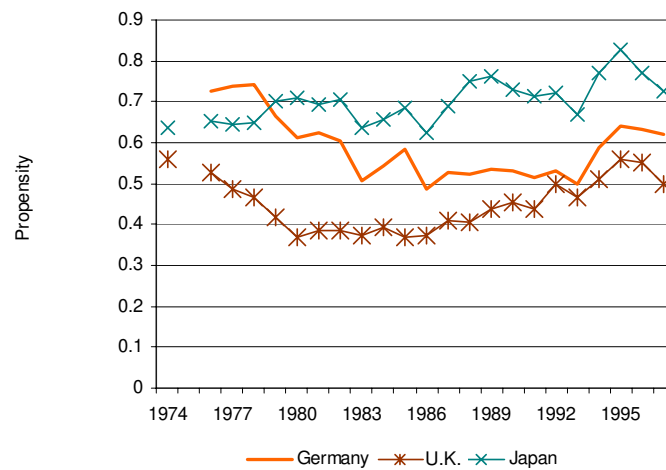
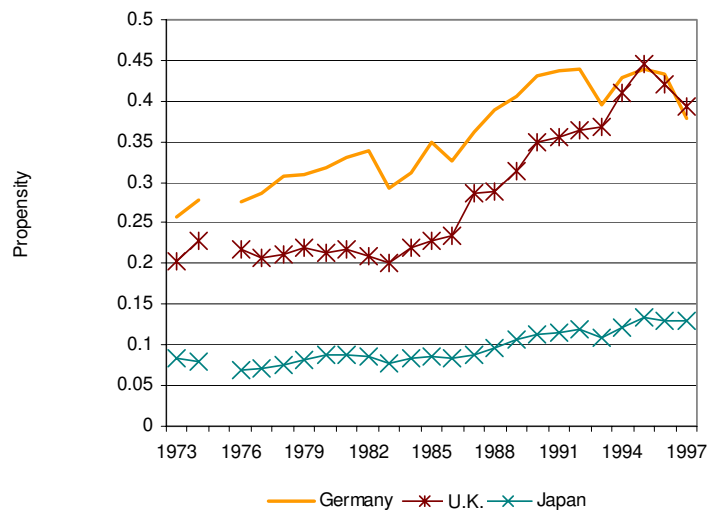


FIGURE 8

PROPENSITY TO PATENT IN THE UNITED STATES, RATIO OF APPLICATIONS IN THE UNITED STATES TO SOURCE COUNTRY PATENTS, 1973-97



LITERATURE REVIEW

WITH CHANGES IN THE U.S. PATENT REGIME providing a natural experiment, Kortum and Lerner (1998) set out to determine whether the recent rise in patenting into and out of the United States (Figures 3 and 4) can be attributed to pro-patent policy changes. If so, they hypothesize, the United States should have become an increasingly attractive destination for both domestic and foreign inventors, relative to other countries. They call this the “friendly court” hypothesis, in reference to the most prominent change, the creation (in 1982) of the Court of Appeals for the Federal Circuit (CAFC), which hears the appeals of all patent-related judicial decisions.¹⁵ A related hypothesis, the “regulatory capture” hypothesis, explains the increased patenting activity by lobbying pressures from large firms. The “fertile technology” hypothesis explains the increase in patenting either by an expansion in the set of new patentable areas (e.g. biotechnology, software and business methods) or by an increase in the productivity of managing R&D that redirected research efforts toward more applied activities. According to Kortum and Lerner, the last hypothesis reflects changes that lie outside of the patent system.

Using aggregate data, they test a model similar to equation (5), where the destination and source countries, time and interaction effects are represented by a set of dummy variables. Based on evidence of a weak increase in foreign

patenting in the United States relative to the increase by U.S. inventors at home and abroad, they reject the friendly court hypothesis. Also rejecting the regulatory capture hypothesis and the first part of the fertile technology hypothesis, Kortum and Lerner attribute the rise in U.S. patenting activity to a (primarily U.S.-based) productivity increase in the management of the R&D process that led to an increase or re-orientation toward applied research.

Kortum and Lerner's study provides an innovative analysis of patenting patterns into and out of the United States, but it raises some questions. In particular, the authors claim that the increase in U.S. patenting activity abroad is not consistent with the pro-patent hypothesis. However, as the expression in equation (5) implies, stronger patent rights may have induced more innovation in the United States, which may account for some of the increase in patenting abroad. (See also Hall and Ziedonis, 2001.)¹⁶ Also, the *management* explanation, attributed to productivity effects outside of the patent system may, in fact, have been motivated by changes in patent policy.¹⁷ As Hall and Ziedonis (2001) interpret the management hypothesis, firms may have harvested more of their R&D *output* (rather than redirected R&D *input* toward more applied research, as in Kortum and Lerner) in response to a more litigious environment brought about by a pro-patent regime.¹⁸

In their study on the semiconductor industry in the United States, Hall and Ziedonis (2001) argue that stronger patent rights have stimulated a *strategic* response: patenting to stave off costly litigation, especially for overlapping technologies that are common in this industry. Through detailed field interviews, they find that firms commonly accumulate portfolios of patents that are used as *bargaining chips* in cross-licensing agreements. Under the strategic view, patents are valuable assets that can be traded to avert costly court battles, rather than instruments for protecting one's investment against infringement, as under the traditional view. As a second hypothesis, they conjecture that strong patent rights facilitated vertical specialization by R&D-intensive entrants that contract out the manufacturing of their products.

Using firm-level data from the semiconductor industry, Hall and Ziedonis estimate a patent production function that relates patents to R&D and firm characteristics. Their model can be interpreted within the framework of equation (5) above, with the production function replacing N_i^* and the remaining explanatory variables corresponding to patent propensity. The latter variables are given by year dummy variables, which measure the growth of patent propensities over time that is not attributed to characteristics of the firm.¹⁹ They find strong evidence of increased propensity to patent among manufacturing firms, although the specialized entrants appear to have also added significantly to the increase in patent propensity.

The Canadian experience is analyzed by Rafiquzzaman and Whewell (1998), who perform an analysis similar to Kortum and Lerner to examine the

impact of policy changes that occurred over the past decade. As in Kortum and Lerner, they employ aggregate country patent counts and estimate a model based on Eaton and Kortum and similar to equation (5) above. Likewise, they control for the innovation effect with (aggregate) R&D in the source country. The remaining variables, which they attribute to the propensity to patent, include characteristics of the destination country and destination-source countries' effects. Rather than using year dummy variables to control for changes in patent policy, they include an index of patent strength in the destination country, which they find to be significant. They conclude that the sharp increase in patenting activity in Canada can be attributed to both the pro-patent hypothesis and the fertile technology hypothesis.

As an alternative to the approach in equation (5), the relationship in equation (6) has been estimated in several studies, with patents per unit of R&D as the endogenous variable [Scherer and Weisburst (1995), Arundel and Kabla (1998) and Hicks et al. (2001)]. In these studies, the strength of patent protection is found to impact significantly on the propensity to patent. Scherer and Weisburst (1995) find that the introduction of product patents for pharmaceuticals in Italy, while not generating more innovations, increased the propensity to patent abroad. Using survey data on European firms, Arundel and Kabla (1998) find that the propensity to patent is significantly higher among firms for which patents are effective instruments against infringement. Hicks et al. (2001) show that the propensity to patent in the United States between 1991-94 and 1995-98 increased by 70 percent in information technologies, but was stable for other technology categories which, they conjecture, may be explained by the strategic effect suggested by Hall and Ziedonis (2001).

Lessons from the Literature

As this brief review indicates, notable attempts have been made to disentangle the impact of policy changes from alternative explanations of the increase in patenting activity. Falling squarely under explanations attributed to patent reform would be more effective enforcement of patents and the extension of patentability to new classes of products. Less clear are hypotheses regarding changes in the management of the R&D process but, as Hall and Ziedonis (2001) insightfully note, a reorganization of the way in which firms conduct their R&D business may be attributed to changes in the patent regime. Arguably, a change in the *technical* production of R&D lies outside of the patent system but, even then, patents may play a role in facilitating licensing and alliances between research firms that permit them to re-orient their research toward more productive uses.²⁰ Not to consider this wider impact of patent changes would be to underestimate the role of policy, but crediting patent policy entirely with changes to the R&D process would grossly overestimate its impact.

With these lessons from the literature reviewed above, we proceed cautiously to our empirical analysis.

THE EMPIRICAL MODEL

WE ATTEMPT TO IDENTIFY THE VARIABLES that determine the propensity to patent, focusing on the Canadian experience. Our empirical model is based on equation (6) with a measure of patent propensity as the dependent variable, as in the second set of studies listed above. Because of data limitations, we employ aggregate country data, as in Kortum and Lerner (1998) and Rafiquzzaman and Whewell (1998), but for a larger number of countries over fewer time periods.

Our central hypothesis is related to Kortum and Lerner's *friendly court* and Hall and Ziedonis's *pro-patent* hypotheses that an increase in intellectual property rights in a destination country j impacts significantly on the propensity of source country i to patent in country j . We test this hypothesis with an empirical model based on the relationship depicted in equation (6) (taking logs and including the t subscripts), that is given by:

$$(7) \quad \log P_{ijt}/n_{it} = \alpha_0 + \beta s_{jt} + \gamma x_{jt} + \delta z_{ijt} + \eta c_{jt} + \alpha_t + \alpha_i + \alpha_{it} + \epsilon_{ijt}$$

where the dependent variable, P_{ijt} , is the number of patent applications filed in destination country j by source country i at time t ; n_{it} is a proxy for N_{it} (either R&D or domestic patents); s_{jt} is the strength of patent protection in country j ; x_{jt} is a set of variables describing the economic environment in country j ; z_{ijt} are source-destination pair variables that may influence the decision to patent; and c_{jt} is the cost of filing a patent application in country j . Since we are particularly interested in explaining why countries may be attractive destinations for patenting, we include specific features of their environments rather than dummy variables as in Kortum and Lerner.

We also include time and source-country fixed effects, denoted by the α parameters. To capture idiosyncratic features of source countries, such as the level of patent protection and economic conditions that may influence the decision to patent abroad, we include α_i .²¹ Global effects, such as international agreements bearing on patents, are captured by α_t . In some specifications, we include time-source country fixed effects to account for changes over time in the economic or legal environments of source countries that may impact on patenting decisions. Finally, ϵ_{ijt} is an error term.

We look to the estimated coefficient on s_{jt} for support of our central hypothesis. For this to be a persuasive test, we must be able to distinguish among the alternative hypotheses discussed above. First, consider a hypothesis related to Kortum and Lerner's *fertile technology* hypothesis, that the variation in patent propensity can be explained by changes in the productivity of the R&D process.

If the set of inventions patented abroad is a subset of inventions patented at home, then the second propensity measure (based on innovative output) will not be influenced by an increase in the productivity of the research process, either on the R&D input side [as in Kortum and Lerner (1998), or on the output side, as in Hall and Ziedonis (2001)].²² However, a variant of Hall and Ziedonis's output hypothesis — that inventors have become more efficient at international patenting — might impact on the measure of this patent propensity. Since data are unavailable to estimate this effect, we simply include source country dummy variables, both by country and interacted with year effects.

A second alternative to the central hypothesis is that a change in the propensity to patent may be explained by policy changes in source countries. For example, as implied in equation (1) above, an increase in the economic value of patents in source country i may lower the *quality* of the marginal patent in country i (i.e. q_{ii}^* falls). But, if the quality level above which patenting is desirable in destination country j does not change, then the additional lower-quality patents in i will not be patented in j . Hence, the propensity to patent in country j , as given by the second propensity measure, may fall.²³ As noted earlier, the source-country and time-source-country dummy variables are used to control for these effects. Finally, global effects may alter patent propensities throughout the world. This may be attributed to international treaties or a reduction in the cost of patenting abroad, which we control for with year dummy variables.

Our study most closely resembles the aggregate analysis in Rafiquzzaman and Whewell (1998). As discussed in more detail in the next three sections, we extend their analysis in several directions. Most notably, we: (1) propose a second propensity measure, based on innovative output; (2) expand the set of destination variables to include a measure of antitrust strictness and ease of imitation in the destination country; and (3) evaluate the model for Canada. Lastly, using disaggregated industry patent and import data, we offer some insights on patenting activity in Canada by industrial sectors.

We now turn to the estimation results of the model corresponding to equation (7).

AGGREGATE ANALYSIS

EXPLANATORY VARIABLES

IN THIS SECTION, WE PRESENT THE ESTIMATION RESULTS for an empirical model based on equation (7). Our model contains several important explanatory variables, some of which are destination-specific (s_{jt} , c_{jt} and x_{jt}), while others correspond to source-destination pairs (z_{ijt}). We also include year and source-country dummy variables.

Country-specific Variables

As the central hypothesis highlights, countries that provide stronger protection of intellectual property should receive more patent applications; thus, there should be a positive relationship between the strength of patent protection (s_{jt}) and the propensity to patent.

The cost of obtaining patent protection in country j (c_{jt}) is also a determinant of the propensity to patent. We capture the cost effect in two ways. First, from Helfgott (1993), we classify countries according to whether their filing costs (the sum of application and agent's fees) are high, where we define high as above the mean level in 1992.²⁴ Second, as translation fees represent an important component of costs for foreign patentees, we include a dummy variable indicating whether translation is necessary, which will be the case when the source country and destination country do not share an official language. We expect these cost measures to be negatively related to the propensity to patent.

Next, we turn to additional destination-specific variables (x_j) which both our model and previous studies have shown to be important [Eaton and Kortum (1996) and Rafiquzzaman and Whewell (1998)]. Since larger markets are likely to be more attractive to foreign patentees, we include the log of the destination country's real GDP to control for market size.

A destination country with a highly educated population is expected to receive a higher share of patent applications, as such countries can more readily absorb or imitate technologies from abroad. We control for this by including a term based on the average number of years of schooling. Following Eaton and Kortum (1996), we use the negative reciprocal of the average number of years of schooling as our measure of human capital.²⁵

A destination country that can easily imitate foreign technologies may be seen as a less desirable place in which to patent. Thus, while we expect destination country human capital to have a positive impact on the propensity to patent, we hypothesize that if imitation is a concern this positive effect should be driven largely by countries with strong patent rights. In contrast to Eaton and Kortum (1996), who posit the hazard of imitation simply as a function of destination country patent protection, we capture the threat of imitation by including an interaction term between destination patent strength and our measure of human capital. We hypothesize that if imitation is an important concern, specifications including this interaction should generate a negative coefficient on the human capital term and a positive coefficient on the interaction term.

Finally, the extent to which a destination country's antitrust policy constrains the ability of a patentee to exercise market power may influence the patenting decision. To capture this effect, we interact a measure of the strength of patent rights with a proxy for the effectiveness of antitrust policy in some specifications. We hypothesize that stronger patent rights increase the negative

effect of antitrust policy on the propensity to patent, as patentees with stronger (e.g. broader) patents may be subject to closer scrutiny. The interaction of anti-trust strictness with patent strength is thus expected to have a negative sign.

Destination and Source Country-specific Variables

Next, we turn to explanatory variables corresponding to specific pairs of source and destination countries (z_{ijt}). Exports from a source country to a destination country provide a mechanism for technology diffusion: trade in R&D-intensive intermediate goods helps diffuse technology internationally [Coe and Helpman (1995) and Eaton and Kortum (1996)]. We expect to see a positive relationship between the destination country's imports from the source country and the propensity to patent. We also explore a variant of this idea, based on findings by Maskus and Penubarti (1995) and Smith (1999) that a country's exports are influenced positively by the strength of patent rights in the importing country. Patents on technologies used with or embodied in highly-traded products are expected to be more valuable, the stronger is patent protection against imitation of those technologies. Therefore, the coefficient on the interaction term between destination country imports and patent strength is expected to be positive.

We control for the distance between the source and destination countries by including distance and distance squared terms to capture transportation and other distance-related transaction costs. Geographical features naturally act as barriers to the international diffusion of technologies (see also Eaton and Kortum, 1996).

Time and Country Fixed Effects

The explanatory variables discussed above are all specific to j , the destination country. Although we are primarily interested in these destination country-specific determinants of the propensity to patent, the framework discussed in the previous section suggests that source-country effects (such as the strength of domestic patent protection) may be important. To capture time-invariant source country-specific heterogeneity in the propensity to patent, we include source-country dummy variables in all of our specifications. In addition, globalization and participation in the General Agreement on Tariffs and Trade (GATT) and the TRIPs Agreement would imply an increase over time in the patenting activity abroad of all countries. To control for this, we also include year dummy variables. Lastly, we estimate specifications that include a full set of dummy variables for source country-time interactions to account for changing domestic patent policies or other economic changes.

DATA AND VARIABLE CONSTRUCTION

OUR AGGREGATE ANALYSIS COVERS 17 COUNTRIES: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom and the United States. We consider two ways of empirically measuring the propensity to patent. First, as discussed above, we could take the total amount of R&D performed domestically as a proxy for the country's innovative effort, and define a propensity measure as the number of patent applications filed in the foreign country per million dollars of domestic R&D (in the previous year).²⁶ We thus construct $PROP1 = P_{ijt}/R\&D_{it-1}$, where i indicates the source country and j the destination country. Alternatively, the propensity to patent is captured by the proportion of domestic applications that are also filed the following year in the (foreign) destination country. Our variable $PROP2 = P_{ijt}/P_{it-1}$ corresponds to this definition.²⁷ If inventors in country j subsequently patent only a fraction of their inventions abroad, then $PROP2$ will vary between zero and one.²⁸

Because our patent strength and human capital data are available only at five-year intervals, our study covers the years 1980, 1985, 1990 and 1995. Business expenditures on R&D (in U.S. dollars) are taken from the Organisation for Economic Co-operation and Development (OECD) ANBERD database, and are expressed in 1990 dollars. Patent application data are from the OECD *Basic Science and Technology Statistics* publications. GDP data are also from OECD publications. Bilateral trade data in U.S. dollars come from Robert C. Feenstra's *World Trade Flows, 1980-1997* database.

We use the Ginarte and Park (1997) index of patent rights (updated to include 1995, courtesy of Walter Park) to proxy for the strength of intellectual property rights (IPRs). The updated Barro-Lee dataset on educational attainment (discussed in Barro and Lee, 2000) contains average years of education at five-year intervals, which we use as our measure of human capital. Distances are in thousands of kilometres between capital cities and are taken from Fitzpatrick and Modlin (1986). As indicated above, we use as a cost measure Helfgott's (1993) estimates of the total costs involved in obtaining patent protection. The index of antitrust policy is taken from the 1994 issue of the *World Competitiveness Report*, and is the product of a survey of a large sample of managers in each country.²⁹ We were able to obtain these data for only one year, so we assume the values are constant across time periods for each country.

EMPIRICAL RESULTS

TABLE 1 PRESENTS SUMMARY STATISTICS for the primary variables of interest. As discussed above, some of the values correspond to source or destination countries, while others relate to a pair of source-destination countries (for a given year). The average source country conducts \$12.6 billion of business

TABLE 1

SUMMARY STATISTICS

VARIABLES	NUMBER	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
PROP1	1,017	0.409	0.812	0.006	12.718
PROP2	1,121	0.259	0.27	0.001	1.41
Real R&D Expenditures	1,020	12,591.1	23,889.73	319.066	108,395.6
Distance	1,088	4.736	5.063	0.174	17.58
High Cost	1,156	0.294	0.456	0	1
Translation Required	1,156	0.824	0.381	0	1
IPR Index	1,156	3.752	0.431	2.76	4.86
Human Capital	1,156	8.922	1.615	5.15	12.18
Real GDP	1,156	881,115.3	1,270,844	90,014.9	6,149,520
Imports/GDP	1,088	0.012	0.022	0	0.221
Exports to Low IPR/GDP Countries	1,156	0.007	0.004	0.002	0.019
Antitrust Index	1,156	6.102	0.876	4.1	7.45

R&D per year. Because of the variability of R&D expenditures, PROP1 has a larger variance than PROP2. Approximately 26 percent of a country's domestic patent applications are also filed abroad. The mean distance between source and destination countries is over 4,700 kilometres. About 30 percent of our observations are from countries with high filing costs, while 82 percent of source-destination pairs require translation of the patent application. The imports/GDP ratio for a given source-destination pair is 1.2 percent on average.

Table 2 reports regression coefficients for our base specification using both $\log(\text{PROP1})$ and $\log(\text{PROP2})$ as the dependent variable. Robust standard errors are used to account for heteroscedasticity of an unknown variety. The specification in column (1) explains almost 80 percent of the variation in the propensity to patent. The signs of our variables of interest are as hypothesized. An increase of 0.1 points in the patent strength index for a destination country increases the propensity to patent by approximately 4 percent. The import term is also positive and significant, although small in impact: an increase in country j 's imports from country i (normalized by j 's GDP) of 10 percent raises i 's propensity to patent by 2 percent. Our control variables are also signed as expected and significant. The propensity to patent is decreasing with distance and cost (including both filing and translation costs) and increasing with destination market size and level of education. Because this specification includes observations for which the source and destination countries are the same, a dummy variable was included. Not surprisingly, the coefficient is positive, suggesting that more patenting takes place in the home country. [Eaton and Kortum (1996) and Rafiquzzaman and Whewell (1998) present a similar finding.]

TABLE 2		
REGRESSION ESTIMATES: COMPARISON OF DEPENDENT VARIABLES		
INDEPENDENT VARIABLES	(1) LOG(PROP1)	(2) LOG(PROP2)
Constant	-6.713*** (0.331)	-9.258*** (0.298)
Distance	-0.073** (0.035)	-0.079*** (0.026)
Distance Squared	0.003* (0.002)	0.004*** (0.001)
High Cost	-0.154*** (0.052)	-0.209*** (0.049)
Translation Required	-0.199*** (0.042)	-0.182*** (0.037)
IPR Strength	0.414*** (0.045)	0.481*** (0.042)
-1/(Human Capital)	2.184** (0.947)	2.586*** (0.827)
Log(GDP)	0.486*** (0.019)	0.487*** (0.018)
Log(Imports/GDP)	0.201*** (0.038)	0.178*** (0.030)
Dummy Variable (Source=Destination)	0.657*** (0.173)	
N	1,017	1,052
R ²	0.792	0.862
Notes: Robust standard errors appear in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. Regressions include year and source-country dummy variables.		

The coefficients in column (2) for PROP2 are quite similar in magnitude and significance, although the data used for estimation are slightly different: here, observations for which the source country is the same as the destination country are dropped. Even so, the similarity suggests that we can restrict our attention to one dependent variable without substantial loss of generality. Accordingly, for the remaining specifications we report only the results corresponding to the use of PROP2 in our dependent variable. Column (2) will be referred to as our *base* specification.

Table 3 presents results of our main hypothesis tests. In column (1), we add the proxy for the threat of imitation, the interaction between destination country human capital and patent rights. The results do not confirm our hypothesized imitation relationship. In fact, human capital influences patent propensity positively when patent rights are weak, and has a decreasing effect with

TABLE 3

HYPOTHESIS TESTING: DEPENDENT VARIABLE LOG (PROP2)

INDEPENDENT VARIABLES	(1)	(2)	(3)	(4)
Constant	-5.700*** (0.631)	-11.072*** (0.639)	-11.958*** (1.514)	-9.906*** (0.659)
Distance	-0.080*** (0.025)	-0.096*** (0.027)	-0.088*** (0.026)	-0.240* (0.141)
Distance Squared	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.011* (0.007)
High Cost	-0.160*** (0.050)	-0.173*** (0.051)	-0.205*** (0.051)	-0.205*** (0.051)
Translation Required	-0.181*** (0.036)	-0.191*** (0.038)	-0.149*** (0.040)	-0.303*** (0.113)
IPR Strength	-0.458*** (0.151)	0.949*** (0.151)	1.326*** (0.380)	0.492*** (0.044)
-1/(Human Capital)	35.105*** (5.398)	3.295*** (0.873)	4.783*** (1.038)	4.214** (1.657)
Log(GDP)	0.487*** (0.018)	0.497*** (0.019)	0.503*** (0.020)	0.471*** (0.022)
Log(Imports/GDP)	0.173*** (0.030)	-0.151 (0.108)	0.180*** (0.031)	-0.070 (0.214)
-1/(Human Capital)*IPR	-8.612*** (1.374)			
Log(Imports/GDP)*IPR		0.084*** (0.026)		
Antitrust Stringency			0.445* (0.234)	
Antitrust Stringency*IPR			-0.135** (0.058)	
R ²	0.866	0.863	0.864	0.851
Chi-square Statistic				0.17

Notes: Number of observations = 1,052. Robust standard errors appear in parentheses.
Columns (1) through (3) are estimated by the ordinary least squares (OLS) method; column (4) is estimated by instrumental variables (IV).
All regressions include year and source-country dummy variables.
***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.
Column (4) reports the results of a Hausman specification test; the test statistic is a distributed chi-square with 26 degrees of freedom.

stronger patent rights. This suggests that the channel through which imitation might operate is subtler than our proposed mechanism.³⁰

In column (2) we further investigate our finding that imports have a positive effect on the propensity to patent, which previous studies have failed to find. [See, for example, Eaton and Kortum (1996) and Rafiquzzaman and Whewell (1998).] When the interaction between imports and patent strength is included, we find that as hypothesized the interaction term is positive while

the import term is insignificant. To the extent that imports embody new technologies (Coe and Helpman, 1995), a larger amount of trade to the destination country enhances the value of strong patent rights.

Column (3) presents a specification incorporating our index of the effectiveness of antitrust policy. While the other coefficients remain essentially unchanged from the base specification, the interaction between antitrust and patent rights yields our anticipated result. This negative coefficient can be given the following interpretation: a foreign firm is better able to exploit strong patent rights when antitrust is relatively weak, since its potentially strong market position is less likely to be actively scrutinized.

In column (4) of Table 3 we address a potential concern with our specification of the basic patent equation, namely the possibility that imports are determined endogenously with patenting activity. For instance, random shocks to the error term of the propensity to patent equation may also affect the amount of imports into the destination country (as, for example, if the same foreign firms are responsible for filing patent applications and for exporting goods). Then, the coefficient on imports would be biased and inconsistent. To attempt to address this possibility, we adopt an instrumental variables (IV) approach. The gravity model of international trade (e.g. Bergstrand, 1989) posits that bilateral trade is a function of source and destination countries' incomes and populations, as well as other factors. Therefore, the logarithm of source country population might qualify as a suitable instrument, as it is likely correlated with trade, but uncorrelated with disturbances to the patent propensity equation.

The results of the IV regression suggest that when this potential endogeneity is accounted for, imports are not an important predictor of international patenting, as the coefficient is not significantly different from zero. However, most of the other coefficients remain relatively precisely estimated, and comparable to the estimates in column (2) of Table 2. This lack of significance parallels similar results in Eaton and Kortum (1996) and in Rafiqzaman and Whewell (1998). Whereas these studies found imports to be insignificant in OLS regressions, we find that this can only be established if endogeneity is believed to be a serious problem. In fact, a Hausman test does not allow us to reject the null hypothesis that the OLS specification is consistent, so we retain column (2) of Table 2 as our base set of estimates, and thus the finding that imports appear to help predict the propensity to patent.

ROBUSTNESS TESTS

WE PERFORM A VARIETY OF ADDITIONAL ROBUSTNESS TESTS on our base specification, a selection of which are reported in Table 4. To control for the possibility that source country characteristics might be changing over time (and thus not be adequately captured by source country dummy variables), we include in

TABLE 4

ROBUSTNESS TESTS

INDEPENDENT VARIABLES	(1) OLS ¹ Log(PROP2)	(2) WLS ² Log[PROP2/(1-PROP2)]
Constant	-9.601*** (0.316)	-9.162*** (0.264)
Distance	-0.082*** (0.025)	-0.111*** (0.021)
Distance Squared	0.004*** (0.001)	0.004*** (0.001)
High Cost	-0.210*** (0.049)	-0.121*** (0.032)
Translation Required	-0.184*** (0.037)	-0.083** (0.039)
IPR Strength	0.486*** (0.041)	0.509*** (0.036)
-1/(Human Capital)	2.618*** (0.799)	2.816*** (0.584)
Log(GDP)	0.486*** (0.017)	0.512*** (0.013)
Log(Imports/GDP)	0.173*** (0.029)	0.140*** (0.028)
Year Dummies	Yes	Yes
Source Country Dummies	Yes	Yes
Year*Source Country Dummies	Yes	No
N	1,052	1,040
R ²	0.875	0.887
Notes: ¹ OLS: Ordinary least squares method. ² WLS: Weighted least squares method. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.		

equation (1) a full set of source country-year interaction dummy variables. While these improve the fit of the equation somewhat, the other estimated coefficients remain almost exactly the same as in the base regression. As an alternative control for time-variant source country characteristics, we estimate an (unreported) specification including source country per-capita real R&D expenditures (in the previous year) and find that while the R&D coefficient is positive and significant, the other coefficients are essentially unchanged.³¹

As an additional test of our specification, we exploit the fact that PROP2 is theoretically a proportional measure and varies between zero and one. We estimate in column (2) a logit model for grouped data; again, the coefficients are found to be significant in the same pattern as specification (2) of Table 2.³²

APPLYING THE MODEL TO CANADA

THE PREVIOUS SECTION'S RESULTS ESTABLISH that equation (2) of Table 2 provides a fairly robust explanation of international patenting activity patterns. However, these results reflect data from all 17 countries. In this section, we briefly examine how well the predictions of the empirical model apply to Canada, exploring in particular some of the model's properties when attention is restricted to Canada as a destination country.

Figure 9 plots the difference between actual and predicted propensities to patent from specification (1) as a function of time, with Canada as the destination country, for each of the five primary technology-exporting countries. This graph strongly suggests that as a destination, Canada's characteristics have changed over time in ways that our regression model does not entirely capture. It appears that the model initially under-predicts the propensity of each of these countries to patent in Canada, while over time this under-prediction disappears; for the United States, Germany and France, there is a high degree of over-prediction by the final year of the sample. Thus, by 1995, it seems that factors which accurately predict patent flows for the full set of countries in the aggregate tend to overestimate the propensity of foreign inventors to patent in Canada.

FIGURE 9

RESIDUALS WITH CANADA AS DESTINATION COUNTRY, 1980-95

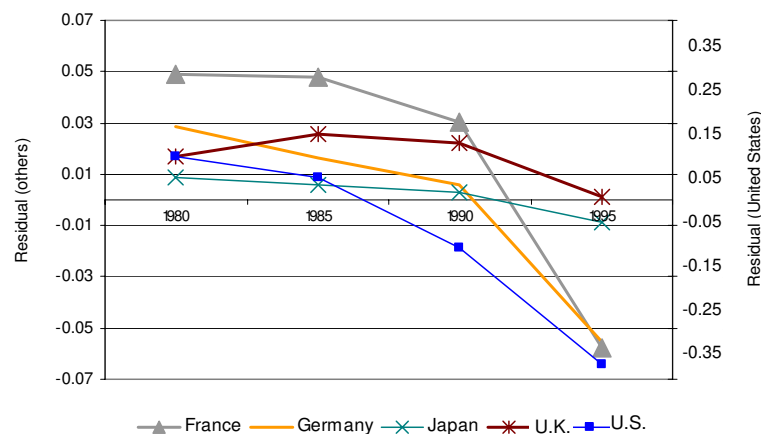


FIGURE 10

PROPENSITY TO PATENT, GERMANY, 1990-1995

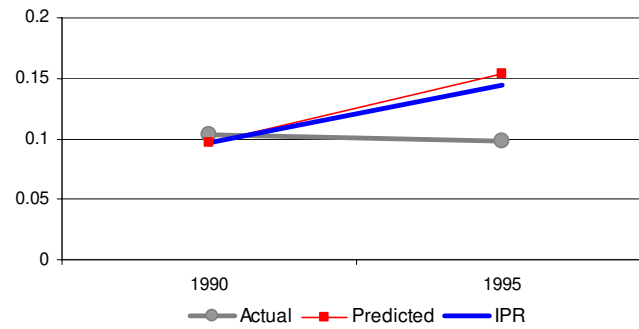


FIGURE 11

PROPENSITY TO PATENT, UNITED KINGDOM, 1990-1995

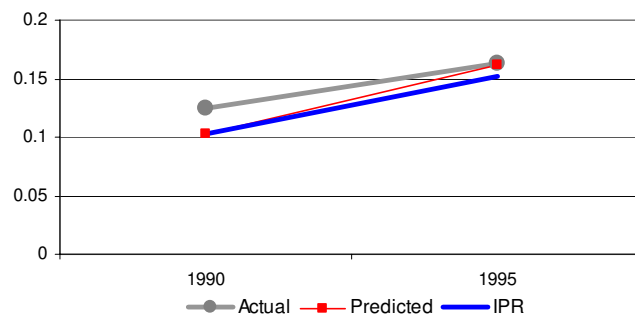
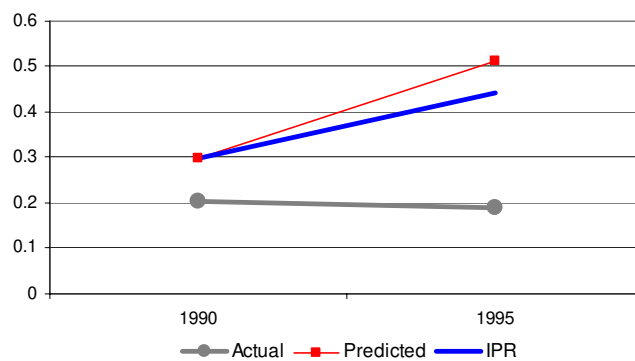


FIGURE 12

PROPENSITY TO PATENT, UNITED STATES, 1990-1995



Why might this be the case? Figures 10-12 plot actual and predicted propensities to patent for Germany, the United Kingdom and the United States. The figures also show the contribution of patent rights to the change in the predicted propensity, holding all other factors constant at their 1990 levels. The Ginarte and Park data indicate that Canada's score on the patent rights index increased from 2.76 prior to 1995 to 3.57 in 1995. The index increases in Canada's case due to the enhanced patentability of pharmaceuticals, and Canada's participation to the Patent Cooperation Treaty (simplifying administrative procedures) and to the International Convention for the Protection of New Varieties of Plants (allowing for plant breeders' rights). Therefore, according to that index, Canada was providing significantly stronger protection of intellectual property rights in 1995 than previously. Our regression estimates suggest that this should have a major impact on foreign patent applications in Canada. Specifically, holding other factors constant, the propensity for each source country to patent in Canada should increase by $\exp[(3.57-2.76)*0.481]-1 = 47.6$ percent.

As presented in Figures 10-12, the predicted propensities to patent in Canada indeed increased from 1990 to 1995 for these countries, with the change in the patent strength index accounting for the majority of the increase. However, in unreported plots of the eight most active patenting countries in Canada in 1995, five countries exhibited either a decrease or no significant change in the *actual* propensity to patent in Canada between 1990 and 1995. Because our predicted propensities are largely driven by the change in the patent strength index, these results suggest that the index may be overstating the degree of change in intellectual property protection, at least for Canada.

This over-prediction may be attributed to two types of aggregation in our analysis. First, the data are aggregated across industries. This may confound potentially significant industry-specific responses to patent policy, or systematic changes in the industrial composition toward low- or high-propensity industries. Second, the patent strength index is a broad combination of regime changes that occurred contemporaneously in Canada, some of which may not be as important as the weights imply, either in the aggregate or for particular industries. These suggestive findings motivate our analysis in the following section in which we disaggregate patenting activity by industry and offer some speculations on the importance of industry-level changes in patent policy.

INDUSTRY-LEVEL ANALYSIS

IN THIS SECTION, WE APPLY THE FRAMEWORK developed in the second section to data disaggregated by industry in order to determine whether patent policy may have differential effects across technologies in Canada, as documented in previous studies for the United States based on survey data (e.g. Cohen, Nelson and Walsh, 2000).³³ Estimates of the distribution of patent

value at the industry level likewise suggest a considerable amount of heterogeneity among industries [e.g. Lanjouw (1998) and Schankerman (1998)], although these studies do not take account of industry-specific economic activity or other variables that might affect patent value. In our model, we control for the level of industry economic activity, measured by industry imports, to isolate differences in the propensity to patent across manufacturing industries.

Following the reduced-form specification discussed in the previous sections, we estimate the propensity to patent as a function of year, source-country and industry effects, and industry imports. For this estimation, we need to construct measures of the propensity to patent at the industry level. This is a challenging task, since patents are not classified by industry, but rather by field of technology. Because industries are both sources and users of many types of technology, there is no good one-to-one map from patent counts (which are classified by technology type) to industry. One approach to this problem has been to construct a probabilistic *concordance* among industries and technologies. The most widely used of these concordances is based on data originally collected in Canada, which for many years classified its patents by technology, industry of origin and industry of use.

The concordance has also been applied to other countries, but its usefulness may be limited by unobserved differences in the joint distribution of industries and technologies between Canada and other countries. Kortum and Putnam (1997) offer alternative means of constructing a concordance based on Canadian data and test the stability of such concordance by source country and time period.³⁴ We employ the Johnson-Evenson data to construct estimates of the propensity to patent in Canada at the industry level for patents originating from four countries: the United States, France, the United Kingdom and Germany. The data are then aggregated to the approximately 2½-digit level of the International Standard Industrial Classification in order to match them to standard industry-level trade data.

Not surprisingly, the data have some significant limitations. First, patent grants (rather than applications) are observed. This implies that propensity measures can only be approximately correct, since we cannot ascertain the exact application dates in the source and destination countries.³⁵ Also, as Rafiqzaman (1999) points out, Canadian patent grants have fallen dramatically over our sample period, both absolutely and relative to applications. While we can control for this to some extent by using year dummy variables, we do not know whether the use of grant data involves any additional biases.³⁶ Second, the Johnson-Evenson data do not permit propensities to be constructed prior to 1993, which limits our ability to directly address the reforms adopted from 1989 to 1992. We can, however, describe cross-sectional variation at the industry level and, by constructing two cohorts (for 1993 and 1995), increase the efficiency of the estimation.

TABLE 5**ANALYSIS OF VARIANCE: INDUSTRY DATA**

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	F-TEST STATISTIC	P-VALUE
Year	0.072	1	42.70	0.000
Country	0.072	3	14.11	0.000
Industry	0.174	16	6.42	0.000
Model	0.317	20	9.39	0.000
Residual	0.194			
Total	0.512			
R ²	0.620			

Notes: Number of observations = 136.

The dependent variable is the number of patents granted in Canada divided by the number of patents granted in the source country.

The analysis of variance results in Table 5 show that, as one might expect, industry-level variation dominates source country variation in patenting propensity, accounting for one-third of the total sum of squares. Interestingly, cohort effects figure as prominently as source-country effects in this sample, which likely reflects the sharp drop in the number of Canadian patents granted between the two periods.

In addition to the variables used in the analysis of variance, we obtained data on industry-level Canadian imports from each source country. To isolate the effects of industry economic activity on the rate of patenting, we regress the propensity to patent on the level of industry imports into Canada, in addition to source-, year- and industry-level dummy variables. Because the propensity to patent is a proportional measure, we use logit estimation for grouped data. The dependent variable is thus the log of the odds ratio. The results are shown in Table 6.³⁷

As in the aggregate analysis presented in the third section, we find that the level of imports significantly affects the propensity to patent. The U.S. dummy variable is negative, suggesting that the U.S. propensity to patent in Canada is lower than that of France (the omitted country), controlling for other factors.³⁸ Among European exporters, inventors from the United Kingdom patent relatively more frequently in Canada, while those from Germany patent relatively less frequently, than those from France, holding the level of imports constant. This ranking corresponds to the degree of language similarity between these countries and Canada, and reflects, in part, the cost of translation, shown to be a significant predictor of the propensity to patent in the aggregate analysis. Since we focus on a single destination country, all such pairwise-specific terms (e.g. distance and language) are absorbed into the source country intercepts.

TABLE 6**WLS LOGIT ESTIMATES: INDUSTRY DATA**

INDEPENDENT VARIABLES	(1)
Constant	-3.484*** (0.346)
Log(Imports)	0.323*** (0.112)
Year 1995	-0.707*** (0.048)
Germany	-0.667*** (0.134)
United Kingdom	0.267** (0.129)
United States	-1.005** (0.442)
Electrical and Electronics	-0.694** (0.349)
Chemicals	-0.073 (0.257)
Drugs	0.323 (0.198)
Petroleum	0.838* (0.432)
Transportation	-0.932** (0.410)
Rubber and Plastics	-0.115 (0.407)
Non-ferrous Metals	0.168 (0.479)
Fabricated Metals	-0.224 (0.213)
Instruments	-0.001 (0.194)
Other Machinery	-0.739** (0.372)
Food	1.221*** (0.272)
Textiles	0.388* (0.230)
Rubber and Plastics	-0.118 (0.223)
Non-metallic Minerals	0.046 (0.264)

TABLE 6 (CONT'D)	
WLS LOGIT ESTIMATES: INDUSTRY DATA	
INDEPENDENT VARIABLES	(1)
Paper	-0.044 (0.283)
Wood	0.013 (0.269)
R ²	0.772
Notes: Number of observations = 136. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. Standard errors appear in parentheses. The dependent variable is $\log[p'/(1-p')]$, where p' indicates the number of patents granted in Canada as a proportion of the number of patents granted in the source country.	

Unsurprisingly, the rate of patenting varies substantially across industries; an F-test decisively rejects the equality of intercepts across industries. Several of the individual coefficients are also significant and can be given intuitive interpretations. In most countries, one might expect that the rate of patenting in the pharmaceutical industry is higher than in other industries. Our estimated pharmaceutical coefficient shows that indeed, immediately after Canada repealed compulsory licensing, the rate of foreign pharmaceutical patenting was higher than average, although the standard error of the estimate is large. However, this policy change did not affect other important determinants of the value of pharmaceutical patents, such as the precision with which pharmaceutical claims are specified in chemical formulae, or regulatory barriers to entry that retard the ability of imitators to invent around the patent. In this sense, the relatively large pharmaceutical fixed effect is likely not due to the regime change but rather to the technological and regulatory features inherent in pharmaceutical inventions.

Among other industries, the results show much higher than average patenting for petroleum, food and textile inventions, perhaps reflecting Canada's comparative advantage in resource-based industries. It should be noted that our reduced-form model and data cannot distinguish the *supply side* effects of relatively high imitation by domestic Canadian firms, from the *demand side* attributes like relatively inelastic demand for patented products in industries such as pharmaceuticals where these effects are relevant. At the other end of the spectrum, the electrical and electronics industry exhibits a relatively low rate of patenting, probably reflecting the relatively rapid rate of technological obsolescence. The "other machinery" industry, which encompasses mechanical

inventions that are relatively easy to imitate, and transportation also exhibit relatively low propensities.³⁹

The primary finding of this section is the considerable degree of heterogeneity among industries in their propensity to patent in Canada. This heterogeneity illustrates the inherent difficulty in assuming that the efficacy of patent rights is the same across industries (as in the aggregate analysis). Apart from the fact that patent reform may target industry-specific practices, such as compulsory licensing, the factors that influence the value of patents may vary across industries along a number of other dimensions. Among these are technology (e.g. the ease of specifying claims), industry practices (e.g. established licensing practices) and unrelated regulatory requirements (e.g. pharmaceutical safety and efficacy).

Thus, although the results presented in the section entitled *Aggregate Analysis* indicate that the strength of patent protection positively influences the propensity to patent in the aggregate, this section suggests that, at a more micro level, a multinational firm's decision to patent abroad must incorporate a richer set of determinants. These results accord with our conjecture in the section entitled *Applying the Model to Canada* that industry effects may account for the aggregate model's weak performance with Canada as the destination country. Even if a broad index of patent strength accurately reflects IPR policy, a trend in the industrial composition of patenting away from high-propensity industries could dominate the patent strength effect. Providing accurate empirical evidence of such trends remains an important task for future research.

CONCLUSIONS

IN THIS STUDY, WE HAVE ATTEMPTED TO DETERMINE whether a causal link exists between the 1989 patent reforms in Canada and the acceleration in foreign patenting activity over the past decade. By focussing on the propensity to patent, we control for the possibility that increased foreign innovation, unrelated to Canadian policy changes, may be the driving force behind the recent surge in patenting.

The study is only a first step in carrying out this objective. Although the data used are primarily at the aggregate level, we have been able to make some new observations. Most striking is the robust significance of patent strength in explaining a source country's propensity to patent in a destination country, especially when the latter's antitrust laws are weak or trade flows with the source country are large.

While the model has a good fit overall, it over-predicts the propensity to patent in Canada following the most recent patent reforms. A second analysis, employing disaggregated patent and import data for 17 industrial sectors in Canada, provides evidence that the over-prediction is likely attributed to

heterogeneity in the value of patenting across industries. An extended time series and data on a wider set of explanatory variables (as in the aggregate analysis) would allow for a richer exploration of these sectoral responses to changes in patent protection.

In such an analysis, it would be useful to consider separately the influence of the various policy changes, rather than to package them into a composite index, as in the aggregate analysis.⁴⁰ As noted earlier, the effect of individual policy changes may vary across industries (e.g. strengthening plant breeders' rights is not likely to have much significance in the electronics industry). Moreover, if policy changes have *opposing* effects on patent protection, an index may yield biased results. For example, if two such reforms are weighted equally, the level of the composite index may stay constant but the joint impact may result in an increase in the number of patents observed.⁴¹ So, if the respective effects of policy changes cannot be identified in the data (perhaps because they occurred simultaneously, or because theoretical predictions on their joint effect are ambiguous), one may incorrectly under-estimate the role that policy may play in influencing patent decisions.

Some studies have examined empirically the impact of isolated policy changes; for example, conversion to multi-claim patents in Japan (Sakakibara and Branstetter, 2001) and the granting of product patents in Italy (Scherer and Weisburst, 1995). Where policy changes occur contemporaneously, as they did in Canada, or where the impact of a policy is not obvious, we must turn to economic theory for guidance.

Unfortunately, testable predictions are not always evident, especially when innovation is cumulative. For example, a strengthening of patents, defined by a broadening of patent scope, may: (1) reduce innovation if early inventors can *hold-up* later researchers [Merges and Nelson (1990) and Bessen and Maskin (2000)]; (2) incite costly litigation, thus lowering the economic value of patents [Lanjouw (1994), Lerner (1995) and Lanjouw and Schankerman (2001)]; or (3) facilitate coordination of future research if contracting over R&D is possible, increasing the likelihood that subsequent research will be developed (Green and Scotchmer, 1995). In an ambitious empirical study, Lerner (2001) collects these results and hypothesizes an inverted U-shaped relationship between patent strength and patenting activity. Categorizing 177 policy changes over 150 years in 60 countries into those that clearly strengthen, clearly weaken, and have an ambiguous effect on patent strength, he tests his hypothesis and finds that strengthening patents increases patenting activity if patents are initially weak, and reduces patenting if protection is initially strong. As the study by Hall and Ziedonis (2001), Lerner's analysis is particularly valuable in linking together theoretical results and empirical testing.

The time is ripe for continuing this trend, especially given the growing theoretical literature on specific patent reforms [e.g. conversion to first-to-file

from first-to-invent (Scotchmer and Green, 1990), public disclosure of patent applications (Aoki and Spiegel, 1998) and changes in the standards for patentability (O'Donoghue, 1998)]. Attaining a better empirical understanding of these aspects of patent policy would undoubtedly lead to further theoretical refinements, and more importantly would provide some guidance to policy-makers regarding the practical decisions that must be made.

ENDNOTES

- 1 Patent strength is not a clearly defined concept in the literature. Economists would consider a change in policy as having strengthened patents if it increased the value of patents. Three instruments of the patent system that can affect the value of patents are: the standards for patentability (novelty, non-obviousness), the scope of a patent and enforcement of a patent against infringement. Generally, whether patents are *strong* (higher-valued) depends on a mix of policies offered both ex ante (via patentability standards) and ex post (via enforceability in court). Although it seems plausible that an increase in (or broadening of) any of the three patent components will make patents more valuable, this may not necessarily be the case especially in a cumulative context, as cautioned by the recent theoretical works (e.g. Green and Scotchmer, 1995). See the last section for further discussion of this point.
- 2 For example, in a study of patent reform in Japan, Sakakibara and Branstetter (2001) show that the addition of multiple-claim patents to the prior *single-claim-only* regime in Japan did not result in any perceptible increase in innovation. Baldwin, Hanel and Sabourin (2000) find only a weak relationship between innovation and the effectiveness of patents. Bessen and Maskin (2000) show that the extension of patent protection to software has not induced an increase in R&D relative to sales in the United States. Kortum and Lerner (1998) identify an increase in innovative output, as measured by patents, but do not attribute this increase to the reforms. Jaffe (2000) rejects the hypothesis that the increase in patenting is attributed to increased R&D investment since the significant increases in R&D occurred prior to the reforms.
- 3 Several studies have examined more generally the determinants of innovation in Canada. See, for example, Baldwin, Hanel and Sabourin (2000), Tepperman (2001a), Baldwin (1997), Baldwin and Da Pont (1996) and Caves, Porter, Spence and Scott (1980).
- 4 See Binkley (1998) for further discussion of the Canadian patent system.
- 5 As Lerner (2001) suggests, if a country's market is modest relative to an invention's total market (as the Canadian market is likely to be for many countries), then changes in patent protection in that country are not likely to guide a foreign inventor's research agenda. However, they may very well alter incentives to seek patent protection in Canada, which is captured by the propensity to patent.

- 6 By “patentable” we mean inventions whose subject matter is patentable and that satisfy patentability standards. The latter typically include novelty, non-obviousness and usefulness. Research may also be conducted on non-patentable projects, which may include some forms of basic research, as well as development and other types of technical know-how. For simplicity, we treat the benefits and costs of these two research programs as separable and focus only on the former type of research.
- 7 In reality, the set of patentable subject matter and the standards for patentability may not be the same in both jurisdictions. For example, business methods are patentable in the United States but not in Canada. This assumption is made for convenience; relaxing it would not alter the qualitative results.
- 8 Note that the value of patenting does not depend on characteristics of country i , except through interaction terms. However, this would not be the case if some of the assumptions of the model were relaxed, as is explained below.
- 9 For example, if patent protection is strong, firms may be more inclined to enforce their rights; thus, the return from not patenting may be less than if patents are weak.
- 10 We adopt the simplifying assumption that costs are independent across countries. In reality, the applicant may incur fixed costs of filing a patent application (regardless of the number of countries in which protection is sought), along with an incremental cost for each additional country. This cost structure induces dependence in the decision to file across countries. The effects of introducing this dependence on the applicant’s filing decisions are examined in Putnam (1996).
- 11 We use “secrecy” as short-hand for non-disclosure of the patented invention in country j . Obviously, if the inventor draws a q greater than the minimum required to justify filing in the home country, the initial decision to seek patent protection at home destroys secrecy worldwide.
- 12 This may not always be true. For example, in some years the number of patent applications filed in the United States by Canadian researchers exceeded the number of patent applications they filed in Canada.
- 13 In a more elaborate model, the coefficient on s (ignoring subscripts) in the propensity relationship may also reflect an *innovation effect*, but of a different type than noted above. That is, ρ may depend on N if firms can direct their research toward projects that have a higher chance of being patented (e.g. because it is more likely to pass the novelty requirement or to satisfy the cut-off quality). To see this, suppose that the firm faces a three-stage decision: first, it chooses total patentable inventions, N ; second, it chooses λ , the proportion of projects that will be patented with probability 1; third, for the $1-\lambda$ projects with random quality, it decides whether to patent, after observing quality. Then, the solution to the firm’s maximization problem will yield an expected number of patents equal to $N(s)[\lambda(s) + (1-\lambda(s))\rho(s)]$ implying that when patent strength, s , increases, more of the uncertain projects may be patented; the mix of projects may change toward a larger proportion of certain projects; and the total number of inventions may increase. The propensity in this case will be $\lambda(s) + [1-\lambda(s)]\rho(s)$, which reflects an innovation effect attributed to a change in the mix of research projects toward patented ones, as well as a propensity effect (as before) in which a smaller proportion of

uncertain projects are kept secret due to a reduction in the cut-off quality. Then, the coefficient on s in a regression based on equation (5) would reflect the three effects on innovative output, mix of research projects and propensity.

- 14 In reality, the inventions patented in country j may not be a subset of those patented in country i .
- 15 Among the other changes were: an expansion in the set of patentable products to include life forms (1980), software (1978-84) and business methods (1996); and the enactment in 1984 of the *Bayh-Dole Act* (which gave universities and non-profit institutions title to patents on inventions made with the use of public funds). See also Merges (1997) and Jaffe (2000) for a discussion of the changes. Jaffe (2000) reports that, after the creation of the CAFC, the proportion of cases that resulted in a finding of infringement and validity rose from 62 percent to 90 percent.
- 16 Solving for N_i^* from equation (2) and differentiating with respect to s_j reveals that under reasonable conditions, $\partial N_i / \partial s_j > 0$; that is, a strengthening of patent rights increases innovative output. In a context of cumulative innovation, this may not be true, as discussed in more detail in the last section. Whether this relationship holds empirically has been the subject of a great deal of research. Sakakibara and Branstetter (2001) hypothesize that if the reforms in Japan had resulted in more innovation, some may have appeared in the United States in the form of increased patenting. But, after adjusting patent counts for quality, they find no evidence to support that hypothesis.
- 17 For example, the management explanation is consistent with a pro-patent hypothesis in the extension of the model described in note 13.
- 18 If firms are harvesting more of their marginal patents, then a reduction in quality would be expected. Hall and Ziedonis (2001) test this hypothesis against no change that would be consistent with Kortum and Lerner's input interpretation of the hypothesis. Note that this prediction is consistent with the framework in equation (1) above; in particular, if $\partial v_p / \partial s_j > 0$ and $\partial v_n / \partial s_j < 0$, then the quality cut-off, q_{ij}^* , will fall. They find only weak support for that hypothesis, although they emphasize that quality is measured with error.
- 19 Sakakibara and Branstetter (2001) model the relationship between patent applications and patent reforms in Japan, particularly the conversion from single-claim to multiple-claim patents. Like Hall and Ziedonis (2001), they estimate a patent production function and, in addition to variables that enter the production function, they include year dummy variables to measure the impact of the reforms. However, they interpret the latter parameters as growth in innovative output rather than growth in the propensity to patent, as in Hall and Ziedonis (2001). Their study is thus more about the response of innovation than of patent propensity to changes in the patent regime. Lerner (2001) also estimates the impact of the patent system on innovation by examining 177 policy changes in 60 countries over a 150-year period. The propensity to patent is assumed to be stable, in which case patenting activity is a reasonable proxy for innovation. Lerner finds that a strengthening of patent protection has a stronger impact on patenting activity by foreign inventors than by residents of the country undergoing the change.

- 20 For example, see Merges (1998), Tepperman (2001b) and Gallini and Scotchmer (2001) for discussions on the impact of strengthening intellectual property rights on firms' incentives to reorganize those rights through integration, licensing and other forms of alliances.
- 21 The theoretical framework in equation (6) and in Kortum and Lerner (1998) assumes that features of the source country will not impact on the propensity to patent in a destination country. However, there are reasons why source-country characteristics may, in fact, influence the propensity to patent abroad (for example, if the standards for patentability are not identical in the two countries, as noted in note 7 for Canada and the United States). If R&D and domestic patent decisions depend on patentability standards in the source country, then the variation in patentability standards will impact on the propensity to patent abroad.
- 22 The propensity measure will be less than one if the home country is the priority country for most of their inventions. In that case, the patents filed in a foreign country will be a subset of the patents filed at home. This is not true for Canada since the United States is the priority country for many Canadian inventions.
- 23 Offsetting this may be a reduction in the marginal cost of filing in a destination country after the invention has been patented in the source country, since the fixed cost of prior art searches has already been incurred (Scherer and Weisburst, 1995). If the increase in domestic value is large enough to overcome this fixed cost, filing abroad may become feasible even if the marginal cost of filing has not changed, leading to an increase in the propensity to patent abroad (Putnam, 1996).
- 24 We only observe application fees for a single year, but we assume that countries that are classified as high cost in 1992 remain so over our sample period.
- 25 Our results do not depend qualitatively on this construction.
- 26 Hausman, Hall and Griliches (1984) show that contemporaneous R&D is the best predictor of current patents. But, because most of our observations are from foreign countries which file inventions in the home (priority) country one year earlier, we lag R&D by one year.
- 27 The lag on patents in the source country reflects the Paris Convention that gives inventors 12 months to file in other countries after filing in the priority country (which we take to be the source country).
- 28 As a practical matter, this variable presents a construction challenge for Canada in particular, as the majority of Canadian patent applications are filed first in the United States. For example, out of 3,056 (ultimately successful) patent applications filed by Canadian inventors in the United States in 1994, only 404 were previously filed in Canada (U.S. Patent and Trademark Office database). We therefore use patent applications in the United States for Canada's *domestic* applications. See Putnam (1996) for details about patent priority and the correct definition of the *home* country.
- 29 The precise question corresponding to this index was the extent to which managers agree with the statement "Antitrust laws do prevent unfair competition in [my] country." Countries are assigned a value ranging from 0 to 10 based on these responses.

- 30 We also estimated specifications including destination-country R&D expenditures as a proxy for the threat of imitation, with similar results.
- 31 One further concern might be that unobserved bilateral (i.e. source-destination countries specific) heterogeneity causes a mis-specification of our model. To address this possibility, we run unreported regressions in which the 1980 values of our dependent and independent variables are subtracted from the 1995 values. This differencing sweeps out any time-invariant unobservables. With this specification, we find that the patent rights coefficient is essentially unchanged, while other coefficients are imprecisely estimated.
- 32 The logit model for grouped data estimates weighted least squares for the equation where $\log[\text{PROP1}/(1-\text{PROP1})]$ is the dependent variable.
- 33 Rafiquzzaman (1999) also presents some descriptive statistics on patenting by industry in Canada.
- 34 The data have subsequently been updated by Dan Johnson of Wellesley College and used by both Johnson and Robert Evenson; see <http://www.wellesley.edu/economics/johnson/jeps.html>.
- 35 For example, patents granted in Canada to German inventors in 1995 may not correspond to the 1995 cohort of German domestic patent grants, as we assume here, if the lag between application date and grant date differs across countries.
- 36 The drop in the number of patents granted may have been due to the change from a mandatory to an elective examination system. If some industries exhibit a higher ratio of applications to examination requests than others, our propensities constructed with grant data would be biased. The extent to which this is a problem remains an issue for future research.
- 37 The reference year is 1993, the reference country is France and the omitted industry is 'Other manufacturing'.
- 38 Interestingly, in an unreported regression excluding the import term, the U.S. effect is strongly positive. This suggests that trade between Canada and the United States accounts for a great amount of the existing technology diffusion.
- 39 The latter includes the U.S.-dominated automobile industry, which has evolved a fairly stable set of licensing practices that do not depend on patenting in Canada, despite extensive intra-industry trade between the two countries.
- 40 See Tepperman (2001a) for further discussion of this point.
- 41 See, for example, Scherer and Weisburst (1995) for an empirical analysis of pharmaceutical patent protection, and O'Donoghue (1998) for a theoretical analysis of patentability standards. More precisely, O'Donoghue predicts that R&D will fall with a reduction in the non-obviousness requirement but that more low-quality inventions will be patented.

ACKNOWLEDGMENTS

THE AUTHORS WISH TO THANK Don McFetridge, Walter Park, Mohammed Rafiquzzaman and Dan Treffer for their useful comments and advice.

BIBLIOGRAPHY

- Aoki, Rieko, and Yossi Spiegel. 1998. *Public Disclosure of Patent Applications, R&D, and Welfare*. Tel Aviv, Working Paper No. 30-98 (December).
- Arundel, Anthony, and Isabelle Kabla. 1998. "What Percentage of Innovations are Patented? Empirical Estimates for European Firms." *Research Policy* 27: 127-141.
- Baldwin, John R. 1997. *Innovation and Intellectual Property*. Ottawa: Statistics Canada. Cat. No. 88-515-XPE.
- Baldwin, John R., and Moreno Da Pont. 1996. *Innovation in Canadian Manufacturing Enterprises*. Ottawa: Statistics Canada. Cat. No. 88-513-XPB.
- Baldwin, John R., Petr Hanel and David Sabourin. 2000. *Determinants of Innovative Activity in Canadian Manufacturing Firms: The Role of Intellectual Property Rights*. Paper No. 11F0019MIE2000122. Statistics Canada (Micro-Economic Analysis Division).
- Barro, Robert J., and Jong-Wha Lee. 2000. *International Data on Educational Attainment: Updates and Implications*. Cambridge, Mass.: National Bureau of Economic Research, Working Paper No. 7911.
- Bergstrand, Jeffrey H. 1989. "The Generalized Gravity Equation, Monopolistic Competition, and the Factor-proportions Theory in International Trade." *The Review of Economics and Statistics* 71: 143-153.
- Bessen, James, and Eric Maskin. 2000. *Sequential Innovation, Patents, and Imitation*. Massachusetts Institute of Technology, Working Paper No. 00-01.
- Binkley, Gregor P. 1998. "Patent Rights and New Product Development in Canada." *Canadian Intellectual Property Review* 15: 231-238.
- Caves, R.E., M.E. Porter, A.M. Spence and J.T. Scott. 1980. *Competition in the Open Economy: A Model Applied to Canada*. Cambridge, Mass.: Harvard University Press.
- Coe, David T., and Elhanan Helpman. 1995. "International R&D Spillovers." *European Economic Review* 39: 859-887.
- Cohen, Wesley M., Richard R. Nelson and John P. Walsh. 2000. *Protecting Their Intellectual Assets: Appropriability Conditions and why U.S. Manufacturing Firms Patent (or not)*. Cambridge, Mass.: National Bureau of Economic Research, Working Paper No. 7552.
- Eaton, Jonathan, and Samuel Kortum. 1996. "Trade in Ideas: Patenting and Productivity in the OECD." *Journal of International Economics* 40: 251-278.
- EMF Foundation. 1994. *World Competitiveness Report*. Geneva, Switzerland: EMF Foundation.
- Fitzpatrick, Gary L., and Marilyn J. Modlin. 1986. *Direct-Line Distances: International Edition*. London: Scarecrow Press.
- Gallini, Nancy, and Suzanne Scotchmer. 2001. "Intellectual Property: When is it the Best Incentive System?" In *Innovation Policy and the Economy*, Vol. 2. Edited by Adam Jaffe, Josh Lerner and Scott Stern. Cambridge, Mass.: MIT Press, pp. 51-77.
- Ginarte, Juan C., and Walter G. Park. 1997. "Determinants of Patent Rights: A Cross-national Study." *Research Policy* 26: 283-301.

- Green, Jerry R., and Suzanne Scotchmer. 1995. "On the Division of Profit in Sequential Innovation." *RAND Journal of Economics* 26: 20-33.
- Hall, Bronwyn H., and Rosemary Ham Ziedonis. 2001. "The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-1995." *RAND Journal of Economics* 32: 101-128.
- Hausman, J.A., B.H. Hall and Z. Griliches. 1984. "Econometric Models for Count Data with an Application to the Patents-R&D Relationship." *Econometrica* 52: 909-938.
- Helfgott, Samson. 1993. "Patent Filing Costs around the World." *Journal of the Patent and Trademark Office Society* 75: 567-580.
- Hicks, Diana, Tony Breitzman, Dominic Olivastro and Kimberly Hamilton. 2001. "The Changing Composition of Innovative Activity in the U.S. — A Portrait Based on Patent Analysis." *Research Policy* 30,4: 681-703.
- Jaffe, Adam B. 2000. "The U.S. Patent System in Transition: Policy Innovation and the Innovation Process." *Research Policy* 29: 531-557.
- Kortum, Samuel, and Josh Lerner. 1998. "Stronger Protection or Technological Revolution: What is Behind the Recent Surge in Patenting?" *Carnegie-Rochester Conference Series on Public Policy* 48: 247-304.
- Kortum, Samuel, and Jonathan Putnam. 1997. "Assigning Patents to Industries: Tests of the Yale Technology Concordance." *Economic Systems Research* 9: 161-175.
- Lanjouw, Jean O. 1994. *Economic Consequences of a Changing Litigation Environment: The Case of Patents*. Cambridge, Mass.: National Bureau of Economic Research, Working Paper No. 4835.
- . 1998. "Patent Protection in the Shadow of Infringement: Simulation Estimations of Patent Value." *Review of Economic Studies* 65: 671-710.
- Lanjouw, Jean O., and Mark Schankerman. 2001. "Characteristics of Patent Litigation: A Window on Competition." *RAND Journal of Economics* 32: 129-151.
- Lerner, Josh. 1995. "Patenting in the Shadow of Competitors." *The Journal of Law and Economics* 38 (October): 463-495.
- . 2000. *150 Years of Patent Protection*. Cambridge, Mass.: National Bureau of Economic Research, Working Paper No. 7478.
- Maskus, Keith E., and Mohan Penubarti. 1995. "How Trade-related are Intellectual Property Rights?" *Journal of International Economics* 39: 227-248.
- McFetridge, Donald G. 1999. *Intellectual Property and the Location of Innovative Activity: The Canadian Experience with the Compulsory Licensing of Pharmaceutical Patents*. Carleton University. Working Paper.
- Merges, Robert P. 1997. *Patent Law and Policy: Cases and Materials*. 2nd ed. Charlottesville, Penn.: MICHIE Law Publishers.
- . 1998. "Intellectual Property Rights, Input Markets, and the Value of Intangible Assets." Berkeley: University of California. Mimeo.
- Merges, Robert P., and Richard Nelson. 1990. "On the Complex Economics of Patent Scope." *Columbia Law Review* 90,4: 839-916.
- O'Donoghue, Ted. 1998. "A Patentability Requirement for Sequential Innovation." *RAND Journal of Economics* 29: 654-679.
- OECD. Various years. *Basic Science and Technology Statistics*. Paris: Organisation for Economic Co-operation and Development.

- Pazderka, Bohumir. 1999. "Patent Protection and Pharmaceutical R&D Spending in Canada." *Canadian Public Policy – Analyse de Politiques* 25: 29-46.
- Putnam, Jonathan D. 1996. "The Value of International Patent Rights." Yale University. Unpublished dissertation.
- Rafiquzzaman, Mohammed. 1999. *The Importance of the Intellectual Property Rights System to Economic Performance: A Study of the Canadian Experience*. Micro-Economic Policy Analysis Branch, Industry Canada (October). Mimeo.
- Rafiquzzaman, Mohammed, and Lori Whewell. 1998. *Recent Jumps in Patenting Activities: Comparative Innovative Performance of Major Industrial Countries, Patterns and Explanations*. Industry Canada Research Publications Program, Working Paper No. 27. (December).
- Sakakibara, Mariko, and Lee G. Branstetter. 2001. "Do Stronger Patents Induce More Innovation? Evidence from the 1988 Japanese Patent Law Reforms." *RAND Journal of Economics* 32: 77-100.
- Schankerman, Mark. 1998. "How Valuable is Patent Protection: Estimates by Technology Field." *RAND Journal of Economics* 29: 77-107.
- Scherer, F.M., and Sandy Weisburst. 1995. "Economic Effects of Strengthening Pharmaceutical Patent Protection in Italy." *International Review of Industrial Property and Copyright Law* 6: 1009-1024.
- Scotchmer, Suzanne, and Jerry Green. 1990. "Novelty and Disclosure in Patent Law." *RAND Journal of Economics* 21, 1(Spring): 131-146.
- Smith, Pamela J. 1999. "Are Weak Patent Rights a Barrier to U.S. Exports?" *Journal of International Economics* 48: 151-177.
- Tepperman, Andrew. 2001a. "Do Priority and Disclosure Rules Matter? Canadian Evidence from the 1989 Patent Reform." University of Toronto. Mimeo.
- . 2001b. "Intellectual Property Rights in a Theory of the Firm." University of Toronto. Mimeo.

OTHER REFERENCE

- Arundel, Anthony. 2001. "The Relative Effectiveness of Patents and Secrecy for Appropriation." *Research Policy* 30: 611-624.



Do Intellectual Property Rights Stimulate R&D and Productivity Growth? Evidence from Cross-national and Manufacturing Industries Data

INTRODUCTION

THROUGH DOMESTIC AND INTERNATIONAL LEGISLATIVE REFORMS, various countries are adopting new and stronger intellectual property protections. Canada is among them. In recent years, Canada has undertaken (and is expected to undertake further) actions to revise its laws. For example, through Bill C-32, Canada has amended its *Copyright Act*, and through Bill S-17, it will update its *Patent Act* to conform with its obligations under the *Agreement on Trade-Related Aspects of Intellectual Property Rights* (TRIPs), of the World Trade Organization (WTO). Canada has also become a signatory to treaties of the World Intellectual Property Organization (WIPO), for example the *Copyright Treaty* and the *Performances and Phonograms Treaty* in 1997. More recently (in May 2001), Canada became a signatory to WIPO's *Patent Law Treaty* (PLT). Both the PLT and the TRIPs Agreement are major (and complementary) international initiatives. Whereas the TRIPs Agreement largely focuses on substantive laws, the PLT focuses mainly on procedural laws and formalities and seeks to simplify and harmonize administrative practices. Differences in these laws and practices across countries (or jurisdictions) are viewed as imposing significant *transaction costs* on inventors interested in obtaining global patent protection. In the future, further intellectual property (IP) reforms are expected in Canada in light of new technological developments (related, for example, to the Internet, telecommunications, software, biotechnology, etc.).¹

These changes in intellectual property laws come with some costs; for instance, *infrastructural* costs (of rewriting national laws and providing the means for enforcement and administration), static *deadweight* losses (in terms of the deviation of markets from competitive structures), and rent transfers (from consumers and rival producers to rights holders). Offsetting these costs, it is argued, are the benefits of IP reform — namely the stimulation of research and development (R&D), innovation, and ultimately productivity growth. In policy debates, arguments are often made that strengthening and clarifying intellectual property laws is vital to Canada's domestic economic progress and international competitiveness. It is also argued that these changes will help Canada become a major player in the emerging international digital economy.

However, outside of these debates, a severe shortage of evidence exists as to the effects of intellectual property rights (IPRs) on R&D and productivity growth, among other things. The purpose of this study, therefore, is to help enhance the debate by providing some quantitative estimates of the benefits of IP protection to national economies, such as Canada. The plan of the study is to examine the extent to which various kinds of IPRs can explain productivity growth, *directly* and *indirectly*. The different kinds of IPRs considered here include: patent rights, copyright, trade-mark rights, parallel import protection, software protection, prevention of piracy, and enforcement mechanisms (statutory and actual execution of laws).² These kinds of rights can impact on potential output *directly* by affecting the technical efficiency of production, or *indirectly* by stimulating factor accumulation (particularly R&D capital) by enhancing the returns to investment (or rather the *ability to appropriate* those returns). These two channels by which IPRs can affect productivity (technical efficiency of production and R&D accumulation) have been stressed in academic and policy debates. The institutionalists would emphasize the important role of the legal environment in which markets operate. The *new growth* and/or *knowledge-based economy* adherents would emphasize the role of R&D, inventions and technology as the primary *engines* of growth. The focus in the study is to develop quantitative measures of different kinds of IPRs and determine the extent to which technical efficiencies and R&D investments are functions of these different kinds of IPRs.

The outline of the study is as follows: the next section provides a brief literature review of the few studies that investigate the impact of IPRs on economic growth and R&D. The third section, entitled *Conceptual Framework*, develops a model of how IPRs may affect productivity growth directly and indirectly. It derives the empirical growth rate equation and R&D investment equation that will be estimated. The fourth section, entitled *IPR Indexes*, discusses indexes for the different kinds of IPRs. The fifth section, entitled *Data*, discusses two sample datasets: a national sample and a manufacturing industries sample. In both samples, the unit of analysis is the country. The sixth section,

entitled *Empirical Results*, presents the empirical results and discusses their implications for the Canadian macro-economy. The *Conclusion* summarizes the results of this study and suggests extensions for future work.

BRIEF LITERATURE REVIEW

CURRENTLY, THERE IS STILL QUITE A CONTROVERSY about whether IPRs matter for productivity growth, directly or indirectly. The theoretical literature is divided over the welfare and efficiency effects of stronger intellectual property regimes, and empirical works are few and far between. For example, in a theoretical study, Takalo and Kanninen (2000) find that a strengthening of patent rights can delay the introduction of new technology to the market (i.e. raises the value of waiting for the innovator). Bessen and Maskin (2000) develop a model of sequential and complementary innovation in which patent protection reduces innovation and social welfare. In an international (North-South) setting, Helpman (1993) argues that weak IPRs in the South may actually be welfare-enhancing for that region, while stronger IPRs in the South may not necessarily benefit the North (consumers, for example, would forgo the benefits of cheaper imitated imports). On the other hand, theoretical studies by Diwan and Rodrik (1991) and Taylor (1994) reveal that stronger IPRs may enhance global welfare and productivity.

Though not always explicit about it, a large number of theoretical studies on IPRs actually deal with patent rights and inventive activity. Landes and Posner (1987, 1989) provide a theoretical analysis of non-patent IPRs, such as trademarks and copyright. Essentially, trade-mark protection encourages economic efficiency by reducing search costs for consumers (allowing them to recognize quality products through symbols or names). Furthermore, firms or intellectual property owners invest in promotional expenditures to attract consumers, and in expenditures aimed at maintaining the quality of their products and services. If they were unable to link their investments and products to their trade-marks, they would have less incentive to invest in those quality-promoting investments. However, there are occasions where trade-mark protection can be too broad (e.g. when a name or symbol becomes generic) and would increase the cost of business for rival firms such that economic efficiency is harmed in the aggregate. Copyright over original and derivative works also stimulates creativity by increasing the odds of appropriating the benefits of the creations. Copyright can also complement other rights, such as patent rights, where the ideas are not protectable but the expression is — e.g. pure computer and mathematical algorithms. There may also be situations where stronger copyright may be adverse to economic efficiency — namely, where those rights reduce the incentive of rivals to create, or the owner's incentive to produce new creations. Each creator is part of an intertemporal chain of creators. Thus, stronger protection

of expressions affects subsequent generations of creators (who themselves would like to build on previous works).

In terms of empirical work, a survey by Levin, Klevorick, Nelson and Winter (1987) of U.S. firms finds that patent protection is not the most important means for firms to appropriate the returns to their R&D (as compared to lead time and reputation). Moreover, firms patent for reasons other than to protect their innovations (for example, to acquire strategic bargaining chips for cross-licensing negotiations). These findings suggest that patent rights are not very important to stimulate innovation. On the other hand, case studies conducted in developing countries indicate that IPRs are considered very important for innovation (see Sherwood, 1990). This suggests that the marginal value of patent rights (or IPRs) is higher in developing markets (where legal and other institutions are not as well developed and where, as a result, firms have few alternative means of appropriation, if any). Another interesting case study is that of Korenko (1999) who finds that, in Italy's pharmaceutical industry, a strengthening of local intellectual property rights helped expand domestic R&D and market share (rather than create a situation where foreign firms crowded out domestic).

As far as econometric evidence is concerned, two studies show that patent rights contribute to economic growth, but they emphasize different mechanisms. Gould and Gruben (1996) focus on how this effect depends on the degree of *openness* of countries in their external trading, while Park and Ginarte (1997) emphasize that patent rights stimulate factor accumulation (human capital, R&D capital, and physical capital) which, in turn, directly influences economic growth.

Few econometric works exist because, until recently, measures or indexes of patent rights have been limited. Moreover, because available IPR indexes relate exclusively to patent rights, empirical growth studies have not been able to assess the impact on growth of other kinds of IPRs, such as copyright and trade-marks. Thus, the present study develops and incorporates indexes of other types of IPRs and tests their role in explaining productivity growth.

In a related study, Siwek (2000) examines the importance of copyright industries for U.S. economic growth. Rather than using indexes of copyright protection, the author's strategy is to separate groups of IP-based industries (computer software, motion pictures, music, publications, etc.) from traditional manufacturing industries. The study finds that copyright industries account for 4.94 percent of U.S. gross domestic product (GDP) and that this share is growing fast. Copyright industries also account for 3.24 percent of all jobs and employment growth in this group is three times the national average. Two criticisms can be made: first, the study does not show how sensitive copyright industries are to copyright legislation and enforcement. Even if it may be presumed that copyright industries seek copyright protection, it would still be

useful to know to what degree. For example, what is the *elasticity* of demand for copyright protection with respect to the strength of protection? This is important for policy purposes if the objective of strengthening copyright protection is to stimulate the output of copyrightable works — which lead to increased productivity. A second related criticism is that the study does not explicitly show that copyright laws and enforcement are directly or indirectly responsible for the growth of IP-based industries (or of other industries).

CONCEPTUAL FRAMEWORK

IN THIS SECTION, TWO EQUATIONS ARE DERIVED for empirical estimation, the first to capture the direct effects of IPRs on productivity growth and the second to capture the indirect effects on growth via the effects of IPRs on R&D. The two equations are derived in turn.

PRODUCTIVITY GROWTH

THIS SUB-SECTION BUILDS ON MANKIW, ROMER AND WEIL (1992). Assume the following Cobb-Douglas production function:

$$(1) \quad Y = K^\alpha R^\beta (AL)^{1-\alpha-\beta},$$

where Y denotes output, K physical capital, R intangible (R&D) capital, and L labour. The technical efficiency of production is denoted by A , and is assumed to be a function of environmental and institutional factors. Holding other environmental and institutional factors constant, let

$$A = A(IPR) = a IPR^\gamma,$$

where IPR denotes intellectual property rights and γ the elasticity of technical efficiency with respect to the level of IPR .

Therefore:

$$(1)' \quad y = k^\alpha r^\beta (IPR)^{\gamma(1-\alpha-\beta)},$$

where $y = (Y/aL)$, $k = (K/aL)$, $r = (R/aL)$. That is, output and the reproducible inputs are expressed in terms of efficiency labour units.

Physical and R&D capital accumulation is given by:

$$(2) \quad \dot{K} = I_K - \delta K \quad \text{and}$$

$$(3) \quad \dot{R} = I_R - \delta R,$$

where I denotes investment and δ the geometric rate of depreciation. In efficiency units, the equations of motion are:

$$(2)' \quad \dot{k} = i_k - (n + g + \delta)k$$

$$(3)' \quad \dot{r} = i_r - (n + g + \delta)r,$$

where $g = \dot{a}/a$ and $n = \dot{L}/L$ are the rates of growth of technical efficiency and of the labour force, respectively. Let:

$$\begin{aligned} i_k &= s_k y \\ i_r &= s_r y, \end{aligned}$$

where s_k and s_r are the respective savings rates from output.

In the steady state,

$$(4)' \quad k^* = \frac{s_k y}{(n + g + \delta)}$$

$$(5)' \quad r^* = \frac{s_r y}{(n + g + \delta)}.$$

Substituting equations (4)' and (5)' into equation (1)', taking the logs of both sides and rearranging yields:

$$(6) \quad \ln y^* = \phi_1 \ln s_k + \phi_2 \ln s_r + \phi_3 \ln(n + g + \delta) + \gamma \ln IPR,$$

where $\phi_1 = \alpha/(1 - \alpha - \beta)$, $\phi_2 = \beta/(1 - \alpha - \beta)$, and $\phi_3 = -(\alpha + \beta)/(1 - \alpha - \beta)$.

While equation (6) gives the steady-state level of output, the dynamic behaviour of output can be derived from time-differentiating equation (1)' and linearizing around the steady state:³

$$(7) \quad \frac{d \ln y(t)}{dt} = -\lambda (\ln y(t) - \ln y^*),$$

where $\lambda = (1 - \alpha - \beta)(n + g + \delta)$.

Solving the differential equation (7) backwards to time 0 yields:

$$(8) \quad \Delta \ln y(t) = \ln y(t) - \ln y(0) = (1 - e^{-\lambda t}) (\ln y^* - \ln(y(0))).$$

Substituting equation (6) into equation (8), and using the definition of $y = Y/aL$, and assuming that $\ln a(0)$ is distributed randomly across countries (that is, $\ln a(0) = \text{constant } c + \text{error } \varepsilon$), yields the equation to be estimated:

$$(9) \quad \Delta \ln\left(\frac{Y(t)}{L(t)}\right) = c + \Omega_0 \ln\left(\frac{Y(0)}{L(0)}\right) + \Omega_1 \ln(s_k) + \Omega_2 \ln(s_r) \\ + \Omega_3 \ln(n + g + \delta) + \Omega_4 \ln(IPR) + \varepsilon$$

where $\Omega_0 = -(1 - e^{-\lambda t})$, $\Omega_1 = -\Omega_0 \phi_1$, $\Omega_2 = -\Omega_0 \phi_2$, $\Omega_3 = -\Omega_0 \phi_3$, and $\Omega_4 = -\Omega_0 \gamma$.

From estimates of the Ω s, the implied values of α , β and γ can be determined.⁴

R&D MODEL

THIS SUB-SECTION BUILDS ON LICHTENBERG (1987).⁵ First, the optimizing demand for R&D is characterized, and secondly, the optimizing supply of R&D. The two equations are then solved to obtain the equilibrium rate of R&D investment in the steady state.

On the demand side, it is assumed that there are many *identical* competitive firms that demand R&D output. Thus, in the aggregate, firms maximize the following function:⁶

$$(10) \quad \max_{\dot{R}, R} V = \int_t^\infty [Y(R, \dots) - p_R I_R] e^{-\int_t^s \rho_u du} ds,$$

subject to equation (3) above, where Y , as before, denotes output, R the stock of R&D capital, V the firm value, ρ the real interest rate, and p_R the price of R&D capital. The necessary condition for value maximization is:

$$\frac{\partial Y}{\partial R} = (\rho + \delta) p_R - \dot{p}_R.$$

This is the standard condition where the marginal product of R&D capital appears on the left-hand side, while the user cost of R&D capital is on the right-hand side.

In the steady state,

$$(11) \quad p_R = \frac{\frac{\partial Y^*}{\partial R^*}}{\rho + \delta}.$$

On the supply side, it is also assumed that there are many identical competitive firms. In the aggregate, firms choose the quantity of R&D output, I_R , to maximize the present discounted flow of profits:⁷

$$(12) \quad \max_{I_R} \Pi = \int_t^\infty [\theta p_R I_R - c(I_R, R)] e^{-\int_t^s \rho_u du} ds,$$

where θ is a measure of the appropriability (of revenues or sales of R&D output, given by $p_R I_R$). In the absence of imitation, $\theta = 1$; under perfect imitation, $\theta = 0$. It is assumed that $\theta = \theta(IPR)$.

In equation (12), $c(I_R, R)$ is the cost function for R&D output. The cost of producing R&D output depends positively on the quantity of output produced, I_R , and negatively on the stock of existing R&D knowledge capital, R . That is, the past stock of R&D capital generates intertemporal externalities.⁸ As to how firms treat these externalities, there are two possibilities: if firms are small, it would be reasonable to assume that they would treat nationwide (or sector-wide) R as given. However, if they are sufficiently large, they would likely take into account the contribution of R&D output to future cost reductions. For now, it will be assumed that R&D producers are sufficiently small. This would be consistent with the assumption that they also treat p_R as given. It is assumed that $c_1 > 0$, $c_{11} > 0$, $c_2 < 0$, $c_{22} > 0$, and $c_{12} < 0$.

The necessary condition for profit maximization is:

$$(13) \quad p_R = \frac{1}{\theta} \frac{\partial c}{\partial I_R},$$

which holds for each period. Combining equation (13) with the demand-side condition of equation (11) yields, in the steady state:

$$(14) \quad \frac{\partial c}{\partial I_R} = \frac{\theta \left(\frac{\partial Y^*}{\partial R^*} \right)}{\rho + \delta},$$

where the left-hand side represents the marginal cost of producing R&D and the right-hand side represents the discounted marginal return to R&D (adjusted for the degree of appropriability).

$c(I_R, R)$ will be specified as a Cobb-Douglas function:

$$(15) \quad c(I_R, R) = \Psi I_R^{\sigma_1} R^{-\sigma_2},$$

where Ψ is a parameter. Note that when $\sigma_1 - \sigma_2 = 1$, the R&D cost function exhibits *constant* returns to scale. This specification addresses an aggregation matter: the marginal cost of R&D ($\partial c / \partial I_R$) in equation (14) is *independent* of the number of firms. Moreover, as long as the ratio of gross R&D investment to R&D stock (I_R/R) is the same across countries or sectors, the cost of R&D production per stock of R&D is the same as well. In preliminary analyses, the assumption that $\sigma_1 - \sigma_2 = 1$ could not be rejected in the data.

From equation (15), the partial derivative $\partial c / \partial I_R$ can be calculated, and from equation (1), $\partial Y^* / \partial R^* = \beta Y^* / R^*$. Substituting these expressions into equation (14) yields:

$$(16) \quad \left(\frac{I_R}{Y}\right)^{\sigma_1-1} = \frac{\beta \theta (IPR)}{\sigma_1 \Psi (\rho + \delta)} \left(\frac{R}{Y}\right)^{\sigma_2-1}.$$

Let $\theta(IPR) = \theta_0 IPR^\mu$. Substituting this into equation (16), taking logs of both sides and rearranging yields:

$$(17) \quad \ln(s_r) = \eta_0 + \eta_1 \ln(R_Y) + \eta_2 \ln(IPR) + \varepsilon,$$

where

$$\eta_0 = \log [\beta \theta_0 / (\sigma_1 \Psi (\rho + \delta))] = \text{constant}$$

$$\eta_1 = (\sigma_2 - 1) / (\sigma_1 - 1)$$

$$\eta_2 = \mu / (\sigma_1 - 1)$$

and where s_r is the ratio of R&D to output (as defined earlier) and R_Y is the ratio of the stock of R&D to output. The error term reflects random disturbances in the R&D investment rate and deviations from the steady-state conditions which yielded this equation.

Equation (17) is the basic R&D equation to be estimated in the empirical section. Note that some parameter restrictions can be formulated. First, in order for the R&D cost function to exhibit the property of being increasing in I_R (at an increasing rate), it is necessary that $\sigma_1 > 1$. Secondly, if this function is

decreasing in R , it is necessary that $\sigma_2 > 0$. Thirdly, if the cost function exhibits constant returns to scale in I_R and R (i.e. $\sigma_1 - \sigma_2 = 1$), then these restrictions altogether imply that $\eta_1 < 1$. If the intertemporal externality effect is not very large, it is also possible that $\eta_1 < 0$. The reason is that in general, an increase in the stock of R&D knowledge, R , has ambiguous effects on R&D investment. On the one hand, a higher stock of R reduces the cost of producing each unit of R&D output; on the other hand, it reduces the marginal productivity of R&D capital (and reduces the market's demand for R&D output). If $\sigma_2 < 1$, the cost reduction effect will not outweigh the reduction in marginal productivity. From estimates of η_1 and η_2 , the implied values of σ_1 , σ_2 , and μ can then be obtained.⁹

IPR INDEXES

THIS SECTION DESCRIBES THE VARIOUS INDEXES of intellectual property rights used in the study. In total, eight different kinds of indexes are used. Three of them cover standard statutory rights: patent rights, copyright and trade-mark rights. Two of them deal with aspects of IPRs that have been the subject of much recent policy debate: software protection and parallel import protection. Finally, the remaining three examine different aspects of IP enforcement; for example, piracy rates (which tend to be high in regions where enforcement is lax or ineffective), enforcement mechanisms and enforcement in practice.

PRELIMINARY REMARKS

MULTIPLE INDEXES OF IPRS ARE EXAMINED in order to get a broad perspective on the state of IP rights in a country. Individual intellectual property owners (or potential owners) may be heterogeneous as to what kinds of IPRs they value. By way of analogy, consider the surveys that rank cities according to quality of residential life (surveys on best places to live). What do people look for in a city: school quality, low crime, low taxes, scenic views, quality of air? How do people rank these different characteristics? Obviously, residents would want all of these good characteristics, but how would they prioritize them? What weights would they attach to the different characteristics? Likewise, what do inventors, artists, writers, producers, etc., look for? Ease of application, no compulsory licensing, no working requirements, strong penalties for infringement, expansion of rights into new areas (software, biotechnology, Internet commerce, folk dances, etc.)? Again, how would they prioritize and weight different IP law features? Of course, a major difference between rating IP systems and rating cities is that, in the latter, the surveys are attempting to measure something about *quality*. The rating of IP systems, in contrast, is not about

measuring the quality of IP regimes, but rather their *strength*. It is not for instance attempting to determine the *optimal* level of protection. The optimal level need not be the one associated with maximal strength. Quality and strength may go together, but they are distinct. Issues of quality would deal with equity of rights (between different intellectual property owners, and between them and non-owners) the effect on welfare and economic efficiency. The indexes here measure how these regimes protect the rights of intellectual property owners.¹⁰ The empirical section then determines whether certain efficiency factors (like productivity and innovation) are influenced by the strength of those IP rights.

Another important remark is that the indexes largely measure statutory levels of protection (the laws on the books) rather than actual practice, although this study does incorporate a few variables that help to assess actual enforcement of laws. Nonetheless, a common concern is that IP indexes only measure perceived protection — not real protection. However, as will be discussed later, the correlation between statutory protection and actual enforcement, while not perfect, tends to be high. Countries that have strong laws on the books tend to be the ones that also enforce their laws. Moreover, enforcement aside, statutes can play a role. For instance, empirical results will show that even perceived (statutory) protection has real effects. This might be due to, among other things, a *signalling* effect. The laws on the books may affect agents' expectations or confidence levels, and thus influence their investment and other decisions.

Related to the issue about perceived vs. actual protection is the practice of judging the accuracy of index values according to certain a priori views. Of course, it is useful to incorporate information based on experiences and expert opinion. Indexes and expert opinion should be viewed not as substitutes but as complements. However, a common pitfall is to judge whether a country's IP index value is too low or too high according to the country's level of economic development, the prior assumption being that richer countries should have stronger levels of IP protection. In general this is the case, but there are instances where it is not (some rich countries have weak IP systems, while some poor countries have strong systems). In such cases, other factors are not held constant (for example, richer economies with weak IP systems may have good educational systems to compensate, or poorer economies with strong IP systems may follow poor fiscal and monetary policies which offset the effects of IPRs). In all cases, it should be understood that IPR indexes are not measures of economic development. They may be important determinants of development, but are not themselves indicators of it. The approach in constructing these IP indexes should be to let the chips fall where they may, with minimal (if any) reliance upon a priori views about the economic consequences of IPRs.

Legal features are chosen to measure the strength of intellectual property regimes. If there is ambiguity or uncertainty as to whether a feature contributes to the strength of IP rights, it is not incorporated (for example, priority rules: first-to-file vs. first-to-invent). Another guiding principle in choosing legal features is not to be exhaustive but selective: that is, to choose those legal features that yield maximum variability across countries.¹¹ Furthermore, the information has to be widely available across countries.¹²

OVERVIEW

THE EIGHT MEASURES OF IPRS considered in this study cover the gamut of statutory and enforcement provisions, piracy and enforcement experiences.

For each of the three basic IP instruments (patents, copyright and trade-marks), the index consists of four sub-categories: coverage, duration, restrictions and membership in international treaties. Enforcement can also be included as a sub-category (as in Ginarte and Park, 1997). However, since the enforcement provisions are available for the enforcement of all three types of rights (patents, copyright and trade-marks), it would be useful to separate it out and treat it as a distinct index.

Coverage refers to the subject material (type of invention, expression, or symbol) that can be protected; duration refers to the length of protection; restrictions refer to the less than exclusive use of those rights; membership in international treaties indicates the adoption into national law of certain substantive and procedural laws of these international agreements. Note that, for signatory nations, there may be some *double-counting* in that a nation gets credit for having certain legal features in national law, but those features may be part of an international law treaty to which the nation is a signatory and for which the nation already gets credit for being a member of that particular treaty. However, membership in an international treaty in and of itself provides some value-added information, particularly about the willingness of particular nations to adhere to shared international principles such as non-discrimination.

The following sub-section provides further details about each of the measures of IP protection. The acronym to be used in the empirical section is given in parentheses. Appendix 1 provides a quick summary of the legal features included in each type of IPR index and of how the indexes are scored.

DESCRIPTION OF INDEXES

Patent Rights (*Pat4*)

The measure of patent rights is taken from Ginarte and Park (1997) and Park and Wagh (2002).¹³ The index of patent rights ranges from 0 (weakest) to 4 (strongest). The value of the index is obtained by aggregating four

sub-indexes: extent of coverage, membership in international treaties, duration of protection and absence of restrictions on rights (such as compulsory licensing).

The numerical value of each sub-index ranges from 0 to 1 and indicates the fraction of legal features in that sub-index available in the particular country. For example, a value of 0.33 for membership in international treaties indicates that a country is a signatory to one-third of the international treaties listed under that sub-index. A value of 0.5 for duration implies that a country grants protection for half the international standard time (of 20 years from the date of application or 17 years from the date of grant). The value for coverage indicates the fraction of invention classes the country allows as patentable subject matter. Finally, several conditions exist under which authorities can revoke or restrict patent rights. The value for the restrictions category indicates the fraction of those restrictions which are not exercised in the country.

Copyright (Copyrig)

This index varies also from 0 to 4. Each of its four categories is scored out of one. The score is again the fraction of features that are available. The *coverage* category includes works that are among the primary victims of piracy, such as literary, dramatic, artistic, musical, cinematographic works, etc. The duration of protection is based on an international standard of 50 years. Note that countries may provide different lengths of protection for different types of copyrightable works. The duration score for each of these types of works is the ratio of its statutory duration to 50 years. If more than 50 years of protection is provided, the maximum score of 1 is given. The country's overall duration score is the average of the duration scores of the different types of copyrightable works.

The restrictions category includes rights to resale (*droit de suite*), which permit the copyright owner to share in a percentage of all subsequent sales of her work, thus enabling her to benefit from any appreciation in the value of her creations. It also covers extended collective licensing schemes. Collective licensing societies are organizations of authors and performers. These societies are somewhat common in Europe. Their extended licensing schemes are deemed to weaken copyright since they can at times interfere with the freedom of contract of individual rights holders (see Campbell and Cotter, 1997); moreover, the licensing schemes may typically permit more liberal reproduction of works by photocopy or by broadcasting. For instance, organizations that obtain authorization from a collecting society to photocopy some author's work may in some cases be entitled to photocopy that author's published works in the same field not represented by the collective society. Also, authorization to record works in a broadcast may also include authorization to record works of non-represented rights holders that happen to be in the same broadcast.

The copyright restrictions category also incorporates compulsory licensing. One kind of compulsory licensing is for private use and another is for government use. Private individuals may apply for a compulsory licence in some jurisdictions if (typically) a foreign work is not available locally after it has been published elsewhere for some specified period of time (e.g. six months or a year). Some countries provide explicitly for compulsory licensing (e.g. the United States for satellite broadcasting) and mechanical licensing (for musical works, etc.). These are treated as private use. Government use (e.g. by a ministry of culture) is typically for educational purposes, local technological development or judicial and administrative uses (such as proof in legal proceedings).

Major international copyright treaties include the Berne Convention, the Rome Treaty, the Universal Copyright Convention (UCC) and the Phonogram Convention. The Berne Convention is the oldest international copyright treaty, providing for effective and uniform global protection. The basic underlying principles are national treatment, automatic protection and independence of protection (independent of whether protection exists in the country of origin of the work). The Rome Treaty offers protection for *neighbouring rights* (rights of performers). The UCC provides minimum legal obligations for each contracting state, emphasizing rights and protections that ensure an author's economic interest. The Phonogram Convention focuses on strengthening rights of producers of phonograms (given the increased piracy of records and tapes, at the time of its signing). This convention, unlike the Rome Treaty, does not provide substantive rights; as long as phonograms are protected, the mode of protection is left to domestic law (see Leaffler, 1997, p. 451).

Trade-marks (*Tmark*)

The trade-mark index also varies from 0 to 4. It is the sum of scores from four categories (again coverage, duration, restrictions and membership in international treaties). Each category is scored out of 1 (indicating the fraction of available provisions). The coverage category lists three types of marks: service marks, certification marks and collective marks.¹⁴ Countries vary as to whether these types of marks can be granted trade-mark protection. Service marks are words, names, symbols or devices that identify services. Certification marks are words, names, symbols or devices that certify the origin (region) of particular types of goods, such as *champagne*. These marks help identify the type of product. Collective marks identify trade associations or membership in some cooperative or other organization. The association (or its independent members) may be responsible for some product(s). The collective mark should tie the product(s) to the reputation of the collective.

As for the duration of trade-mark protection, the international norm is 10 years. Again, the duration score is the ratio of the statutory length of

protection to ten years; if the statutory length exceeds 10 years, the maximum score of 1 is given. The restrictions category indicates whether countries require proof of use at the time of trade-mark rights renewal (e.g. demonstrate commercial use); whether there are linking requirements (e.g. linking foreign trade-marks to a locally-owned firm); whether there are licensing restrictions (on royalties, technology transfer agreements); and whether there are conditions for the protection of well-known marks (e.g. that they be used in the local economy).

The international treaties category includes three major treaties: the Madrid Agreement, which governs the international registration of marks. It does not protect any trade-mark rights but facilitates their acquisition in member states. The Nice Agreement governs the international classification of goods and services for the purposes of registering trade-marks. Official documents and publications refer to these classes. However, countries can use this international classification as their principal system of classification or alongside their own national classification system. The Paris Convention also contains provisions on trade-mark rights. They deal with the use of registered marks and of well-known marks.

Parallel Import Protection (*Parallel*)

Parallel imports refer to the importation of legally manufactured products by agents other than those who have exclusive distribution rights. The right to prevent parallel imports is essentially the international equivalent, or extension, of domestic vertical restrictions. Domestically, wholesalers may grant retailers exclusive dealerships to help solve free-rider problems (whereby other distributors, such as parallel traders, free ride on the promotion and other marketing activities of authorized dealers).¹⁵

Countries also vary in how they treat parallel importation. Under a national exhaustion system, parallel imports are not permitted; under an international exhaustion system, they are. Under a regional system, parallel importing is permitted within the region, but it is not permitted from outside the region. Based on these different policy regimes, the International Intellectual Property Alliance (1998) has undertaken a survey of whether IPR owners can be protected against parallel imports. This index has three values: 1 if yes, 0 if no; 0.5 if probably yes.

Software Rights (*Software*)

In light of the prominent developments in the computer industry (particularly software) and the related impact on economies, it would be useful to incorporate the effects of software protection. The above measures do not explicitly, if at all, incorporate computer software in their coverage categories. A separate

index would be required. Software protection is available in several forms, depending on whether it is the idea (technical effect) or expression for which protection is sought. Agents can thus use patents or copyright, or a combination of them. Software can also be protected under existing trade secret laws. Hence, this index is the sum of three components: trade secrecy, copyright and patents. Each of these components gets a score: 1 if such protection is available, 0 otherwise. In the case of software patentability and software copyrightability, a score of 0.5 is given if the protection is possibly available but is not clear from existing statutes. In total, this *Software* index varies from 0 to 3.

Piracy Rates (*Piracy*)

Software laws may look good on the books, but in practice piracy may be rampant. Piracy may be rampant because laws do not exist and/or are not effectively enforced. But piracy occurs even in systems where laws exist and are enforced. That is, holding laws and enforcement constant, piracy may rise because agents become more adept at copying — they are better educated or have access to better technology (e.g. digital reproductive technologies or exchange mechanisms such as *Napster*). Like lax laws and enforcement, these copying skills provide greater opportunities for piracy, which all together determine the equilibrium level of piracy. But as a *complement* to the statutory provisions (in the *Software* index), it would be useful to look at measured rates of piracy. The idea is that piracy would be more prevalent in regimes where the laws are not very effectively enforced (if at all, since copying may even be encouraged or tolerated by policy authorities), but subject to the understanding that piracy in and of itself is not a measure of the lack of law enforcement.¹⁶

Enforcement Provisions (*Enf-GP*)

This index is the fifth component in the Ginarte and Park (1997) index of patent rights, separate from the rest of the components. In this category, the selected conditions are the availability of: *preliminary injunctions*, *contributory infringement pleadings* and *burden-of-proof reversals*. A country that provides all three receives a value of 1 for this category. While litigation, arbitration and settlement comprise different enforcement routes should infringement occur, patent holders may have recourse to a number of statutory provisions that can aid in enforcement. Preliminary injunctions, for example, are pre-trial actions that require the accused infringer to cease the production or use of the patented product or process during the trial. Preliminary injunctions are a means of protecting the patentee from infringement until a final decision is made in a trial. Contributory infringement refers to actions that do not in themselves infringe a patent right but cause or otherwise result in infringement by others. Thus, contributory infringement permits third parties to also be liable if they

contribute negligently to the infringement. Burden-of-proof reversals put the onus on the accused to prove innocence. Given the difficulty IP owners may have to prove that others are infringing on their ideas, expressions or symbols, shifting the burden of proof can be a powerful enforcement mechanism.

Enforcement in Practice (*Enf-USTR*)

At present, no scientifically conducted studies have been done on how laws are actually enforced in practice. The closest available are reports filed with the United States Trade Representative (USTR) concerning intellectual property enforcement in various countries. A major limitation is that these reports are biased towards the views of U.S. firms (of what constitutes effective and adequate enforcement). Another limitation is that some complainants may have ulterior motives for filing complaints; for example, to seek assistance in penetrating foreign markets because they are not able to compete against local firms on price, product quality or some other factor alone. A third limitation is that because the reports are descriptive and qualitative in nature, any attempt to construct quantitative indexes based on them is likely to depend subjectively on the author's interpretation of the nature of complaints.

On the other hand, having no measure at all of enforcement in practice would be a serious omission. Thus, notwithstanding these limitations, an index is developed to reflect the experience of IP enforcement as documented in these reports (see USTR, *National Trade Estimates*). It can then be compared to, and used in conjunction with, the other, largely statutory, IP indexes.

The index focuses on the execution of laws. Laws may be ineffectively implemented: i) because of a *lack of willingness* on the part of policy authorities to provide or enforce them (because, for whatever reason, they do not agree with a strong intellectual property policy), or ii) because of a *lack of capacity* to enforce laws effectively. This may arise because of a lack of resources, training and experience.

As was discussed earlier for the *Piracy* index, IP violations occur not only because of weak laws and enforcement, but also because imitators or infringers are very capable of copying. Therefore, it is important to control for the capacity of a nation's "imitative" sector to make copies. In nations where the capacity for imitation is low, weak enforcement may not be an important factor for innovators. The weak imitation capacity itself acts as a protection against such practice. On the other hand, even if strong laws exist (on the books) and enforcement is strong (that is, the authorities are both willing and able to protect rights), there will always be some infringement (even in regions where IP laws and rights are strong, such as in the United States). Thus, the level of infringement activity is not, in and of itself, a good indicator of whether laws are lax or ineffective, particularly if the laws exist and the court system enforces

them (in which case the system is working well). While lax laws and poor enforcement do contribute to IP infringement, there are other factors driving IP infringement activity [including the capacity for imitation, such as the level of technology (for copying) and the quantity of innovations and creations].

Thus, for purposes of this index (which attempts to measure the actual enforcement of IP laws), the focus will be on how authorities enforce or carry out the laws in practice — not on the actual extent of infringement activity. This particular index looks first at whether enforcement mechanisms are available or adequate; secondly, whether laws are enforced; and thirdly, how effectively. For instance, if enforcement measures are not available or inadequate, the enforcement of laws will not be effective. Thus, countries in this situation would score 0. Countries would also score 0 if they have the enforcement mechanisms, but are not applying their laws (as a policy choice or because certain other policy choices make enforcement ineffective, such as weak fines or sentences). However, if countries are deemed to be enforcing the laws, but not effectively because of barriers to enforcement (e.g. resource constraints) or delays in policy implementation (that is, an intellectual property law goes into effect six months or a year later), they would score 0.5. Essentially, countries should score a half point if they are trying to enforce the laws (but are less successful because their capacity to enforce needs to be strengthened). Countries without enforcement problems would score 1. Note that complaints about the lack of laws (other than enforcement provisions) are not counted in this index since the previous indexes (*Pat4*, *Copyrig*, *Tmark*, etc.) already incorporated information about the absence of laws.

SAMPLE STATISTICS

TABLE 1 SHOWS THE VALUES of the various indexes by country, for roughly the period 1987-94. Thus, the TRIPs provisions are not incorporated.

The mean patent rights score is 2.51 (with a coefficient of variation of 0.27). The mean level for copyright and trade-marks is 2.89 and 2.88, respectively (with coefficients of variation of 0.17 and 0.24, respectively). The country with the strongest measured patent rights is the United States (with a level of 3.69), while the weakest is Venezuela (with a score of 1.13). Canada's patent rights level is average, with a score of 2.50. For copyright, the country with the strongest measured regime is France (score of 4.00) and the weakest is Singapore. Canada's copyright level of 2.96 is slightly above the average (of 2.89). For trade-marks, the countries with strongest measured regime are France, Switzerland and the United Kingdom (with scores of 4.00), while the weakest are Mauritius and India (with scores of 1.28). Canada's trade-mark level of 3.08 is also slightly above the average (2.88).

TABLE 1

INTELLECTUAL PROPERTY RIGHTS, VARIOUS MEASURES

	PAT4	COPYRIG	TMARK	PARALLEL	SOFT-WARE	PIRACY	ENF-GP	ENF-USTR	MANUF. SAMPLE
Australia	2.59	2.87	3.08	0.50	2.50	34.00	1.00	1.00	Yes
Austria	3.40	3.33	3.42	0.50	2.00	44.00	1.00	1.00	Yes
Belgium	2.90	3.50	3.67	0.50	1.50	44.00	1.00	0.50	Yes
Brazil	1.78	2.93	2.42	0.00	2.00	70.00	0.67	0.00	
Canada	2.50	2.96	3.08	1.00	3.00	43.00	0.67	1.00	Yes
Chile	2.41	2.50	2.17	0.00	1.50	65.00	0.33	0.00	
Colombia	1.18	2.75	2.50	0.00	1.50	72.00	0.67	0.00	
Denmark	3.31	3.67	3.67	0.50	2.50	41.00	0.67	1.00	Yes
Egypt	1.66	2.17	2.83	1.00	2.00	85.00	0.33	0.00	
Finland	2.57	3.28	3.67	0.50	2.50	46.00	1.00	1.00	Yes
France	2.97	4.00	4.00	1.00	2.50	48.00	1.00	1.00	Yes
Germany	2.79	3.54	3.17	1.00	3.00	40.00	1.00	1.00	Yes
Greece	1.82	3.10	2.83	1.00	2.00	81.00	0.67	0.50	Yes
India	1.16	2.75	1.28	0.50	2.00	76.00	0.33	0.00	
Ireland	3.16	2.88	2.70	1.00	2.50	70.00	0.00	0.50	
Israel	2.90	2.45	3.12	0.00	2.00	69.00	0.67	0.50	
Italy	3.12	3.42	3.42	1.00	2.50	57.00	1.00	0.50	Yes
Japan	2.94	3.10	2.50	0.50	3.00	49.00	1.00	1.00	Yes
Kenya	2.07	2.63	2.53	0.00	0.50	78.00	0.67	0.00	
Korea	3.07	2.80	2.25	0.50	3.00	72.00	1.00	0.50	Yes
Mauritius	2.56	2.07	1.28	0.00	0.50	86.00	0.33		
Mexico	1.91	2.66	2.00	0.00	2.00	70.00	0.33	0.00	Yes
Netherlands	3.31	3.10	3.67	0.50	2.50	57.00	1.00	1.00	Yes
New Zealand	2.92	2.82	2.45	0.00	2.50	38.00	0.67	1.00	Yes
Norway	2.93	3.00	3.42	1.00	2.50	52.00	0.67	1.00	Yes
Pakistan	1.99	2.43	1.78	0.00	0.50	92.00	0.00	0.00	
Peru	1.53	2.70	2.50	0.00	2.00	78.00	0.33	0.00	
Philippines	2.66	2.68	2.50	0.00	1.50	90.00	0.00	0.00	
Portugal	2.15	3.50	3.67	0.50	1.50	58.00	0.33	0.50	Yes
Singapore	2.57	1.93	2.50	0.00	2.50	57.00	0.67	0.00	
South Africa	2.90	2.03	2.75	0.50	2.00	55.00	0.67	0.00	
Spain	2.83	3.65	3.75	1.00	2.50	69.00	1.00	0.50	Yes
Sri Lanka	2.79	2.40	2.50	0.50	1.50		0.33		
Sweden	3.07	3.67	3.67	0.50	3.00	50.00	1.00	1.00	Yes
Switzerland	3.19	3.03	4.00	0.50	2.00	42.00	0.67	1.00	
Thailand	1.38	2.18	2.75	0.00	1.00	83.00	0.67	0.00	
Turkey	1.79	2.42	2.75	1.00	1.00	87.00	0.00	0.00	
United Kingdom	3.24	3.47	4.00	1.00	3.00	36.00	0.33	1.00	Yes
United States	3.69	3.35	3.17	1.00	3.00	28.00	1.00	1.00	Yes
Uruguay	2.10	2.55	2.67	0.00	1.50	81.00	0.33		
Venezuela	1.13	2.12	1.92	0.00	2.00	70.00	1.00	0.00	

TABLE 1 (CONT'D)

INTELLECTUAL PROPERTY RIGHTS, VARIOUS MEASURES

	PAT4	COPYRIG	TMARK	PARALLEL	SOFT- WARE	PIRACY	ENF- GP	ENF- USTR	MANUF. SAMPLE
Mean	2.51	2.89	2.88	0.46	2.06	61.58	0.63	0.50	
Standard Deviation	0.67	0.51	0.70	0.40	0.70	17.59	0.33	0.44	
Minimum	1.13	1.93	1.28	0.00	0.50	28.00	0.00	0.00	
Maximum	3.69	4.00	4.00	1.00	3.00	92.00	1.00	1.00	
Notes: <i>Pat4</i> is an index of patent rights (without an enforcement component). <i>Copyrig</i> and <i>Tmark</i> are indexes of copyright and trade-mark rights. <i>Parallel</i> is an index of parallel import protection. <i>Software</i> is an index of software intellectual property rights. <i>Piracy</i> refers to the percentage of software piracy. <i>Enf-GP</i> is the enforcement component of the Ginarte and Park (1997) patent index. <i>Enf-USTR</i> is a qualitative index of effective enforcement based on reports to the USTR. <i>Manuf. Sample</i> indicates that the country is both in the national sample and in the manufacturing industries sample.									

As for parallel import protection, 12 out of 41 countries provide measures (including Canada), 15 do not, while the rest provide uncertain or partial protection. As for software protection, 7 countries provide measures (trade secrecy, patents and copyright): Canada, Germany, Japan, Korea, Sweden, the United Kingdom and the United States. Thailand and Turkey provide the weakest level of protection in this regard. Most are providing some protection, but not completely or certainly. Piracy rates average about 62 percent. The lowest rate is in the United States (28 percent) and the highest in Pakistan (92 percent) followed by the Philippines, Turkey, Mauritius and Egypt. Canada's is among the lowest (with a piracy rate of 43 percent).

On measures of enforcement, the *Enf-GP* index, indicates that countries are about evenly dispersed in terms of those that have full protection (1.00), near full protection (0.67), near incomplete (0.33), and incomplete (0.00). The *Enf-USTR* index indicates that 15 out of 38 countries score high on enforcement experiences [largely the Organisation for Economic Co-operation and Development (OECD) countries], 8 countries have a medium score and 15 have a low score. The latter tend to be the less developed economies. Canada's level of enforcement in practice is rated very good (*Enf-USTR* score of 1.00) while its statutory level is near full protection (*Enf-GP* of 0.67). A comparison of *Enf-GP* and *Enf-USTR* can show where statutory levels and perceived experiences differ; for example, Kenya and Brazil score relatively high on statutory provisions but low on practice. The United Kingdom does the opposite: score low on statutory protection, but high on experience. The United Kingdom (during this sample period) did not provide preliminary injunctions and burden-of-proof reversals. Ireland also scores low statutorily, but it rates high on actual enforcement experience. Overall, there are more overestimates (19)

than underestimates (10), where overestimate means that the *Enf-GP* score exceeds the *Enf-USTR* score. As the next section shows, the raw correlation between the two is 0.531 in one sample and 0.321 in another (consisting primarily of OECD economies).

As the next section also explains, the two different samples employed in the empirical analysis are a cross-country macro-economy sample and a cross-country manufacturing industries sample. The far-right column of Table 1 indicates whether a country is in both samples.

DATA

TWO DATASETS ARE USED to examine the role of IPRs in productivity growth and R&D activities. Each has advantages and disadvantages. The main advantage of the national (macro-economy) sample is that it has more countries. But the disadvantage is that it averages across industries in each country, thus suppressing sectoral variations. The manufacturing sample allows for sectoral variations to be reflected, but it does not have as much cross-country variation. Fewer countries are in this sample because detailed manufacturing data are only available for a subset of the national sample.

In order to facilitate the description of the data, let:

Y : Output

L : Labour (or number of workers)

YL : Output per Worker

$\Delta \ln(YL) = \ln(YL_{1995}) - \ln(YL_{1980})$: Long-term Growth Rate

$s_K = (I_K/Y)$: Physical Capital Investment per Output

$s_R = I_R/Y$: R&D Capital Investment per Output

R : Stock of R&D Capital

$n = \dot{L}/L$: Growth Rate of Labour.

The stock of R&D capital is obtained as follows:

$$(18) \quad R(t) = I_R(t) + (1 - \delta) R(t - 1)$$

$$(19) \quad R(0) = \left(\frac{1 + \iota}{\iota + \delta} \right) I_R(0).$$

The initial stock, $R(0)$, is obtained by backward recursive substitution of equation (18), where ι is an historical average of the growth rate of investment [$1 + \iota(t) = I_R(t)/I_R(t - 1)$].¹⁷ A 10-percent geometric depreciation rate is assumed.

NATIONAL SAMPLE

IN THIS SAMPLE, there are 41 nations (as listed in Table 1). The measure of output (Y) is GDP. Data on GDP, number of workers (L), and investment rates (I_K) are taken from the *Penn World Tables* (Version 5.6a). The data are already in real 1985 U.S. dollars (at purchasing power parity) and go up to 1992. For 1995 data, the World Bank *Development Indicators* were used to update the investment rates, number of workers and GDP.¹⁸ The R&D data (s_R) are from the various issues of the UNESCO's *Statistical Yearbook*.

To obtain the stock of R&D, the flows of R&D investment were first derived (by multiplying the s_R figures by the GDP), and then the perpetual inventory method, using equations (18) and (19), was applied.

MANUFACTURING SAMPLE

THIS SAMPLE CONSISTS OF 21 COUNTRIES and 18 manufacturing industries. Appendix 2 provides a list of these industries. The manufacturing production and investment data are from the OECD STAN database. For each industry, the output measure refers to production, the labour measure refers to the number of employees, and the physical capital investment rate refers to the ratio of investment to production. The output data are in real 1990 U.S. dollars at purchasing power parity. The exchange rate data are taken from the STAN database. Deflators can be derived from real and nominal value-added figures; however, deflator data are still missing for some countries, in which case GDP deflators from the International Monetary Fund's *International Financial Statistics* were used as a replacement.

The R&D data are from the OECD's *Basic Science and Technology Indicators* (1997 edition). The industry-by-industry R&D figures are called the BERD (Business Enterprise Research & Development) data. Here, s_R is the ratio of privately funded BERD to production, while s_G is the ratio of publicly funded BERD to production. Appendix 2 also indicates how the BERD sectoral codes match with the sectoral codes used in the STAN database.

SAMPLE STATISTICS

TABLE 2 SHOWS SAMPLE STATISTICS for the national sample over the period 1980-95. Part A presents basic descriptive measures. The long-term growth rate varies from -0.388 (Peru) to 0.989 (Korea). GDP per worker is highest in the United States (\$38,554) and lowest in Kenya (\$1,905). The United States has the highest R&D investment rate and largest stock of R&D capital. Uruguay has the lowest R&D investment rate and lowest stock of R&D capital. The highest rate of physical capital investment is undertaken by Singapore and the lowest by Egypt. Canada's GDP per worker is the second highest in this

sample (\$37,157), but its national R&D investment rate (1.55 percent) is the 13th highest. Within the OECD, Canada's R&D investment rate is 11th out of 21 countries. The disparity between Canada's relatively high GDP per worker and medium rate of R&D can be reconciled by the fact that GDP per worker captures both relatively recent developments (occurring at about the time of the 1980-95 sample period) as well as longer term (historical) factors. For instance, Canada enjoys a high level of institutional development (that has been attained and maintained for a relatively long period of time), which other economies do not enjoy, or have not enjoyed, to the same extent. There are also offsetting factors in Canada that can compensate for relatively average R&D investment rates and thereby contribute to a relatively high level of GDP per worker (such as high human capital, open trade, and a large capital stock per worker). Thus, these factors need to be taken into account when trying to understand why Canada's GDP per worker is fairly high despite the fact that the country has quite average levels of intellectual property protection and R&D investment rates (compared to other countries). Moreover, as will be discussed in the next section, Canada's productivity performance is somewhat weaker when looking at data on manufacturing GDP (instead of overall, aggregate GDP). Among OECD economies, Canada ranks 10th (over the sample period) in terms of average manufacturing GDP per worker.¹⁹ It turns out, as the empirical results show, that intellectual property rights matter more significantly for manufacturing productivity.

Part B of Table 2 shows the correlation among these variables and the IPR variables. R&D is positively correlated with all the IPR variables, except the piracy rate, with which it has a negative correlation. GDP per worker and the stock of R&D capital are also positively correlated with the IPR variables (except piracy, with which they have a negative correlation).

Note that the growth rate has a positive correlation with GDP per worker. But this is the unconditional correlation; once other factors are controlled for (as in the regression analysis), their (conditional) correlation is negative. Essentially, all the simple correlations are as expected. What is of interest is how the IPR measures correlate among themselves:

- Patent rights are positively correlated with *Enf-USTR*. Apparently, the countries in which there is least concern about enforcement in practice are those where patent statutes are strong, and vice versa: the countries with the poorest enforcement experience are those with weak or nonexistent laws. Patent rights are also positively correlated with trade-mark rights and copyright. Thus, countries that protect patent rights well also protect other forms of intellectual property.

SAMPLE STATISTICS, 41 NATIONS

	MEAN	STD DEV.	MIN	MAX									
Growth	0.223	0.267	−0.388	0.989									
GDP/Worker	21,181	10,892	1,905	37,157									
RDY	1.179	0.879	0.074	3.059									
IY	20.96	6.623	7.812	39.49									
RDSock	2.3E+10	4.4E+10	9.5E+07	7.5E+11									
CORRELATION MATRIX													
	GROWTH	GDP/W	RDY	IY	RDSOCK	PAT4	COPYRIG	TMARK	PARALLEL	SOFTWARE	PIRACY	ENF-GP	ENF-USTR
Growth	1.000												
GDP/Worker	0.213	1.000											
RDY	0.247	0.708	1.000										
IY	0.552	0.562	0.399	1.000									
RDSock	0.123	0.379	0.619	0.261	1.000								
Pat4	0.216	0.722	0.705	0.372	0.343	1.000							
Copyrig	0.055	0.619	0.528	0.137	0.454	0.535	1.000						
Tmark	0.019	0.697	0.557	0.199	0.261	0.629	0.722	1.000					
Parallel	0.277	0.517	0.417	0.136	0.391	0.402	0.536	0.553	1.000				
Software	0.131	0.711	0.644	0.471	0.483	0.568	0.501	0.446	0.509	1.000			
Piracy	−0.004	−0.806	−0.682	−0.401	−0.439	−0.681	−0.585	−0.629	−0.338	−0.672	1.000		
Enf-GP	0.037	0.607	0.518	0.436	0.344	0.371	0.441	0.436	0.179	0.514	−0.591	1.000	
Enf-USTR	0.181	0.828	0.776	0.371	0.471	0.739	0.689	0.648	0.499	0.635	−0.802	0.531	1.000
Notes:	GDP/worker: Gross domestic product per worker in 1995 (in constant 1985 US\$). Growth: Growth of GDP per worker over the period 1980-95. RDY: National R&D as a percentage of GDP (average for 1980-95). IY: Physical capital investment as a percentage of GDP (average for 1980-95). RDSock: Stock of R&D capital in 1980 (in constant 1985 US\$). For the rest of the variables, see notes to Table 1.												

- The piracy variable is negatively correlated with the two enforcement variables. Thus, piracy rates are lowest in countries that have strong enforcement mechanisms and practices. The USTR enforcement measure also correlates well with the Ginarte and Park measure of enforcement provisions.
- Parallel import protection is also positively correlated with other IPR variables, except piracy.

Table 3 presents statistics for the manufacturing sample over the period 1980-95. Part A focuses on the macro variables of interest. The mean and standard deviation for the IPR variables are not repeated since they vary only by country, not by industry. The mean and standard deviation are broken down by industry. (The unit of analysis here is the industry, not the country.) The industry-wide average long-term growth rate is 0.182, as the first line (TOTAL) shows.

The highest growth rate of output is in the Office Equipment Industry (which includes computers), followed by Radio-TV. The lowest growth rate is in the Food and Beverages sector, followed by Chemicals (non-drug). The highest rate of R&D investment is in Chemicals (drugs), followed by Office Equipment. About 10 percent of output in Chemicals (drugs) goes to R&D. The lowest rate of R&D investment is in Fabricated Metals, followed by the Wood Industry. The stock of R&D is also the largest in the Aircraft industry, followed by the Office Equipment and Radio-TV industries. The lowest stock of R&D capital is in the Wood industry, followed by Shipbuilding and Textiles.

Part B of Table 3 examines the correlation among these variables and IPRs. The growth rate (of output per worker) is positively correlated with R&D. The stock of R&D is also positively correlated with the growth rate. Patent rights, enforcement, and software are all positively correlated with the growth rate. That is, the fastest growing industries are associated with countries in which those types of IPRs are strongest. The same industries in countries where those kinds of IPRs are weakest tend to have the slowest growth rates. In contrast, the correlation between growth rates and copyright, trade-marks, and parallel import protection is negative.

Private R&D is positively correlated with all IPR measures, except piracy and trade-marks. It is expected that the correlation of private R&D with piracy would be negative, but not with trade-marks (although it is small in absolute value). The correlation with copyright is also small (0.065) in contrast to patent rights which have a correlation of 0.234 with private R&D. The correlation between private and public R&D is 0.156. The stock of R&D is positively correlated with growth, public R&D and private R&D, and negatively with copyright and trade-marks. Now, among the IPR variables, patent rights are negatively correlated with parallel importation. That is, parallel import protection is not necessarily accorded in countries with strong patent regimes.

TABLE 3			
SAMPLE STATISTICS, MANUFACTURING INDUSTRIES ACROSS 21 COUNTRIES			
A) MEAN (STANDARD DEVIATION)	GROWTH	PRIVATE RDY	R&D STOCK
Total	0.182 (0.697)	1.741 (3.117)	3,659 (10,529)
Food	-0.194 (0.534)	0.230 (0.177)	1,973 (3,739)
Textiles	0.042 (0.643)	0.231 (0.183)	356 (830)
Wood	0.155 (0.469)	0.137 (0.105)	220 (469)
Printing	0.181 (0.458)	0.226 (0.234)	430 (659)
Chemicals (non-drug)	-0.088 (0.696)	1.883 (1.670)	10,721 (18,076)
Chemicals (drug)	0.354 (0.38)	10.59 (5.44)	6,648 (9,660)
Petroleum	-0.469 (1.181)	0.613 (0.463)	2,573 (5,761)
Rubber	0.083 (0.567)	0.84 (0.668)	1,073 (2,046)
Non-metallic Minerals	0.071 (0.604)	0.657 (0.548)	1,332 (2,569)
Metals: Iron	0.399 (0.592)	0.545 (0.398)	2,091 (4,193)
Metals: Non-ferrous	0.318 (0.618)	0.570 (0.516)	672 (1,283)
Fabricated Metals	0.330 (0.661)	0.091 (0.054)	3,446 (10,143)
Office Equipment	0.962 (1.132)	6.91 (3.94)	11,924 (29,192)
Radio-TV	0.633 (0.396)	5.581 (2.71)	10,126 (19,077)
Electrical	0.067 (0.702)	2.017 (1.21)	5,000 (7,956)
Shipbuilding	0.564 (0.753)	1.415 (1.339)	323 (653)
Motor Vehicles	0.224 (0.650)	2.236 (1.60)	7,770 (11,238)
Aircraft	0.156 (0.759)	3.85 (1.66)	12,058 (23,209)

TABLE 3 (CONT'D)											
SAMPLE STATISTICS, MANUFACTURING INDUSTRIES ACROSS 21 COUNTRIES											
B) CORRELATION MATRIX	GROWTH	PRIVRDY	RDSTOCK	PAT4	COPYRIG	TMARK	PARALLEL	SOFTWARE	PIRACY	ENF-GP	ENF-USTR
<i>Growth</i>	1.000										
<i>PrivRDY</i>	0.224	1.000									
<i>RDStock</i>	0.168	0.367	1.000								
<i>Pat4</i>	0.446	0.234	0.319	1.000							
<i>Copyrig</i>	−0.021	0.065	−0.034	0.335	1.000						
<i>Tmark</i>	−0.067	−0.003	−0.199	0.354	0.804	1.000					
<i>Parallel</i>	−0.168	0.021	0.118	0.169	0.451	0.471	1.000				
<i>Software</i>	0.287	0.218	0.282	0.454	−0.031	−0.101	0.321	1.000			
<i>Piracy</i>	−0.528	−0.149	−0.297	−0.546	−0.202	−0.299	−0.035	−0.311	1.000		
<i>Enf-GP</i>	0.287	0.078	0.131	0.475	0.231	0.129	0.169	0.282	−0.143	1.000	
<i>Enf-USTR</i>	0.442	0.177	0.179	0.566	0.222	0.375	0.215	0.536	−0.731	0.321	1.000
Notes: <i>Growth</i> : Growth of real industrial output per worker over the period 1980-95. <i>PrivRDY</i> : Privately funded industrial R&D as a percentage of industry output (average 1987-95). <i>RDStock</i> : Stock of privately funded industrial R&D in 1987 (in millions of constant 1990 US\$). For the other variables, see notes to Table 1.											

Software rights are positively correlated with patent rights, but negatively with copyright and trade-marks. This suggests that software rights might be driven largely by patent rights since the software variable is a mixture of copyright and patent rights (and trade secrecy), yet the level is high primarily in countries where patent rights are strong. It could be that countries with strong copyright protection are strong in fields other than software (sound recordings, books, etc.). Not surprisingly, piracy and software are negatively correlated. Enforcement and piracy are also negatively correlated. Both enforcement variables are weakly correlated with each other (in contrast with the national sample). Thus, the deviation between perceived and actual protection is wider in the manufacturing sample. The correlation between *Enf-GP* (which measures statutory enforcement provisions) and *Enf-USTR* (which measures enforcement experience) may have been higher in the national sample which includes developing countries. Among these, countries that do not provide adequate statutory IP enforcement are also not likely to carry out laws adequately.²⁰

EMPIRICAL RESULTS

THIS SECTION PRESENTS ESTIMATES of the productivity growth equation (9) and the R&D investment rate equation (17).

NATIONAL SAMPLE

COLUMN 1 OF TABLE 4 PRESENTS the growth rate equation without IPR variables. This is similar to the augmented model of Mankiw et al. (1992), except that the R&D variable replaces their human capital variable.²¹ The secondary school enrolment rate was tried but found not to be significant at conventional levels (coefficient of 0.16 and standard error of 0.12). This first regression serves as a basis of comparison against previous empirical growth studies that omit IPRs. Thus far, the results are fairly comparable: 58.8 percent of the data is explained. From the coefficient of initial income (1980), one can find the speed of convergence, λ , estimated to be $0.024 [\ln(0.7)/15]$; see the formula for Ω_0 in equation (9), where $t = 15$ years (from 1980-95)]. This implies that deviations from the steady state are closing at a rate of 2.4 percent per year. This is faster than the rate found by Mankiw et al. (1992) (without controlling for R&D), but it is closer to what they get for the OECD sample. As for the other implied parameters, $\alpha = 0.36 [0.425/(0.299+0.833)]$ and $\beta = 0.084 [0.099/(0.299+0.833)]$, both of which are in the ballpark of previous findings.

Given no major departures from previous growth studies, the next step is to examine the consequences of incorporating IPR variables. In columns 2 to 8, each of the different IPR variables is reported to be statistically insignificant. Hence, at the national level, there appears to be no appreciable *direct* effect on

TABLE 4

NATIONAL GROWTH EQUATION ESTIMATES

	DEPENDENT VARIABLE: $GROWTH = \ln(YL_{1995}) - \ln(YL_{1980})$									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
C	4.521 (0.662)	4.545 (0.621)	4.853 (0.616)	4.495 (0.668)	4.610 (0.604)	3.462 (1.001)	4.352 (0.724)	4.439 (0.725)	0.820 (1.690)	6.828 (0.601)
YL_{1980}	-0.299 (0.053)	-0.298 (0.059)	-0.283 (0.053)	-0.284 (0.061)	-0.314 (0.052)	-0.256 (0.061)	-0.299 (0.054)	-0.248 (0.069)	-0.184 (0.066)	-0.560 (0.051)
S_K	0.425 (0.142)	0.425 (0.144)	0.403 (0.125)	0.421 (0.144)	0.417 (0.143)	0.412 (0.143)	0.449 (0.129)	0.454 (0.157)	0.488 (0.216)	0.233 (0.057)
S_R	0.099 (0.035)	0.103 (0.032)	0.119 (0.037)	0.104 (0.033)	0.098 (0.037)	0.131 (0.038)	0.077 (0.039)	0.142 (0.051)	0.147 (0.061)	0.098 (0.026)
NGD	-0.883 (0.189)	-0.895 (0.209)	-1.083 (0.211)	-0.925 (0.211)	-0.887 (0.199)	-0.876 (0.174)	-0.762 (0.221)	-0.929 (0.198)	-0.979 (0.278)	-0.313 (0.195)
$Pat4$		-0.018 (0.103)								
$Copyrig$			-0.355 (0.214)							
$Tmark$				-0.096 (0.126)						
$Parallel$							0.157 (0.121)		(0.172) (0.216)	0.215 (0.086)
$Software$					0.039 (0.109)					
$Piracy$						0.188 (0.122)			0.703 (0.288)	-0.059 (0.051)
$Enf-GP$								-0.208 (0.141)		
$Enf-USTR$								-0.156 (0.173)		
Adjusted R^2	0.588	0.577	0.613	0.583	0.579	0.591	0.597	0.568	0.459	0.911
Number of Observations	41	41	41	41	41	40	41	38	19	21

Notes: YL denotes GDP per worker (in real 1985 US\$) and $\ln$ denotes logarithms (base e).
 S_K is the physical capital investment rate; S_R is the R&D capital investment rate, NGD is $(n + g + \delta)$ (see text).
For definitions of IPR variables, see text or notes to Table 1.
All right-hand-side variables (except the constant C) are logged.
Heteroskedastic-consistent standard errors are in parentheses.
For values of $Parallel$, $Enf-GP$ and $Enf-USTR$, a value of 1 was added to avoid taking logs of zero.

productivity growth from intellectual property protection or enforcement. However, piracy has significance almost at conventional levels (p -value of 0.071).

Because the number of observations is rather small, the IPR variables have been considered one at a time, so as not to lose many degrees of freedom. Also, a few IPR variables take on the value 0. Hence, before logging them, a value of 1 was added — $\ln(IPR + 1)$. Since these variables are indexes, it is the ranking that matters. Absolute scores or values have no particular meaning.

However, the fact piracy has near significance induces one to look further. Thus, in columns 9 and 10, the 41-country sample is split between developed and less developed countries. Basically, the sample is sorted in descending order of GDP per worker, and then divided roughly in half. The results in column 9 show that piracy is contributing positively to the growth of less developed countries (LDCs). For this smaller sample, the output elasticities of physical and R&D capital are $\alpha = 0.42$ and $\beta = 0.13$, respectively. Likewise, the implied elasticity of output with respect to piracy is 1.72. (This is obtained from the fact that the estimated elasticity of technical efficiency with respect to IPRs is $\gamma = 3.82$ (0.703/0.184), while the elasticity of output with respect to piracy is $(1 - \alpha - \beta)\gamma$.) However, less than half the variation in the data is explained by the model (adjusted $R^2 = 0.459$). The model explains the data better for the richer half of the sample (adjusted $R^2 = 0.911$). The implied output elasticities of physical capital and R&D capital are lower ($\alpha = 0.26$ and $\beta = 0.11$). Thus, the less developed economies' output is more sensitive to resource accumulation, as might be expected. Another big difference is that parallel import protection stimulates growth in the richer half. Parallel import protection may matter less for LDCs because they have fewer innovative (and creative) outputs.

Given the weak direct effects of IPRs on growth, it is useful to look at some secondary or indirect benefits of IPRs via their effects on R&D. The first column of Table 5 shows the estimation results of the R&D equation for the 41-nation sample.²² The model explains about 69 percent of the variation in R&D investment rates. As the theory predicts, the coefficient on the initial stock of R&D (as a ratio to GDP) is less than one, and is statistically significant at better than conventional levels. The patent rights index and the enforcement provisions are both significant at conventional levels. From these estimates, the implied R&D cost function elasticities are $\sigma_1 = 2.30$ and $\sigma_2 = 1.30$. Given the coefficient on *Pat4*, the implied elasticity of the appropriability function (with respect to patent rights) is $\mu = 1.90$. This implies that the appropriability function is convex. The ability to capture revenue increases with each *unit* increase in IPRs at an increasing rate. This implies that halfway measures are not very effective instruments for appropriation; starting from no protection to some halfway point of protection does not raise appropriability as much as going from that halfway point of protection to full protection of patent rights. Halfway measures leave much room still for imitation and infringement.

In column 2 of Table 5, the *Enf-GP* variable is replaced by *Enf-USTR*. This variable is statistically quite significant (*p*-value of 0.01). Its presence reduces the importance of *Pat4* (*p*-value rising to 0.057). Each of columns 3, 4 and 5 shows that copyright, trade-mark rights, and parallel importation individually contribute positively to R&D investment. But in effect, what are they

TABLE 5

NATIONAL R&D EQUATION ESTIMATES

	DEPENDENT VARIABLE: LN(S_R)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
C	-9.565 (0.737)	-8.077 (0.548)	-9.732 (1.071)	-9.871 (1.149)	-8.601 (0.935)	-9.555 (0.896)	-8.829 (0.956)	-0.645 (2.148)	-8.140 (1.003)	-8.950 (0.395)
<i>RDStock/GDP</i>	0.232 (0.061)	0.167 (0.045)	0.277 (0.075)	0.303 (0.068)	0.272 (0.073)	0.266 (0.062)	0.284 (0.071)	0.182 (0.066)	0.149 (0.085)	0.184 (0.045)
<i>Pat4</i>	1.464 (0.264)	0.866 (0.439)				1.487 (0.340)			0.878 (0.477)	0.999 (0.527)
<i>Copyrig</i>			1.334 (0.605)			-0.295 (0.689)				
<i>Tmark</i>				1.175 (0.456)		0.252 (0.480)				
<i>Parallel</i>					0.982 (0.439)	0.308 (0.429)				
<i>Software</i>							0.638 (0.263)	0.118 (0.280)		
<i>Piracy</i>								-1.601 (0.409)		
<i>Enf-GP</i>	1.118 (0.572)								0.939 (0.658)	0.509 (0.475)
<i>Enf-USTR</i>		1.291 (0.469)							2.001 (0.791)	1.494 (0.549)
Adjusted R^2	0.688	0.747	0.411	0.470	0.429	0.618	0.447	0.578	0.580	0.812
Number of Observations	41	38	41	41	41	41	41	39	17	21
Notes: All variables are defined in previous tables. All right-hand-side variables (except for the constant term C) are logged. Heteroskedastic-consistent standard errors are in parentheses.										

picking up? Once patent rights are controlled for, these variables lose (statistical) significance, as the results in column 6 show. Patent rights remain a significant explanatory factor. This seems intuitive — namely, that for R&D, the legal variable that matters most is patent rights. Copyright, for any expressive aspects, or protections for trade names or symbols, seem to be a secondary element in the consideration of inventors.

In column 7, the software protection variable also helps to explain R&D, but as the results in column 8 show, once piracy is controlled for — as a proxy for actual experience — the software variable is insignificant. Piracy exerts a significant negative influence on national R&D investment.

Columns 9 and 10 show the results of splitting the sample again between poorer and richer nations. In the poorer economy sample, patent rights exert a

weak influence on R&D. Lagged R&D knowledge stock also has a weak but positive influence on R&D investment (at conventional levels of significance). These variables do not vary as much in this sample. Since there are fewer past inventions, the stock of past R&D capital is small and similar in size. Piracy rates tend to be high and patent rights low. What little there is in the way of statutory patent protection has essentially no impact on the R&D activities of developing economies. The strengthening of enforcement in practice would have a much more important impact on R&D investment. Overall, the model explains 58 percent of the data.

In the richer economy sample, the model explains about 81 percent of the data. Both enforcement in practice and patent rights have the expected signs and are statistically significant explanatory factors. Thus, these two forms of IPRs have the strongest indirect effect on productivity growth, via their influence on R&D capital formation.

The fact that *statutory* patent provisions help stimulate R&D is of interest, since a common criticism of the statutory patent protection variable is that it does not measure *actual* practice. Here, the evidence seems to suggest that the laws on the books can stimulate R&D. This would be consistent with the idea that laws act as a *signal*. They might work by revealing something about the attitude of public authorities towards the protection of intellectual property and promote confidence among agents to invest in risky ventures like R&D.

MANUFACTURING SAMPLE

THE REGRESSION ANALYSES ARE REPEATED for the manufacturing industries sample, and are reported in Tables 6 and 7. With 21 countries and 18 sectors in the sample, there are potentially 378 observations; however, for each sector, about 10-14 observations were actually available per sector.

The growth equation results differ somewhat from those of the national sample. Here, some of the IPR variables do have significant direct effects on productivity growth. In column 1 of Table 6, patent protection is seen to affect productivity directly. The implied elasticities are $\alpha = 0.43$, $\beta = 0.14$, and $\gamma = 4.5$ (1.606/0.357), indicating that the explanatory variables have larger effects in the manufacturing sample (in comparison to the aggregate, national sample).

The results in columns 2 and 3 show that copyright and trade-mark rights do not have any direct effect on growth. Column 4 results show that parallel importation has a negative effect on growth. This differs from the national sample (see Table 4, column 10). It appears that among manufacturing industries, parallel import protection might be establishing too much market power by, among other things, limiting the diffusion of new goods. This might explain why its effect on growth is negative. In column 5, software rights are seen to

TABLE 6

MANUFACTURING GROWTH EQUATION ESTIMATES

	DEPENDENT VARIABLE: GROWTH = $\text{LN}(\text{YL}_{1995}) - \text{LN}(\text{YL}_{1980})$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
C	3.964 (1.008)	6.414 (0.948)	6.728 (0.940)	6.372 (0.878)	8.417 (0.862)	3.783 (0.876)	4.965 (1.311)
YL_{1980}	-0.357 (0.067)	-0.415 (0.071)	-0.418 (0.071)	-0.408 (0.070)	-0.341 (0.064)	-0.382 (0.064)	-0.340 (0.068)
S_K	0.275 (0.092)	0.135 (0.099)	0.125 (0.099)	0.096 (0.102)	0.329 (0.101)	0.223 (0.088)	0.299 (0.096)
S_R	0.089 (0.021)	0.152 (0.022)	0.151 (0.022)	0.154 (0.022)	0.095 (0.020)	0.073 (0.019)	0.052 (0.019)
NGD	-0.287 (0.107)	-0.284 (0.113)	-0.314 (0.117)	-0.268 (0.114)	-0.391 (0.107)	-0.316 (0.113)	-0.368 (0.114)
<i>Pat4</i>	1.606 (0.254)						1.029 (0.307)
<i>Copyrig</i>		-0.121 (0.375)					-0.518 (0.503)
<i>Tmarks</i>			-0.380 (0.332)				-0.149 (0.408)
<i>Parallel</i>				-0.507 (0.248)			-0.138 (0.264)
<i>Software</i>					0.447 (0.217)		0.084 (0.266)
<i>Piracy</i>					-0.827 (0.162)		-0.279 (0.188)
<i>Enf-GP</i>						1.318 (0.245)	1.025 (0.283)
<i>Enf-USTR</i>						1.855 (0.293)	0.887 (0.377)
Adjusted R ²	0.517	0.406	0.409	0.415	0.508	0.553	0.612
Number of Observations	238	238	238	238	238	238	238
Notes: YL denotes real industrial output per worker in constant 1990 US\$. All other variables are defined in previous tables. All right-hand-side variables (except for the constant term C) are logged. Heteroskedastic-consistent standard errors are in parentheses.							

affect productivity positively and significantly, while piracy rates are seen to affect it negatively and significantly. In column 6, the two enforcement variables are seen to affect productivity quite strongly.

When all eight IPR variables are entered together in the model (see column 8), it is patent protection, enforcement provisions and enforcement in

TABLE 7

MANUFACTURING R&D EQUATION ESTIMATES

	DEPENDENT VARIABLE: GROWTH = LN(S_R)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
C	7.669 (0.860)	7.102 (1.025)	8.254 (0.714)	8.416 (0.596)	8.027 (0.735)	7.087 (0.781)	5.782 (1.099)
RDS _{stock} /GDP	0.789 (0.037)	0.803 (0.034)	0.808 (0.033)	0.807 (0.033)	0.794 (0.038)	0.771 (0.036)	0.773 (0.037)
Pat4	0.612 (0.260)						-0.230 (0.417)
Copyrig		1.209 (0.498)					1.465 (0.891)
Tmark			0.324 (0.272)				-0.537 (0.532)
Parallel				0.384 (0.240)			-0.080 (0.345)
Software					0.578 (0.205)		0.343 (0.341)
Piracy					-0.038 (0.183)		0.071 (0.290)
Enf-GP						1.038 (0.310)	0.845 (0.344)
Enf-USTR						0.518 (0.234)	0.576 (0.389)
Adjusted R ²	0.850	0.851	0.848	0.849	0.851	0.858	0.863
Number of Observations	265	265	265	265	265	265	265
Notes: All variables are defined in previous tables. All right-hand-side variables (except for the constant term C) are logged. Heteroskedastic-consistent standard errors are in parentheses.							

practice that matter (directly to productivity growth). All other IPR variables, including software and parallel import protection, have less significance.

Table 7 presents the results of estimating the R&D equation for the manufacturing sample. In column 1, the implied R&D cost function elasticities are much higher: $\sigma_1 = 5.74$ and $\sigma_2 = 4.74$. The elasticity of the appropriability function is $\mu = 2.9$ ($0.612/0.211$), again showing a convex relationship between appropriability and patent rights. The model explains about 85 percent of the data.

Column 2 results show that copyright also matters for R&D, but again they may be picking up the effects of omitted variables: patent rights and enforcement. In columns 3 and 4, trade-mark rights and parallel import protection have weakly significant positive effects on R&D investment rates.

Column 5 focuses on the role of software protections (statutory rights and piracy). For this sample, software statutes are an important explanatory factor but variations in piracy rates do not explain variations in R&D. Piracy rates are relatively low and less varied in the OECD region. Column 6 once again shows that enforcement variables are strongly significant for R&D.

In column 7, when all eight IPR variables are entered together, only the two enforcement variables have explanatory power (in addition to the lagged stock of R&D to GDP). Unlike the national sample which aggregates all sectors, the signalling aspect of intellectual property *statutes* appears weaker in the manufacturing sector. What makes the manufacturing sector particularly different is worth examining further, but one possibility is that manufacturing R&D outputs might be of higher value than the national average (and thus very attractive to imitators). Thus, those intellectual assets are most worth fighting for, in which case the most essential kind of IPRs is enforcement — whether through litigation, settlement, injunctions, etc. Consequently, manufacturing R&D investment rates tend to be influenced most by IPR *enforcement* provisions and practice.

To summarize, in the national sample, patent rights and enforcement variables affect productivity growth *indirectly* via their effect on R&D capital accumulation; in the manufacturing sample, IPRs can affect growth *directly* and *indirectly*. In manufacturing, productivity is directly affected by patent statutes, enforcement provisions, and enforcement in practice; however, manufacturing R&D is not directly affected by intellectual property statutes (once enforcement factors are controlled for). The patent statutes variable on its own likely picks up the enforcement effects.

SENSITIVITY TESTS

THUS FAR, ESTIMATION HAS BEEN BY THE OLS (ordinary least squares) method. The growth model assumes no correlation between the residual and the investment rates. Mankiw et al. (1992) provide defences for this. In the case of the R&D model, however, a legitimate concern is the potential endogeneity between R&D investment and IPRs. Ginarte and Park (1997), for instance, study the determinants of patent rights, among which is the R&D intensity of countries. The idea is that countries that conduct relatively more R&D have a greater incentive to provide and protect patent rights. Other important determinants of patent rights are output per worker and economic freedom. Thus, in Table 8, two-stage least square (2SLS) estimates of the R&D model are provided. The reduced-form equation, and hence the instruments for patent rights (the *Pat4* variable), include the constant term, the lagged stock of R&D (as a ratio of GDP), GDP per worker, and an index of economic freedom (see Gwartney and Lawson, 2002). In Table 8, column 1 presents the results for the

TABLE 8

R&D EQUATION TWO-STAGE LEAST SQUARE ESTIMATES

	DEPENDENT VARIABLE: LN(S_R)	
	(1)	(2)
C	-10.049 (0.853)	4.329 (2.051)
$R\Delta Stock/GDP$	0.243 (0.069)	0.708 (0.062)
$Pat4$	2.452 (0.545)	2.473 (0.986)
Adjusted R^2	0.566	0.821
Number of Observations	41	262
Hausman $\chi^2(3)$	2.10	3.44
[p-value]	[0.552]	[0.328]
Notes: Column 1 presents the results for the national sample, and column 2 for the manufacturing sample. In each case, the instruments for $Pat4$ include the constant term, the log of the ratio of $R\Delta Stock$ to GDP , the log of the index of economic freedom (average for 1980-95), and the log of GDP per worker in 1980. The index of economic freedom is obtained from Gwartney and Lawson, 2002. Hausman $\chi^2(3)$ refers to the Hausman test-statistic (with three degrees of freedom) for testing the null hypothesis of exogeneity of $Pat4$. All other variables are as defined previously. Heteroskedastic-consistent standard errors are in parentheses.		

national sample and column 2 for the manufacturing sample. For both the national and manufacturing samples (comparing column 1 of Table 8 to column 1 of Table 5, and comparing column 2 of Table 8 to column 1 of Table 7), the 2SLS estimates are similar for the lagged R&D stock variable, but the OLS method underestimates the impact of patent rights on R&D. However, as the Hausman test results indicate, the null hypothesis that $Pat4$ is exogenous cannot be rejected.

Another possibility is that the errors from the two equations (growth and R&D) are correlated. Hence, Table 9 presents the results of estimating the two equations jointly with the SUR (seemingly unrelated regression) method. Columns 1 and 2 show the results for the national sample, and columns 3 and 4 for the manufacturing sample. Comparisons should be made to column 2 of Table 4, and column 1 of Table 5 (in the case of the national sample) and to column 1 of Table 6 and column 1 of Table 7 (in the case of the manufacturing sample). The results are fairly similar (except that the magnitude of the effect of R&D on growth is smaller in the SUR estimates of the national sample, and the statistical significance of the effect of $Pat4$ on R&D is weaker in the SUR estimates of the manufacturing sample). The important result, though, is that

TABLE 9

SUR ESTIMATES OF THE GROWTH-R&D SYSTEM OF EQUATIONS

	NATIONAL SAMPLE		MANUFACTURING SAMPLE	
	DEPENDENT VARIABLE			
	GROWTH	LN(S_R)	GROWTH	LN(S_R)
	(1)	(2)	(3)	(4)
C	4.413 (0.591)	−9.840 (0.658)	3.949 (0.577)	7.666 (0.629)
YL_{1980}	−0.303 (0.046)		−0.360 (0.041)	
S_K	0.416 (0.089)		0.275 (0.083)	
S_R	0.079 (0.036)		0.083 (0.021)	
NGD	−0.889 (0.211)		−0.291 (0.104)	
$RDStock/GDP$		0.284 (0.052)		0.770 (0.025)
$Pat4$	0.037 (0.114)	1.618 (0.289)	1.624 (0.217)	0.315 (0.297)
R^2	0.624	0.655	0.527	0.831
Number of Observations	41	41	238	238
B.P. $\chi^2(1)$		1.002		0.356
[p-value]		[0.317]		[0.551]
Notes: Results in columns 1 and 2 are obtained from the national sample, and those in columns 3 and 4 from the manufacturing sample. The dependent variable <i>Growth</i> and all other variables are as defined in previous tables. B.P. $\chi^2(1)$ refers to the Breusch-Pagan test-statistic (with one degree of freedom) for testing the null hypothesis of independent equations (that the disturbance covariance matrix is diagonal). Standard errors are in parentheses.				

the Breusch-Pagan test for testing the null hypothesis of no correlation between the error terms of the two equations cannot be rejected.

IMPLICATIONS FOR CANADA

IT IS NOT EASY TO GENERATE SPECIFIC ESTIMATES of the impact of IPRs on productivity for Canada since the estimates obtained thus far represent an *average* across industries and countries. To get country-specific estimates, time-series observations are needed (or a panel dataset) for two reasons: there is a limited number of manufacturing sectors per country per cross section of time (namely 18 at most), and the IPR variables do not vary by sector (or vary within a country). Thus, this sub-section focuses on the *average* cross-industry,

cross-country estimates and evaluates Canada's productivity response to a strengthening of patent rights based on those estimates.

A large number of empirical results have been presented so far, but they all centre around two equations: the productivity growth equation and the R&D equation. The two can be combined [substitute the R&D equation (17) into the growth equation (9)] to obtain the sum of the direct and indirect effects of IPRs on productivity. Note that it would not be useful to calculate the effects of patent rights on the long-run productivity growth rate since, in these models, the long-run growth rate is pinned down by exogenous factors (such as the exogenous growth rate of technical efficiency, g , and the labour force growth rate, n). In other words, shocks to the growth rate will only be temporary. However, shocks can have permanent effects on the *level* of output per worker. Thus, the focus should be on the steady-state level of GDP per worker. From equation (9), let $\Delta \ln(Y/L) = 0$ and rearrange to obtain the following partial derivative:

$$(18) \quad \frac{\partial \ln(\frac{Y}{L})}{\partial \ln(IPR)} = \frac{\Omega_2}{-\Omega_0} \frac{\partial \ln(s_r)}{\partial \ln(IPR)} + \frac{\Omega_4}{-\Omega_0} = \frac{\Omega_2}{-\Omega_0} \eta_2 + \frac{\Omega_4}{-\Omega_0},$$

where, from equation (17), $\partial \ln(s_r)/\partial \ln(IPR) = \eta_2$. The last term on the right in equation (18) gives the direct effect of IPRs on long-run output per worker. The second last term gives the indirect effect (from the effect of IPRs on the R&D investment rate, and then the effect of the R&D investment rate on output per worker). The total effect or total value of the right side of equation (18) indicates the *elasticity* (the percentage by which long-run output per worker will increase per 1-percent increase in IPRs).

Using estimates from the manufacturing sample (from Table 6, column 1 and Table 7, column 1), the estimate of η_2 is 0.612, and the value of the right side of equation (18) is 4.64 ($0.089 \cdot 0.612 / 0.357 + 1.606 / 0.357$). That is, a one percent strengthening of patent rights raises long-run GDP per worker by 4.64 percent, most of which is due to the direct effect of patent rights on productivity. That is, the direct effect dominates in magnitude.

Consider then an increase in Canada's level of patent rights by 0.33 points (from 2.50 to 2.83). This is equivalent to half the sample standard deviation of *Pat4* (see Table 1). For Canada, this change represents a 13.4 percent increase in the level of patent rights. Thus the steady-state manufacturing R&D investment rate is expected to increase by 12.2 percent ($0.612 \cdot 13.4$) and long-run manufacturing GDP per worker to increase by 62.3 percent ($4.64 \cdot 13.4$). Given that the sample period is 15 years, this long-term 62.3 percent increase in GDP per worker translates into a 3.28 percent

annual rise in *trend* manufacturing output.²³ Now Canada's *potential* increase in long-run GDP could be higher or lower (since this estimate is based on *average* cross-country, cross-industry estimates). How well-off Canada is in relation to other nations depends on whether the change in patent rights is unilateral or whether other countries are strengthening their rights as well (see Park, 2000, for a study of the effects of patent reform on worldwide income distribution).

Now, the effect of this patent reform on Canadian GDP per worker *as a whole* (that is, on aggregate GDP per worker rather than on manufacturing GDP per worker) is smaller. From column 10 of Table 5, the estimate of η_2 is 0.999. Combining this with estimates from column 2 of Table 4, the overall elasticity (of long-run output per worker with respect to patent rights) is 0.345 ($0.103 \times 0.999 / 0.298$, where the *direct* effect is ignored since it is not statistically significant). Hence, a half standard deviation increase in patent rights (which in Canada's case represents a 13.4 percent rise) should raise long-run GDP per worker by 4.63 percent (13.4×0.345) over a 15-year period (or an annual average increase of 0.3 percent). Thus, patent reform may potentially have a large impact on Canadian manufacturing but a modest effect overall on the Canadian economy.

CONCLUSION

THERE IS MUCH CONTROVERSY about the effects of intellectual property rights on economic growth and development. Theoretical analyses can and have shed light on the mechanics or principles by which IPRs affect innovation, productivity and welfare. Eventually, however, empirical work is needed to test some of the assumptions made in the theoretical models, or to estimate some of the functional relationships specified therein. Yet, empirical work lags considerably behind theoretical work in the field of IPRs. Thus, policymakers faced with making choices under uncertainty and imperfect information have very little empirical evidence on which to base their decisions.

A specific policy issue (or option) confronting Canada in the near future is whether to admit newer forms of technologies as patentable subject matter, for example innovations in the areas of business methods, online (e-commerce) transactions, biotechnology, finance, databases, etc. Canada is confronted with this issue because as these new types of innovations emerge, decisions have to be made as to whether to recognize them as inventions. Yet, even if they fit the definition of inventive material, is intellectual property rights protection over them sensible? Several of Canada's trading partners (such as the United States, Japan and Europe) have proceeded to recognize some or all of these innovations as inventions and are providing IP protections. Should Canada follow their example? Will failure to do so disadvantage Canada in terms of competitiveness, innovation and standard of living?

These are challenging questions. The present study has sought to help fill some gaps in empirical work, to provide *pieces* of evidence that can be put together with previous and new research in order to assess the economic effects of IPRs. Using two separate samples of data and various indexes of IPRs, the study examined the extent to which different kinds of IPRs can affect the technical efficiency of production and the rate of R&D capital formation.

In the 41-nation sample, the results show that IPRs do not stimulate productivity growth directly, but do indirectly by stimulating R&D investments. What matters most about IPRs are the mechanisms for enforcement and the level of enforcement effectiveness, rather than the substantive provisions alone (patent rights, software rights, copyright, etc.). However, for the richer subset of the 41-nation sample, substantive patent rights do matter, even after controlling for enforcement effectiveness. In the manufacturing sample, IPRs contribute to productivity growth directly and indirectly by stimulating R&D. But again, different kinds of IPRs matter. Patent protection and enforcement are important for raising the technical efficiency of production, while it is the enforcement component that primarily explains R&D investments. Other kinds of IPRs (e.g. copyright, trade-marks, parallel import protection, software and piracy) matter when examined individually (without other IPR variables), but they would then be picking up the effects of omitted variables (namely enforcement levels). That is, once patent rights and/or enforcement levels are controlled for, copyright and trade-marks have no statistically significant effect on productivity growth. Thus, the results indicate on balance that IPRs — particularly those governing the enforcement of those rights and their execution — contribute significantly to productivity growth.

A related point is that the *kinds* of IPRs targeted by policy do matter. IPRs should not be treated as a homogenous (unidimensional) concept. Of the different kinds of IPRs, it is (perhaps expectedly) patent protection and enforcement levels that are conducive to R&D activity and productivity. It is instructive to note that software rights are not significant once patent rights and enforcement are controlled for. Thus, in view of the recent policy debate about what to do in response to changing technological developments (related to the Internet, the computer information age, and so forth), these results might suggest that it is not so much the protections aimed at emerging areas that matter but rather the age-old concern with effective enforcement and implementation of laws, particularly for patent rights as traditionally understood.

Overall, there are several areas where this research could be extended:

- 1) The first would be to examine copyright and trade-mark-related *output*. The results show that R&D is patent-sensitive, rather than copyright-, trade-marks-, or other IP-sensitive. This does not imply that copyright, trade-marks or other non-patent IP instruments do not matter for *other*

valuable economic activity. Thus, future work could explore other types of economic activity (in other words, possible left-hand-side variables other than R&D) that might be more specifically a function of copyright or trade-mark rights; for example, promotion, marketing and advertising investments, education, community development and cultural activities.

- 2) It would also be useful to obtain time-series observations on non-patent IPRs [as was done with the Ginarte and Park (1997) patent rights index]. This will require looking back through legislative history to identify changes in statutes, and studying past reports or documentation about actual experiences. Having a time-series dimension would allow for a panel data analysis. With more observations, one could estimate the growth and R&D models industry by industry. In this study, with just a cross-sectional dimension and about 10 to 14 observations per industry, it was difficult to provide industry by industry results, and determine which type of industry would be more dependent on IPRs.
- 3) Another useful extension would be to construct measures of *effective* intellectual property by industry. In principle, IP laws vary by country but do not vary by industry within a country, except in coverage (for example, a country may not provide protection for biotechnological innovations, surgical methods, pharmaceuticals or software). By excluding certain patentable subject matter, the legislation does provide a tacit amount of preferential protection across sectors. But in theory, IPR laws are national in scope. However, in practice, there are important inter-industry differences in the level of IPRs that firms can enjoy, and they are measurable. This is important because different kinds of inventions may require different levels of protection for the inventors to recoup their R&D costs. For some inventions, existing rights may be too weak (say for chemical inventions), while for others they may be too strong (say for business methods). For example, the 20-year patent protection period may be sufficient for certain types of innovations for purposes of recouping costs, but may be inadequate for others (due, say, to a lengthy marketing approval process which consumes many years of the 20-year patent duration). Another reason why firms in different industries may enjoy different *effective* levels of IP protection is that the process for obtaining rights and enforcing them may differ. For example, due to differences in technological complexity, firms in some industries may take longer to obtain a patent. The search and examination process may be more involved so that patent *pendency* is longer. It may also be more difficult to detect and prove infringement, and thus enforce property rights, in certain technological fields. The ability to procure and enforce IP rights may also be a function of the degree of competition in the sector.

- 4) Finally, it would be useful to estimate the *costs* of strengthening intellectual property rights and enforcement (e.g. infrastructure costs, cost of rewriting and implementing new legislation). This study focused on estimating the *benefits* of strengthening intellectual property protection in terms of the contribution of IPRs to overall national and manufacturing productivity growth. A remaining issue concerns the *returns* to such a policy — the cost of increased IP enforcement vs. the potential productivity gains.

APPENDIX A

INTELLECTUAL PROPERTY RIGHTS – SUMMARY OF CRITERIA AND MEASUREMENT

THIS APPENDIX REVIEWS THE KEY CRITERIA under each type of IPR index and the method for scoring the strength of protection. It is likely that no one index captures the overall nature of IP protection in a region; but together, the various indexes should provide a general picture.

PAT4

THIS IS THE INDEX OF PATENT RIGHTS without the enforcement category. The original index has five categories (including enforcement). The remaining four categories are:

(1) Membership in International Treaties	Signatory	Not Signatory
– Paris Convention and Revisions	1/3	0
– Patent Cooperation Treaty	1/3	0
– Protection of New Varieties (UPOV)	1/3	0
(2) Coverage	Available	Not Available
– Patentability of Pharmaceuticals	1/7	0
– Patentability of Chemicals	1/7	0
– Patentability of Food	1/7	0
– Patentability of Plant and Animal Varieties	1/7	0
– Patentability of Surgical Products	1/7	0
– Patentability of Micro-organisms	1/7	0
– Patentability of Utility Models	1/7	0
(3) Restrictions on Patent Rights	Does Not Exist	Exists
– “Working” Requirements	1/3	0
– Compulsory Licensing	1/3	0
– Revocation of Patents	1/3	0
(4) Duration of Protection	Full	Partial
	1	$0 < f < 1$

where f equals the duration of protection as a *fraction* of the full (potential) duration. Full duration is either 20 years from the date of application or 17 years from the date of grant (for grant-based patent systems).

COPYRIG

THIS IS AN INDEX OF COPYRIGHT, based on statutory provisions:

(1) Membership in International Treaties	Signatory	Not Signatory
– Berne Convention	1/4	0
– Rome Treaty	1/4	0
– Universal Copyright Convention	1/4	0
– Phonogram Convention	1/4	0
(2) Coverage	Available	Not Available
– Literary, Dramatic, Artistic, ...	1/5	0
– Performance Rights	1/5	0
– Sound Recordings	1/5	0
– Cinema	1/5	0
– Broadcasting	1/5	0
(3) Restrictions on Copyright	Does Not Exist	Exists
– Limit Re-sale (droit de suite)	1/4	0
– Extended (collective)		
Licensing Schemes	1/4	0
– Compulsory Licensing:		
Government Use	1/4	0
Private Use	1/4	0
(4) Duration of Protection	Full	Partial
– Literary, Dramatic, Artistic, ...	1/4	$0 < f < 1/4$
– Performance Rights	1/4	$0 < f < 1/4$
– Sound Recordings	1/4	$0 < f < 1/4$
– Cinema	1/4	$0 < f < 1/4$

where f equals the duration of protection as a *fraction* of the international standard of 50 years, times $1/4$. The duration of protection varies by kind of work covered. Each kind has equal weight in the overall duration score. If the duration of a work exceeds the 50-year norm, a maximum score of $1/4$ is assigned.

TMARK

THIS IS AN INDEX OF TRADE-MARK RIGHTS, based on statutory provisions:

(1) Membership in International Treaties	Signatory	Not Signatory
– Madrid Treaty	1/3	0
– Nice Treaty	1/3	0
– Paris Convention	1/3	0
(2) Coverage	Available	Not Available
– Service Marks	1/3	0
– Certification Marks	1/3	0
– Collective Marks	1/3	0
(3) Restrictions on Trade-mark Rights	Does Not Exist	Exists
– Renewal Proof of Use	1/4	0
– “Linking” Requirements	1/4	0
– Restricted Licensing	1/4	0
– Lack of Protection for Well-known Marks Due to Non-use	1/4	0
(4) Duration of Protection	Full	Partial
	1	$0 < f < 1$

where f equals the duration of protection as a *fraction* of the full duration (of 10 years, the international norm).

PARALLEL

THIS REFERS TO ‘PARALLEL IMPORT’ PROTECTION for intellectual property (books, computer programs, phonograms, videos, etc.), as rated by the International Intellectual Property Alliance (1998).

The index = 1 if YES, country provides parallel import protection,
0.5 if PROBABLY YES,
0 if NO.

SOFTWARE

THIS INDEX MEASURES the intellectual property protection for software. The patent and copyright indexes above do not explicitly include software in their coverage category. Hence, a special index can be created for this particular type of innovation or creative expression (and/or as an extension to the indexes above).

Software rights can be protected by three sources: (a) trade secrecy; (b) patent; and (c) copyright. Thus,

$$\text{Software index} = \underset{(x_1)}{\text{trade secret}} + \underset{(x_2)}{\text{patent}} + \underset{(x_3)}{\text{copyright}},$$

where $x_1 = 1$ if trade secrecy protection exists (0 otherwise);
 $x_2 = 1$ if patent protection exists for software, 0.5 if partial protection exists, and 0 otherwise; and
 $x_3 = 1$ if copyright exists for software, 0.5 if partial protection exists, and 0 otherwise.

Information on software patent and copyright provisions is contained in *International Computer Law* (Matthew Bender, 1999), Chapter 3B. Information on trade secret protection is contained in Hemnes, DiMambro and Moore (1992).

PIRACY

THESE ARE AVERAGE RATES of computer software piracy in 1994, estimated by the Business Software Alliance and Software Publishers Association (1996). The number of pirated copies is estimated to be the difference between the estimated number of software installations and the estimated number of software shipments. The piracy rate is then the number of pirated copies as a fraction of software installations.

ENF-GP

THIS IS THE ENFORCEMENT CATEGORY of the Ginarte and Park (1997) index, as separated from the aggregate index. Since the same enforcement features are available for patent rights enforcement as well as for other types of intellectual property rights enforcement, it is useful to look at this category as a separate index. This index can represent the statutory provisions for enforcing IPRs.

Enforcement	Available	Not Available
– Preliminary Injunctions	1/3	0
– Contributory Infringement	1/3	0
– Burden-of-proof Reversal	1/3	0

Enf-USTR

THIS INDEX IS A QUALITATIVE MEASURE of the effectiveness of IPR enforcement in practice. It is based on reports filed with the United States Trade Representative documenting the experience of IP enforcement in countries outside the United States.

The reports describe complaints, if any, about enforcement procedures and/or about the failure of the proper authorities to carry out the laws on the books. The failure to enforce may be due to some inability on the part of authorities to carry out those laws or to a conscious policy choice. The absence of substantive laws (other than enforcement provisions) is already incorporated in the previous indexes, and thus complaints about the lack of substantive laws are not incorporated here. Thus, the index is given by:

$$\begin{aligned} \text{Enf-USTR} = 0 & \quad \text{if enforcement measures are not available or are inadequate} \\ & \quad \text{(e.g. weak deterrents);} \\ 0.5 & \quad \text{if enforcement measures are available but not effectively carried} \\ & \quad \text{out (due to lag in policy implementation or resource} \\ & \quad \text{barriers);} \\ 1 & \quad \text{otherwise.} \end{aligned}$$

APPENDIX B**MANUFACTURING INDUSTRIES SAMPLE**

TABLE B-1		
LIST OF COUNTRIES IN THE SAMPLE		
Australia	Germany	New Zealand
Austria	Greece	Norway
Belgium	Italy	Portugal
Canada	Japan	Spain
Denmark	Korea	Sweden
Finland	Mexico	United Kingdom
France	Netherlands	United States

TABLE B-2**LIST OF INDUSTRIES IN THE SAMPLE (FOR EACH COUNTRY)**

SECTOR	LINE NUMBER FROM:	
	STAN DATABASE	DSTI DATABASE
1. Food, Beverages, Tobacco	3100	04
2. Textiles, Apparel, Leather	3200	07
3. Wood Products & Furniture	3300	12 and 40
4. Printing & Paper Products	3400	13 and 14
5. Chemicals (non-drugs)	3512x	18
6. Chemicals (drugs)	3522	19
7. Petroleum	3534A	16
8. Rubber & Plastics	3556A	20
9. Non-metallic Mineral Products	3600	21
10. Metals: Iron & Steel	3710	23
11. Metals: Non-Ferrous Metals	3720	24
12. Fabricated Metal Products	3800	25
13. Office & Computing Equipment	3825	28
14. Radio, TV, & Communication Equipment	3832	32
15. Electrical Apparatus (excl. communication equip.)	383X	29
16. Shipbuilding	3841	36
17. Motor Vehicles	3843	34
18. Aircraft	3845	37

Notes: STAN is the OECD Industrial Activity Database.
DSTI is the OECD Science & Technology Indicators Database.

ENDNOTES

- 1 See *IP Policy Initiatives*, www.strategis.ic.gc.ca.
- 2 Other kinds of IPRs (not explicitly treated in this study) are trade secret protection, geographic indications, industrial designs, etc.
- 3 Here, for simplicity, IPRs and the legal environment are held constant.
- 4 That is: $\alpha = \Omega_1/(-\Omega_0 - \Omega_3)$, $\beta = \Omega_2/(-\Omega_0 - \Omega_3)$, and $\gamma = -\Omega_4/\Omega_0$.
- 5 See also Howe and McFetridge (1976) for a model of R&D expenditure behaviour. The underlying basis is similar: investment in R&D proceeds to the point at which the marginal rate of return to R&D equals the marginal cost of funds.

-
- 6 An equivalent way to model the decision problem is to posit an aggregate (representative) firm that behaves competitively and maximizes equation (10) subject to equation (3).
 - 7 In this specification, neither the variety nor the quality of products resulting from R&D (or inventive) activity is explicitly treated.
 - 8 A comparable specification is found in Romer (1986), except that knowledge spillovers occur in the production function. A firm's investment generates learning by doing (which affects the future marginal productivity of capital). As in this model, knowledge spillovers operate at the economy-wide (or sector-wide) level.
 - 9 With constant returns to scale (i.e. $\sigma_1 - \sigma_2 = 1$), $\eta_1 = (\sigma_1 - 2)/(\sigma_1 - 1)$. Thus, $\sigma_1 = (2 - \eta_1)/(1 - \eta_1)$, $\sigma_2 = 1/(1 - \eta_1)$, and $\mu = \eta_2/(1 - \eta_1)$.
 - 10 A further distinction might be made between incumbent and entrant. The indexes tend to measure the strength of existing rights holders. For example, if existing IP owners exercised a very broad scope over their rights, the laws may make it difficult for new inventors to obtain intellectual property protection. This might be interpreted as a failure on the part of the system to provide intellectual property rights to entrants. However, this distinction is not pursued here. Perhaps the solution is to develop different indexes for different classes of inventors and creators.
 - 11 For example, incorporating *derivative works* adds no variability because all countries in the sample provide protection for these works in their copyright laws.
 - 12 For instance, only few countries specify the level of punishment or penalties for IP violations (length of sentences, amount of fines, etc.). Most countries indicate that infringement can be punishable as a civil or criminal offence, but are not explicit enough to allow for comparisons of punishment levels across countries.
 - 13 The authors obtained information on national patent laws from Baxter (2000) and WIPO (2000).
 - 14 Since all jurisdictions with trade-mark laws allow words, names, symbols, devices, or any combination, to be trade-marked, it was not necessary to list these under the coverage category. In some cases, colour, sounds, fragrances, or 3-dimensional objects can be registered, but cross-country variations in the protection of these are small.
 - 15 For a further discussion of the welfare effects of parallel import protection, see Maskus, 2000.
 - 16 For example, the murder rate is highest in the United States. But this does not necessarily indicate that criminal law enforcement in that country is the weakest in the world.
 - 17 Because the sample period is relatively short, $\tau = 0$ is assumed if this method produces negative values for τ .
 - 18 To obtain 1995 GDP figures, GDP growth rates from the *Development Indicators* were used to extrapolate the 1992 figures taken from the *Penn World Tables*.
 - 19 More specifically, a weighted average of manufacturing GDP, where the weights are the shares of each manufacturing industry in total manufacturing output.
 - 20 At least the two enforcement variables are not negatively correlated, which would mean that countries with strong laws on the books are the ones that least carry out their laws.

- 21 For the variable $NGD = \ln(n + g + \delta)$, the exogenous technical efficiency growth rate is assumed to be 2 percent ($g = 0.02$), as in Mankiw et al. (1992), and $\delta = 10$ percent.
- 22 The value of the left-hand-side variable is the average for 1987-95, while the value of the stock of R&D to output is for 1987.
- 23 Let x be the annual (average) trend rate of increase. Then $(1 + x)^{15} = 1 + 0.623$, so that $x = 0.0328$, or 3.28 percent.

ACKNOWLEDGMENTS

I AM GRATEFUL FOR COMMENTS from Wes Cohen, Donald McFetridge, Jonathan Putnam and many other participants at the Industry Canada Conference on *Intellectual Property and Innovation in the Knowledge-Based Economy*, held in Toronto (Canada) May 23-24, 2001. I would also like to thank Irem Dogan for capable research assistance. I remain responsible for any error or omission.

BIBLIOGRAPHY

- Baxter, J.W., J.P. Cent, J.M. Sinnott and W.J. Cadre (eds.). 2000. *World Patent Law and Practice*. New York: Matthew-Bender.
- Bessen, James, and Eric Maskin. 2000. *Sequential Innovation, Patents, and Imitation*. Working Paper No. 00-01. Cambridge, MA: Massachusetts Institute of Technology, Department of Economics.
- Business Software Alliance and Software Publishers Association. 1996. *1995 Software Piracy Survey*. Washington, D.C.
- Campbell, Dennis, and Susan Cotter (eds.). 1997. *Copyright Infringement*. Boston: Kluwer Law International.
- Diwan, Isaac, and Dan Rodrik. 1991. "Patents, Appropriate Technology, and North-South Trade." *Journal of International Economics* 30: 27-47.
- Ginarte, Juan Carlos, and Walter G. Park. 1997. "Determinants of Patent Rights: A Cross-National Study." *Research Policy* 26: 283-301.
- Gould, D., and W. Gruben. 1996. "The Role of Intellectual Property Rights in Economic Growth." *Journal of Development Economics* 48: 323-350.
- Gwartney, James, and Robert Lawson (with W.G. Park and C. Skipton) (eds.). 2002. *Economic Freedom of the World Annual Report*. Vancouver, B.C.: Fraser Institute.
- Helpman, Elhanan. 1993. "Innovation, Imitation, and Intellectual Property Rights." *Econometrica* 61, 6: 1247-1280.

- Hemnes, T.M., M.G. DiMambro and M.L. Moore (eds.). 1992. *Intellectual Property World Desk Reference: A Guide to Practice by Country, State, and Province*. Boston, MA: Kluwer Publishers.
- Howe, J.D., and D.G. McFetridge. 1976. "The Determinants of R&D Expenditures." *Canadian Journal of Economics* 9: 57-71.
- International Intellectual Property Alliance. 1998. "Parallel Import Protection in 107 elected Countries." *Conference on Exhaustion of Intellectual Property Rights and Parallel Importation in World Trade*. Geneva: International Trade Law Association.
- Korenko, George G. 1999. "Intellectual Property Protection and Industrial Growth." *Journal of World Intellectual Property* 2, 1: 47-75.
- Landes, W., and R. Posner. 1987. "Trademark Law: An Economic Perspective." *Journal of Law and Economics* 30: 265-309.
- . 1989. "An Economic Analysis of Copyright Law." *Journal of Legal Studies* 30: 265-309.
- Leaffler, Marshall A. (ed.). 1997. *International Treaties on Intellectual Property*. 2nd ed. Washington, D.C.: The Bureau of National Affairs Inc.
- Levin, R., A. Klevorick, R. Nelson and S. Winter. 1987. "Appropriating the Returns from Industrial Research and Development." *Brookings Papers on Economic Activity* 3: 783-820.
- Lichtenberg, Frank R. 1987. "The Effect of Government Funding on Private Industrial Research and Development: A Reassessment." *Journal of Industrial Economics* 36: 97-104.
- Mankiw, G., D. Romer and D. Weil. 1992. "A Contribution to the Empirics of Economic Growth." *Quarterly Journal of Economics* 107: 407-437.
- Maskus, Keith E. 2000. *Intellectual Property Rights in the Global Economy*. Washington, D.C.: Institute of International Economics.
- Park, Walter G. 2000. *International Patenting, Patent Rights, and Technology Gaps*. Working Paper, American University, Department of Economics, Washington, D.C.
- Park, Walter G., and Juan Carlos Ginarte. 1997. "Intellectual Property Rights and Economic Growth." *Contemporary Economic Policy* 15: 51-61.
- Park, Walter G. and Smita Wagh. 2002. "Index of Patent Rights." In *Economic Freedom of the World Annual Report*, James Gwartney and Robert Lawson (eds.). Vancouver, B.C.: Fraser Institute.
- Romer, Paul M. 1986. "Increasing Returns and Long-Run Growth." *Journal of Political Economy* 94, 5: 1002-1037.
- Sherwood, Robert. 1990. *Intellectual Property and Economic Development*. Boulder, CO: Westview Press.
- Siwek, Stephen E. 2000. *Copyright Industries in the U.S. Economy: 2000 Report*. Prepared for the International Intellectual Property Alliance. Washington, D.C.: Economist Incorporated.
- Takalo, Tuomas, and Vesa Kannianen. 2000. "Do Patents Slow Down Technological Progress? Real Options in Research, Patenting, and Market Introduction." *International Journal of Industrial Organization* 18: 1105-1127.
- Taylor, M. Scott. 1994. "Trips, Trade, and Growth." *International Economic Review* 35, 2: 361-381.

- UNESCO. Various issues. *Statistical Yearbook*. Paris.
- United States Trade Representative (USTR). *National Trade Estimates: Report on Foreign Trade Barriers*. Washington, D.C.: Office of the United States Trade Representative <serial>, 1987-1995.
- World Intellectual Property Office (WIPO). 2000. *IPLEX CD-ROM (Legislative Texts in the Field of Intellectual Property)*. Geneva.

OTHER REFERENCES

- Geller, Paul E. (ed.). 2000. *International Copyright Law and Practice*. New York: Matthew-Bender Publications.
- Horowitz, Ethan (ed.). 2000. *World Trademark Law & Practice*, vols. A, B. New York: Matthew Bender Publications.
- Louwers, Ernst-Jan, and Corien E.J. Prius (eds.). 1999. *International Computer Law*. New York: Matthew-Bender Publications.
- UNESCO. 2000. *Copyright Laws and Treaties of the World*. Paris.



Is Canada Still Missing the Technology Boat? Evidence Based on the Quantity and Quality of Innovations

SUMMARY

IN HIS RECENT STUDY, TRAJTENBERG (2000) points out that Canada has been lagging behind its G-7 counterparts in technological innovation and in research and development (R&D) activity. He further states that Canada seems to be “missing the technology boat” by not being able to innovate in the area of “general purpose technologies,” such as computer and communications, but rather continuing to innovate in traditional fields. All of these trends are direct reflections on Canada’s lagging productivity performance. This study uses the most recent information on U.S. patents awarded to G-7 countries to evaluate whether Canada’s innovative performance is better today than at the time of Trajtenberg’s study, as compared with other G-7 countries.

The study has three objectives: (1) to investigate the nature, pattern and changes in Canada’s innovative activity, as measured by the patenting activity in the United States, and to compare these results with those of other G-7 countries; (2) to understand the importance of quality versus quantity of innovations, and to assess how Canada is doing with respect to both the quality and quantity dimensions of innovation vis-à-vis its G-7 counterparts; and (3) to examine how the technological composition of Canadian innovations has changed in recent years using data for the period 1997-99, and thus assess whether Canada is still missing the technology boat.

The data show that, overall, Canada’s innovation performance has improved since the work of Trajtenberg. Instead of missing the technology boat, Canada has made impressive progress in innovating in strategically important

technology areas such as computers and communications, electrical and electronics, and drugs and medicines.

Trends in innovative activity indicate that, although Canada's record of spending on R&D is one of the poorest among the G-7, Canada has experienced one of the fastest rates of growth in R&D spending in recent years, second only to the United States. Canada's propensity to patent in terms of the ratio of U.S. patents to R&D expenditures has also increased in recent years; Canada ranks third after the United States and Japan in the production of patents per R&D dollar. However, in terms of the absolute number of U.S. patents held by foreign nationals and in terms of U.S. patents per capita awarded to foreigners, Canada's position did not change. A completely different picture emerges when Canada's growth in patenting activity in the United States is compared with that of other G-7 countries. In recent years, Canada experienced an explosive growth rate in patenting activity in the United States along with Japan and the United States; during the period 1997-99, Canada's growth rate was exceeded only by those of these two countries.

The technological composition of Canadian innovations has changed as well in recent years. The technological capabilities of Canada are generally increasing with its growing technological strength, most evident in the strategically important computer and communications, electrical and electronics, and drugs and medicines industries, and particularly computer and communications. This finding suggests that this combined high-technology area in fact offers both actual and potential great strength for Canada. However, relative to other G-7 economies, Canada's innovative performance in these industries is mixed, particularly in the computer and communications industries. On the one hand, the largest share of U.S. patents of Canadian origin went to computer and communications industries; Canada enjoyed the largest increase in its share of all U.S. patents originating from G-7 countries, and experienced the largest growth rate in patenting in this industry (again, as compared with other G-7 countries). On the other hand, it still ranks fourth among G-7 countries in terms of the absolute number of patents in this industry.

As for the quality of innovations, Canadian innovations are better in quality, as measured by the rate of citation of patents, than those of other G-7 countries except the United States. Although the citation rates of all G-7 country patents have improved over time, the rate of citation of U.S. patents awarded to U.S. nationals has increased at a faster pace than those awarded to other G-7 nationals. As a result, the innovation *quality gap* in terms of the patents *citation gap* between the United States and all other G-7 countries has widened. However, relative to the United States, the citation gap for Canadian patents has increased at a slower pace than that of other countries.

A numerical measure of quality based on a quality index indicates that both Canada and the United States produce above average quality innovations.

The quality of innovations of other countries is generally below average. Even though Canadian innovations are well above average quality, the quality index indicates that Canada still suffers a quality gap, as measured by the numerical difference in the average quality of patents between Canada and the United States. Nevertheless, this gap has been narrowing since 1998. The quality index indicates that although Canada produces innovations of above average quality across all industries, the average quality of U.S. innovations in these industries is still better than that of Canada. Over time, the average quality of U.S. patents has increased at a faster pace than the quality of Canadian patents in all industries except drugs and medicines, where Canada has outperformed the United States.

INTRODUCTION

THE IMPORTANCE OF TECHNOLOGY and innovation has been stressed by all national governments as the cornerstone of a country's competitiveness in the world marketplace. Pavitt and Soete (1982) have shown a strong correlation between a country's economic prosperity and its technological activities. With this in mind, the Government of Canada has been assigning increasing importance in recent years to innovation and technology-oriented economic growth. It has developed numerous initiatives to help stimulate the generation and diffusion of innovations, with the view that continuous innovation and adoption of technology by firms would help Canada become more innovative and competitive. In spite of these initiatives, Canada's innovation record remains poor (Trajtenberg, 2000; Conference Board of Canada, 2000).

Although Canada has made significant improvements in innovative activities over the past few years, a recent study by Trajtenberg (2000) points out that Canada has been lagging behind its G-7 counterparts in technological innovation and R&D activity. He finds that Canada stands midway among the G-7 nations in terms of patents per capita and the ratio of patents to R&D expenditures. He points out that the technological composition of Canadian innovations, as measured by the number of patents, is out of step with other competitor countries. In Canada, the share of patents in traditional mechanical and chemical fields is still very high, whereas the strategically important fields of computer and communications and electrical and electronics have grown more slowly. This observation has led Trajtenberg (2000) to proclaim that Canada seems to be "missing the technology boat" by not being able to innovate in the area of "general purpose technologies" (GPT), such as computer and communications, but rather continuing to innovate in traditional fields. The slow growth of innovations in general purpose technologies is disturbing in that it may reduce the growth potential of the Canadian economy, as these technologies are engines of growth (Helpman, 1998; Treffer, 1999). This point

is strongly emphasized by Trajtenberg (2000, p. 18): “As a general purpose technology improves and spreads throughout the economy, it prompts complementary advances in user sectors, bringing about generalized productivity gains. A thriving, innovative general purpose technology sector (in this case, computer and communications) is thus a crucial factor dictating the growth potential of advanced economies.” Moreover, Trajtenberg finds that the relative quality of Canadian innovations, measured by the number of citations per patent, is considerably lower than that of patents awarded to U.S. inventors.

Several authors have commented that Canada’s lag in innovation performance in terms of R&D investment and in the commercialization of technology through patenting activities, as well as the decreased emphasis on strategic technologies, have contributed to the recent erosion of Canada’s competitiveness (Rao, Ahmad, Horsman and Kaptein-Russell, 2001). Many have stressed that these declines are the main causes of the widening productivity gap, and thus the income gap, between Canada and its competitors, particularly the United States.¹ This inference suggests that, overall, Canadian inventions are not having a wide impact on either the national or world economies, largely because many Canadian patents are concentrated in the traditional mechanical and manufacturing technologies and very few are in the strategically important electronics and biotechnology areas. Thus arises Trajtenberg’s provocative question: “Is Canada missing the technology boat?”

While Trajtenberg’s study is impressive, it focuses mainly on the quantity of innovations, as measured by the number of patents. But to be a leader in science and technology, a country must have a strong base of high-quality inventive activity. Therefore, along with the volume of inventive activity, an assessment of the quality of Canada’s inventive activity, as compared to other industrial countries, is of key importance.²

The principal purpose of this study is to assess both the quality and quantity of innovative activity in Canada and to determine whether Canada’s innovation performance is better today than before, both at the national level and across industries. The questions posed are as follows: (1) How much innovative activity is occurring in Canada, compared to other G-7 countries, and is the inventive activity uniformly distributed across all industries? (2) How can we assess the quality of innovations? (3) Is quality more important than quantity? (4) How is Canada doing with respect to both the quality and quantity dimensions of innovations compared to other G-7 countries? and (5) Is Canada still missing the technology boat? To shed light on these issues, we employ highly detailed patent data on: (1) the number of U.S. patents granted between 1975 and 1999 to Canadians and nationals of other G-7 countries; (2) the number of citations of these patents; and (3) the number of these patents assigned to six industry sectors — electrical and electronics, mechanical, chemical, computer and communications, drugs and medicines, and *other* industries — for each of

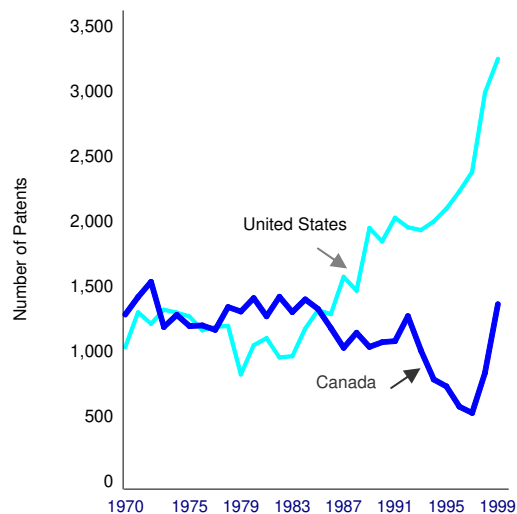
the G-7 countries. Both patent and citation data are drawn from the patent and citation database maintained by the Trade and Forecast (TAF) Branch of the U.S. Patent and Trademark Office (USPTO). We thus focus on both the volume and the quality of innovative activity.

Why do we focus on the number of U.S. patents held by G-7 countries, and particularly Canadian-held U.S. patents? The principal reason behind this is that, over the past few years, the number of U.S. patents obtained by a country has become a norm against which to evaluate its innovative capabilities.³ In fact, there is a strong correlation between the extent to which inventors patent in the U.S. patent system and the gross domestic product of their home country (Narin, 1991).⁴ There are several reasons for this. First, if small, open economies pursue innovation mainly to promote sales outside the home market, and if they expect to appropriate the returns to that innovation, it is the intellectual property rights in target countries with large markets, such as the United States, that have to be protected (Trajtenberg, 2001). Second, apart from the option of protection in the single largest market, the U.S. patent application process provides a distinct signal about the quality of the invention. Also, this signal can be obtained before deciding to pursue examination in countries (like the European Countries and Canada) that offer delayed examination. Thus, a country can truly evaluate and learn about the legal quality of its export-oriented technologies by analyzing its patents in the United States. Third, U.S. patenting by foreign inventors allows measurement of the levels of innovation in foreign countries and can serve as a leading indicator of new technological competition. Thus, a nation such as Canada can learn a great deal about its technologies and the importance, quality, generality and originality of its innovations by analyzing its patents granted in the United States. This was well recognized by Trajtenberg (2000, p. 4): "... thus one can hopefully learn a great deal about innovation in Canada by analyzing the Canadian patents granted in the United States."

Besides those cited above, there is another important reason to analyze patents granted to Canadians in the United States in that the data validate a way to look at Canadian technology. This is illustrated in Figure 1, which shows that U.S. patents granted to Canadians are growing at a much faster rate than domestic patents. Between 1990 and 1999, the number of U.S. patents issued annually to Canadian inventors increased by 74 percent to 3,226. Over the same period, the number of Canadian patents issued annually to Canadian inventors increased by 26 percent to 1,389. This suggests that U.S. patent data provide a more credible window on Canadian technology than Canadian patent data.⁵

FIGURE 1

COMPARISON OF TRENDS IN U.S. AND CANADIAN PATENTS GRANTED TO CANADIAN RESIDENT INVENTORS, 1970-99



Source: For Canadian patents, Canadian Intellectual Property Office (CIPO); for U.S. patents, USPTO.

The study is organized as follows: Overall trends in the growth of patenting activity in the G-7 countries are compared and contrasted in the second section. The third section analyzes patterns and trends in the industrial distribution of patents. The overall quality of patents of these countries is compared and contrasted in the fourth section. Whether the quality of patents differs across industries and across countries is investigated in the fifth section. Finally, the last section summarizes the main points and presents the conclusions.

OVERALL TRENDS IN PATENTING ACTIVITY BY COUNTRY

THIS SECTION PROVIDES THE BROADEST VIEW of patenting activity by country as it examines overall trends in G-7 countries' patenting in the United States. In subsequent sections, patents are divided into specific technological categories. Table 1 reveals that R&D spending in the United States far exceeds that of Canada and other G-7 countries. Canada's R&D performance is one of the poorest among G-7 countries, just ahead of Italy. Over time, all countries

TABLE 1

PATENTS VERSUS R&D SPENDING

COUNTRY	AVERAGE ANNUAL R&D SPENDING (\$10 MILLIONS)		AVERAGE ANNUAL PATENT COUNT		PATENTS PER \$10 MILLION R&D	
	1993-95	1995-97	1995-97	1997-99	1995-97	1997-99
Canada	1,052.6	1,198.2	2,238.3	2,859.7	2.1	2.4
Germany	3,755.0	4,036.8	6,808.7	8,480.0	1.8	2.1
France	2,689.4	2,753.0	2,855.7	3,484.0	1.1	1.3
United Kingdom	2,156.1	2,228.6	2,536.3	3,238.0	1.2	1.5
Italy	1,145.0	1,184.6	1,172.3	1,438.3	1.0	1.2
Japan	7,815.1	8,662.9	22,665.3	28,374.3	2.9	3.3
United States	17,314.8	19,839.1	59,516.7	75,301.3	3.4	3.8

Source: For R&D spending, Organisation for Economic Co-operation and Development (OECD); for patents, USPTO.

increased their level of R&D spending, and Canada experienced one of the fastest rates of growth in R&D spending compared to other G-7 countries. Between 1993-95 and 1995-97, R&D spending in the United States increased by 14.6 percent, followed by Canada (13.8 percent), Japan (10.8 percent) and Germany (7.5 percent). During the same period, other G-7 countries experienced an increase in R&D expenditures that ranged only from 2 to 3 percent.

Table 1 also shows the relationship between patents and R&D expenditures. To examine this relationship, we counted the number of U.S. patents issued to all G-7 countries in the years 1995-97 and 1997-99, and assumed that these were developed with R&D expenditures made from 1993-95 and 1995-97 respectively. Admittedly, this is a rather crude estimate, given that R&D dollars are spent on other things than patentable inventions. Table 1 shows that the number of patents per \$10 million of R&D expenditures varies widely among countries. Interestingly, the United States has produced the most patents in the last three years per R&D dollar, and Italy the least. Canada ranks third after Japan for the number of patents per R&D dollar.

The drawback to using U.S. patent counts is that U.S. data include all patents, while those for other countries include only patents filed abroad. Since foreign applications are (a) more costly and (b) filed a year after domestic applications, they represent a more valuable subset of all domestic applications. The "average annual patent count" and "patents per \$10 million R&D" columns show high numbers for the United States because of the large number of U.S.-only patents included in the total (Table 1).⁶

While the propensity to patent measured by the ratio of U.S. patents to domestic R&D expenditures is low for most countries, it does not suggest that the volume and pattern of innovative activity of these countries are declining.

TABLE 2

SHARE OF U.S. PATENTS HELD BY G-7 COUNTRIES (PERCENT)

	1980-89	1990-99
Canada	1.99	2.25
Germany	10.21	7.53
France	3.63	3.07
United Kingdom	3.78	2.71
Italy	1.42	1.29
Japan	18.28	23.56
United States	60.68	59.59

In fact, the patenting rate of most G-7 countries in the U.S. patent system has increased dramatically in recent years, particularly between 1997 and 1999. All countries gained share, registering an increasing trend and explosive growth during this period. To assess the relative position of Canada vis-à-vis other G-7 countries, we compare share, trend and growth in patenting in the United States.

Table 2 shows the share of U.S. patents held by each G-7 country out of the total held by all seven countries. The United States dominates the patent counts; Japan comes second. Canada had one of the lowest number of U.S. patents compared to other G-7 countries (with the exception of Italy), with only 2.0 percent of U.S. patents originating from Canada during 1980-89. This figure contrasts with 60.7 percent originating from the United States, 18.3 percent from Japan, 10.2 percent from Germany, 3.8 percent from the United Kingdom, 3.6 percent from France and 1.4 percent from Italy. Between the periods 1980-89 and 1990-99, patent shares have decreased considerably for all European G-7 countries; Japan made a substantial gain while Canada experienced a small gain. Comparing the same periods, Canada shows a slight long-term upward trend in U.S. patents held (Figure 2).

Figure 3 compares patenting trends from 1975 to 1999 in Canada and other G-7 countries. It also ranks the relative position of the United States vis-à-vis other G-7 countries. The United States' dominance in patent counts and strong upward trend in patenting activity since 1980 are both evident, making that country the undisputed technological leader of the world. In fact, the number of U.S. patents issued to U.S. citizens reached 83,906 in 1999, a 125-percent increase from 1980. Japan is the clear second while Germany comes in third place. Although, in general, the number of Canadian-originated U.S. patents has grown significantly over the period, Canada continues to lag other G-7 countries. It was next to last for the absolute number of patents in 1999, just ahead of Italy and just behind the United Kingdom. However, if we look at these numbers relative to each country's population base (see Figure 4), the United States, Japan and Germany retain their first, second and third rankings, respectively, while Canada manages to achieve fourth place.

FIGURE 2

SHARE OF U.S. PATENTS HELD BY CANADIAN INVENTORS,
1975-99

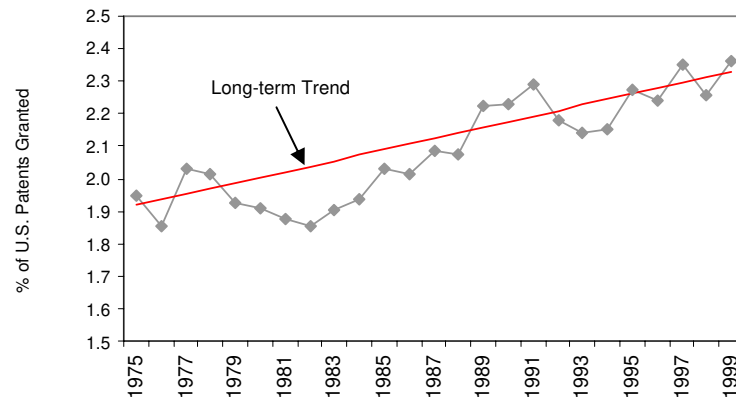


FIGURE 3

U.S. PATENTS GRANTED TO G-7 COUNTRIES,
1975-99

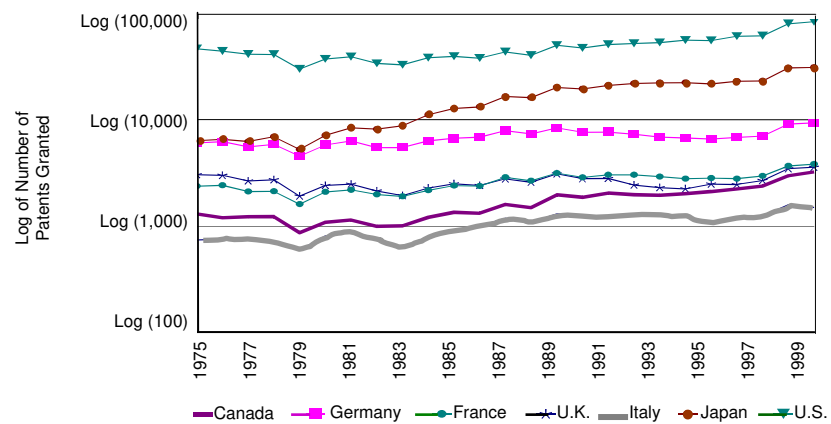
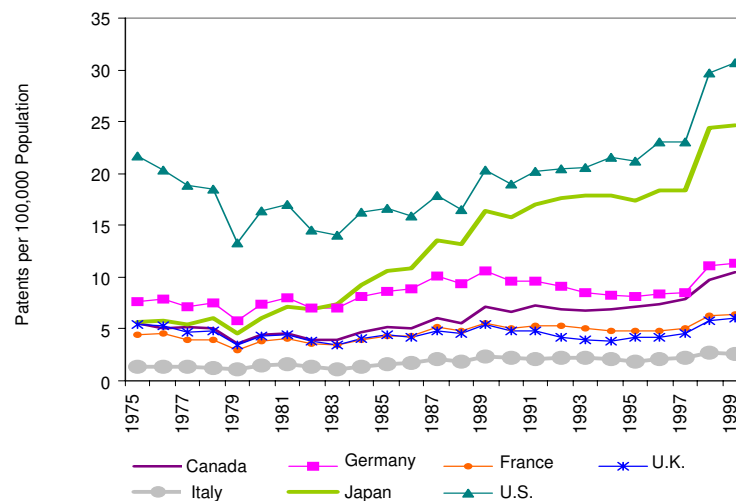


FIGURE 4

U.S. PATENTS GRANTED TO G-7 COUNTRIES PER 100,000 POPULATION, 1975-99



The trend in patenting behaviour in the United States has not been smooth over time and across countries (Figure 3). Patenting by U.S. inventors experienced a steady, dramatic decrease throughout the 1970s. In the 1980s, however, it started climbing again. Innovation experts observed the decline in U.S. patenting with some alarm, and concern was expressed that it reflected a decline in American inventive capabilities. By contrast, U.S. patents granted to Japanese inventors increased consistently throughout the 1970s, 1980s, and 1990s. In the 1970s, the increase was steady but modest; in the 1980s and thereafter, it was explosive. The number of U.S. patents issued to German inventors experienced a sharp decline in the 1970s, a modest increase in the 1980s and a steady decline in the 1990s. The other three European countries and Canada experienced a steady but small gain in U.S. patents held. A similar trend is observed across all countries when the number of U.S. patents held by a country is normalized by the country's population (Figure 4).

One of the most striking features of Figures 3 and 4 is that patenting activity in the United States by all G-7 countries displays an upward trend with a sharp increase starting in 1997.⁷ The rise is particularly important for Canada where the level of patenting activity has significantly improved since 1997. In fact, the number of Canadian-held patents granted in the United States increased from 1,296 in 1975 to 2,379 in 1997, an 84-percent increase over

22 years. Between 1997 and 1999, the number of U.S.-issued patents to Canadians increased from 2,379 to 3,226, a 36-percent increase in only two years.⁸

GROWTH

AS WITH ALL COMPARISONS OF ABSOLUTE LEVELS, differences in growth rates must be kept in mind. Table 3 shows the growth of patents granted in the United States during the 1980s and 1990s broken down by country of origin. All countries experienced an overall growth in patenting in the United States over the period 1980-99. All countries except Canada, the United States, and the United Kingdom experienced faster growth in the 1980s than in the 1990s, and all experienced a new surge in growth starting in 1997. Japan stands out with the highest growth rate in the 1980s, though it experienced slower growth in the 1990s. Canada experienced strong growth both in the 1980s and 1990s; it ranked second to Japan in the 1980s and second to the United States in the 1990s. Canada experienced explosive growth in the latter part of the 1990s. Between 1997 and 1999, the number of U.S. patents issued to Canadian inventors grew at an annual rate of 16.7 percent, lagging only behind Japan (17 percent) and the United States (17.3 percent).

The above statistics illustrate the innovative performance of G-7 countries over the 1975-99 period and for the past two years, 1997-99. The picture that emerges is that Canada ranks lower for both absolute and per capita counts of U.S. patents, as compared to other G-7 countries, in both periods. For the absolute number of patents, it ranks second to last, and for patents per capita, it takes fourth place. On these indicators, Canada's position did not change in most recent years, particularly, since Trajtenberg's study. However, a completely different picture emerges when the growth in Canadian patenting activity in the United States is compared with that of other G-7 countries. Canada experienced one of the highest rates of growth in patenting, second only to Japan in the 1980s and to the United States in the 1990s. In recent years, it

TABLE 3

AVERAGE ANNUAL GROWTH RATE OF PATENTING ACTIVITY IN THE UNITED STATES (PERCENT)

	1980-90	1990-99	1997-99	1980-99
Canada	6.42	6.58	16.74	6.49
Germany	3.27	2.73	16.22	3.01
France	3.80	3.54	14.09	3.68
United Kingdom	2.19	3.39	16.23	2.76
Italy	5.63	2.46	11.02	4.13
Japan	11.21	5.74	16.95	8.62
United States	3.02	6.88	17.31	4.85

experienced explosive growth rates along with Japan and the United States. During the period 1997-99, it was second to Japan and third to the United States. These findings suggest that in order to improve its standing in terms of both the absolute number of patents and patents per capita, Canadian patenting would have to grow significantly faster than at present.⁹

PATENT ACTIVITY IN INDUSTRY SECTORS

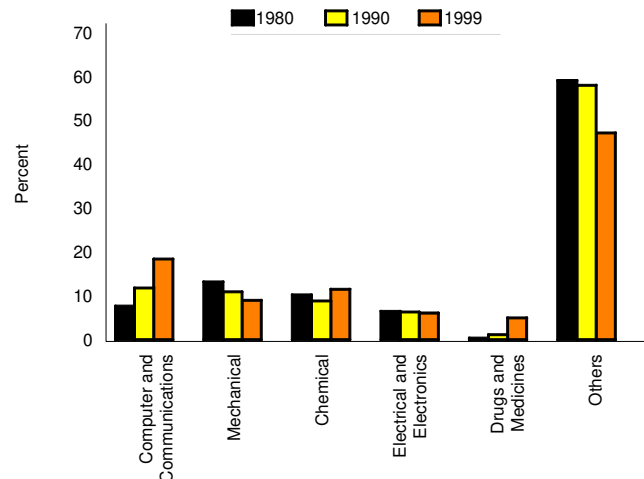
THE ABOVE OVERVIEW PROVIDES some useful insights into countries' patenting activities. However, it may be misleading to examine a country's innovation performance through an overall patent set without paying attention to technological and/or sectoral categories. In this section, we partially correct for this by dividing U.S. patents held by all countries over the study period into a number of industrial categories. U.S. patents can be classified by industry sector, with each patent fractionally assigned according to the number of industry-related product fields to which it is most relevant. In this classification system, each patent is associated with the Standard Industrial Classification (SIC) industry that corresponds to that class's product or apparatus, or process steps (National Science Board, 1996).¹⁰ Six large industry groups are examined here: chemical, computer and communications, drugs and medicines, electrical and electronics, mechanical, and other. Patent activity by Canadian inventors in these six industrial groups will be compared to that of other G-7 inventors. This section has two main purposes: (1) to investigate the technological (industrial) distribution of patents in order to examine whether patenting activities are uniformly distributed across industries in each country or concentrated in some industries; and (2) to investigate whether Canada is *still* missing the technology boat, that is, to determine whether patents assigned to Canada's strategically important industrial sectors, particularly computer and communications, have been gaining in importance. We also compare the distribution of U.S. patents held by all countries to the distribution of U.S. patents held by the United States.

We first evaluate Canada's performance across industries and then compare it with that of its competitors.

Traditionally, the most prevalent Canadian-invented technologies have come out of the relatively *low-tech* mainstays of Canadian industry: the chemical and mechanical sectors. However, the situation has changed in recent years. The technological capabilities of Canada are generally increasing with its growing strength, most evident in computer and communications and drugs and medicines industries. This is clearly demonstrated in Figure 5, which presents the share of U.S. patents of Canadian origin broken down by industrial sectors. Figure 5 shows that, in the United States, Canadian inventors are increasingly patenting in cutting-edge technologies that are expected to play an

FIGURE 5

SHARE OF U.S. PATENTS HELD BY CANADIAN INVENTORS IN
SELECTED INDUSTRIES, 1980, 1990 AND 1999

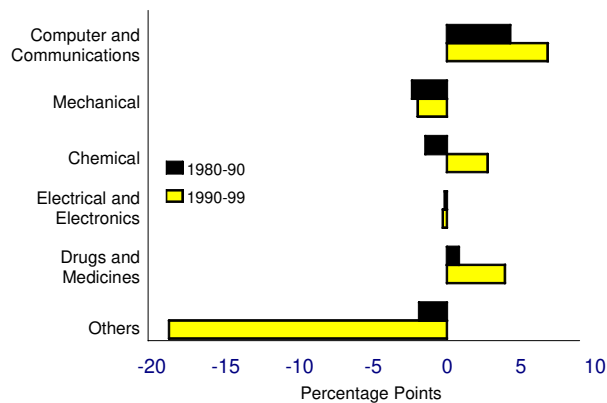


important role in future economic growth. Over the period 1980 to 1999, the largest number of U.S. patents of Canadian origin went to computer and communications industries. Over the same period, the traditionally strong mechanical field lost ground, while chemical industries gained. The largest increase in the share of U.S. patents of Canadian origin occurred in the computer and communications industries, followed by drugs and medicines, chemical, and electrical and electronics industries (Figure 6). The combined computer and communications, electrical and electronics, and drugs and medicines patents ranked second to combined patents in two traditional industry groups — chemical and mechanical — during the 1980s and 1990s, but had moved to first place by 1999. Thus, this combined high-technology area may, in fact, represent a source of current and potential future strength for Canada.

While Canada shows greater potential in the area of computer and communications as compared with any other single industry group, its share of patenting activity in this sector is still well below that of all other G-7 countries, except Germany and Italy (Table 4). Over the 1998-99 period, the share of total patents going to this industry group for Japan and the United States was about twice and one-and-a-half times, respectively, the corresponding share of Canadian patents. Between 1990-97 and 1998-99, all countries experienced an

FIGURE 6

CHANGE IN SHARE OF U.S. PATENTS HELD BY CANADIAN INVENTORS IN
SELECTED INDUSTRIES, 1980-90 AND 1990-99



increase in the share of their U.S. patents received by this industry group, the largest increase occurring in the United States (7.6 percentage points), followed by Canada (6.8 percentage points).¹¹ As for share growth, Canada experienced the largest increase in this industry group between the two periods.

Patenting activity in the United States by Canadian inventors in cutting-edge technologies relating to three industry groups — computer and communications, electrical and electronics, and drugs and medicines — is also below all G-7 countries except Germany and Italy, though Canada enjoyed the largest increase (44 percent) in their combined share between 1990-97 and 1998-99.

The above statistics provide mixed messages, depending on the indicator of comparison. On the one hand, Canada experienced the highest growth rates in patenting in industries related to general purpose technologies (computer and communications) and strategically important cutting-edge technologies, by comparison with other G-7 countries. On the other hand, it still ranks fourth among the G-7 countries in terms of the absolute number of patents in these industries. Although Canadian patenting activity in these industries is currently growing at the fastest rate, it must grow at an even faster rate than at present in order to improve its standing. Much faster growth is essential since that combined high-technology area — computer and communications, electrical and electronics, and drugs and medicines — may, in fact, represent an important source of actual and potential strength for Canada.

TABLE 4												
SHARE OF PATENTS BY INDUSTRY ACROSS COUNTRIES (PERCENT)												
	1975-79	1980-89	1990-97	1998-99	1975-79	1980-89	1990-97	1998-99	1975-79	1980-89	1990-97	1998-99
SECTOR	CANADA				GERMANY				FRANCE			
Computer and Communications	8.47	10.65	11.88	18.63	8.00	8.89	9.68	12.32	12.44	14.78	17.71	18.87
Drugs and Medicines	0.60	0.68	2.01	4.87	0.56	0.62	1.12	1.82	0.99	0.78	1.63	3.82
Electric and Electronics	7.47	7.36	7.10	6.66	8.15	8.76	8.06	8.33	8.60	9.97	9.48	9.55
Total	16.55	18.69	21.00	30.16	16.71	18.27	18.86	22.47	22.03	25.53	28.81	32.24
Chemical	11.37	9.00	9.82	11.79	24.34	19.08	21.54	19.41	20.97	17.25	20.43	21.66
Mechanical	13.96	12.43	10.95	9.66	12.53	13.20	11.91	11.40	12.06	9.84	7.66	5.52
Others	58.13	59.88	58.23	48.39	46.42	49.45	47.69	46.72	44.95	47.37	43.10	40.58
Total	83.45	81.31	79.00	69.84	83.29	81.73	81.14	77.53	77.97	74.47	71.19	67.76
Grand Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	UNITED KINGDOM				ITALY				JAPAN			
Computer and Communications	10.14	12.66	16.91	21.66	9.50	9.24	10.64	16.16	14.60	21.25	30.85	36.75
Drugs and Medicines	0.68	1.13	2.17	5.02	0.95	0.79	1.58	2.31	1.05	0.78	0.81	0.98
Electric and Electronics	9.08	8.45	7.52	7.40	7.14	7.68	6.63	6.70	10.60	11.67	11.77	11.93
Total	19.89	22.25	26.60	34.08	17.60	17.72	18.85	25.16	26.25	33.70	43.42	49.66
Chemical	21.43	18.78	21.66	21.60	25.19	21.07	23.24	19.38	18.23	12.10	11.18	8.82
Mechanical	12.33	11.68	8.85	6.35	10.40	11.77	11.96	11.18	10.05	9.20	6.35	5.54
Others	46.34	47.29	42.90	37.96	46.82	49.44	45.95	44.28	45.47	45.00	39.05	35.97
Total	80.11	77.75	73.40	65.92	82.40	82.28	81.15	74.84	73.75	66.30	56.58	50.34
Grand Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

IS CANADA STILL MISSING THE TECHNOLOGY BOAT?

TABLE 4 (CONT'D)				
SHARE OF PATENTS BY INDUSTRY ACROSS COUNTRIES (PERCENT)				
	1975-79	1980-89	1990-97	1998-99
SECTOR	UNITED STATES			
Computer and Communications	11.73	13.65	18.94	26.57
Drugs and Medicines	0.62	1.06	2.11	3.86
Electric and Electronics	8.25	8.90	8.40	8.07
Total	20.60	23.60	29.45	38.50
Chemical	16.28	14.23	12.88	11.39
Mechanical	10.93	9.80	7.70	6.12
Others	52.19	52.36	49.96	43.98
Total	79.40	76.40	70.55	61.50
Grand Total	100.00	100.00	100.00	100.00

Table 5 presents the average share of patents in each industry for all countries, computed for four periods: 1975-79, 1980-89, 1990-97 and 1998-99. In all periods, the order of the top three countries is the same across all industry groups — the United States, Japan and Germany. The United States has a strong lead everywhere. Canada is generally weak in all industry groups, as the share of U.S. patents awarded to Canadians is much lower than that of all other countries, except Italy.

Over time, particularly in the later part of the 1990s, both Canada and the United States have shown growing strength in high-tech sectors. In the latter part of the 1990s, patent shares in the strategically important computer and communications, electrical and electronics, and drugs and medicines industries have increased considerably for Canada and the United States. Japan lost ground in these industries, especially in computer and communications, and drugs and medicines. The share of other countries in these industry groups has generally declined. Canada's performance has been particularly impressive compared to both the United States and Japan. Between 1990-97 and 1998-99, Canada's share of U.S.-issued patents in computer and communications increased by 23.4 percent, compared to 9.7 percent for the United States, while Japan experienced a 12-percent decline. In drugs and medicines, the increase was 38.2 percent for Canada against 4.1 percent for the United States, while Japan experienced a 34.9-percent decline. Both Japan and the United States made gains in the electrical and electronic industries, while Canada registered a small loss. In the more traditional chemical and mechanical industries, Canada's share has increased by 41.8 percent and 10.6 percent, respectively. Comparing the same periods, the United States experienced a small gain in chemical industries and a small loss in mechanical industries. In these two industry groups, Japan's experience was opposite to that of the United States.

Table 6 further shows the growth of patents granted in the United States in the latter part of the 1970s, the 1980s, the 1990s, and the latter part of the 1990s, broken down by country of origin and sector. It can be seen that, on average, computer and communications, and drugs and medicines industries are associated with high growth in patenting; chemical, and electrical and electronics industries are associated with moderate growth. In the latter part of the 1990s, all countries experienced explosive growth in patenting activity across all industries. For the period 1997-99, Canada stands out with the highest growth rates in all specified industry groups, except electrical and electronics, and mechanical. Surprisingly, in electrical and electronics industries, France ranks first and Canada ranks sixth with 11.3-percent annual growth. The United Kingdom ranks lowest in mechanical industries, while other countries experienced double-digit growth in patenting in these industries.

TABLE 5

AVERAGE SHARE OF PATENTS BY COUNTRY ACROSS INDUSTRIES (PERCENT)

[illegible]

TABLE 6												
AVERAGE ANNUAL GROWTH IN PATENTING ACTIVITY BY COUNTRY ACROSS INDUSTRIES (PERCENT)												
	1975-80	1980-90	1990-97	1997-99	1975-80	1980-90	1990-97	1997-99	1975-80	1980-90	1990-97	1997-99
	CHEMICAL				COMPUTER AND COMMUNICATIONS				DRUGS AND MEDICINES			
Canada	-2.23	6.85	7.39	20.08	-1.19	10.74	14.24	42.54	19.20	28.89	27.41	42.75
Germany	-1.70	3.50	1.14	5.78	-2.31	6.09	7.22	26.78	16.99	4.36	15.61	21.55
France	0.52	3.50	5.46	8.09	5.17	5.48	5.19	13.20	-1.67	15.32	21.06	16.44
United Kingdom	1.11	1.79	4.47	12.50	-3.22	7.18	9.03	32.43	12.16	9.54	21.06	20.68
Italy	4.00	4.13	1.47	3.10	10.83	8.08	8.50	14.62	32.33	64.72	13.68	17.96
Japan	0.96	8.33	2.10	8.69	3.01	17.86	10.32	22.33	3.51	4.44	11.91	16.16
United States	-3.31	1.28	5.30	7.80	-2.22	6.18	13.67	28.95	6.63	10.04	21.24	16.73
	ELECTRIC AND ELECTRONICS				MECHANICAL				OTHERS			
Canada	-4.48	8.18	6.38	11.26	-3.80	4.95	1.61	18.33	-0.34	6.24	2.71	8.59
Germany	-2.17	4.04	3.68	17.60	0.43	2.41	-1.93	16.34	2.75	3.17	-2.09	18.17
France	0.75	5.87	5.18	26.43	-3.37	2.17	-8.32	18.58	-1.84	3.85	-1	14.65
United Kingdom	-3.43	4.67	2.27	20.61	-1.99	-0.63	-3.26	4.98	-4.23	1.98	-1.97	11.93
Italy	-0.32	9.43	4.90	6.85	3.08	7.03	-1.2	21.01	3.33	5.91	-1.8	12.44
Japan	9.68	10.97	5.86	15.31	6.98	7.74	-1.55	19.06	4.43	10.60	0.54	14.43
United States	-2.39	3.12	6.32	13.95	-4.55	0.72	-0.17	14.99	-2.87	3.05	1.65	15.11

The overview presented above once again provides some useful insights into Canada's technological strength. Canada's explosive growth in U.S. patent holdings in computer and communications and drugs and medicines industries, and moderate growth in electrical and electronics industries indicate that, in this combined high-technology area, Canada may in fact have greater actual or potential strength compared to its competitors.

The above findings provided motivation to further study the three major strategically important high-technology industry groups — drugs and medicines, electrical and electronics, and computer and communications. In each of these high-tech sectors, we first present a detailed comparison between Canada and the other G-7 countries, revealing trends and fluctuations over time.

Figures 7a-7c show the U.S. lead over all other G-7 countries in terms of the number of patents granted in drugs and medicines, computer and communications, and electrical and electronics industries, a lead that is increasing especially in the 1997-99 period. In all three areas, Japan places a distant second, but still leads all other nations by a wide margin in terms of the number of U.S. patents granted. Japan also shows an increasing trend similar to that of the United States in all these sectors, with a surge in patenting activity after 1997, except in drugs and medicines industries where patenting declined after 1997. Trends for Canada and European countries have been less steep, as compared to Japan and the United States, throughout the period covered by the study.

When we normalize against the population base of each country, all countries show an upward trend in patenting activity in the United States for all three industry groups and a surge in patenting starting in 1997 (Figures 8a-8c). However, the pattern of per capita patenting activity differs markedly by industry group across countries.

In computer and communications industries, per capita patenting activity in the United States by U.S. nationals shows a declining trend until 1986, while Japan's shows an increasing trend. Both show an upward trend thereafter (Figure 8a). One of the striking features of Figure 8a is that Japan has had a consistent lead in per capita patents in computer and communications industries since 1986. Other countries also experienced an upward trend in patenting in the United States over the 1975-99 period. Surprisingly, Canada leads all the European countries starting from 1997.

The total number of patents per capita granted to U.S. nationals in industries related to drugs and medicines is consistently above that of all other G-7 countries, as shown in Figure 8b. In terms of patents per capita, the other six countries were running a very tight race through 1995. But the last five years of data suggest that Canada is strikingly and consistently pulling ahead.¹²

FIGURE 7a

U.S. PATENTS GRANTED TO G-7 COUNTRIES,
COMPUTER AND COMMUNICATIONS INDUSTRIES, 1975-99

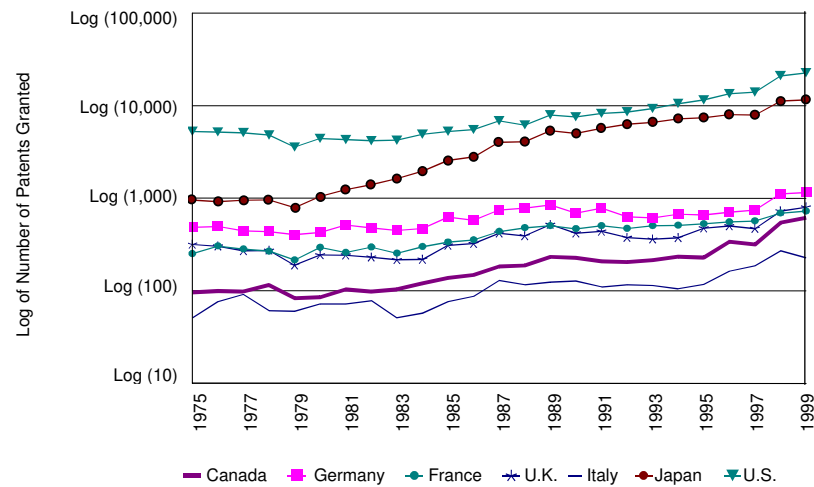


FIGURE 7b

U.S. PATENTS GRANTED TO G-7 COUNTRIES,
DRUGS AND MEDICINES INDUSTRIES, 1975-99

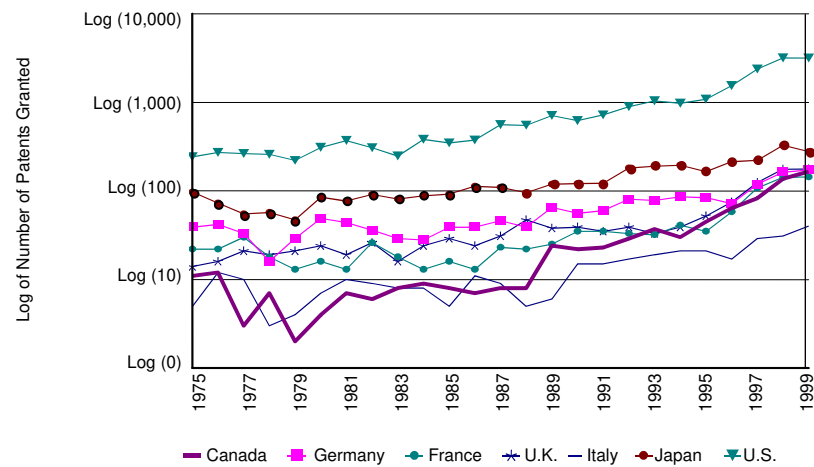


FIGURE 7c

U.S. PATENTS GRANTED TO G-7 COUNTRIES,
ELECTRICAL AND ELECTRONICS INDUSTRIES, 1975-99

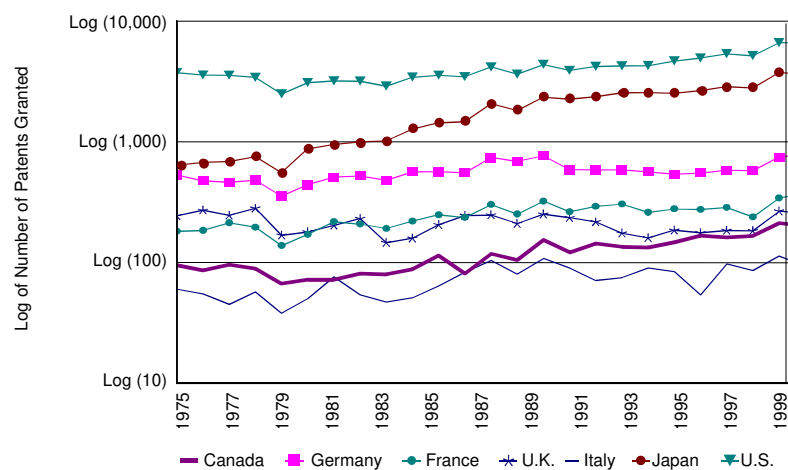


FIGURE 8a

U.S. PATENTS GRANTED TO G-7 COUNTRIES PER 100,000 POPULATION,
COMPUTER AND COMMUNICATIONS INDUSTRIES, 1975-99

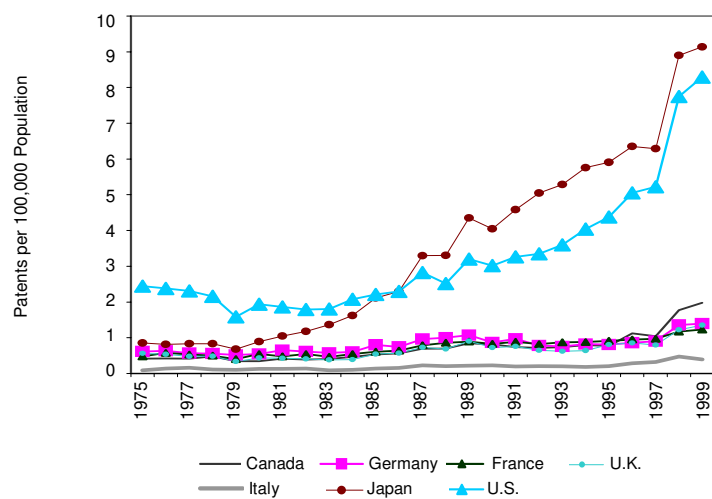


FIGURE 8b

U.S. PATENTS GRANTED TO G-7 COUNTRIES PER 100,000 POPULATION,
DRUGS AND MEDICINES INDUSTRIES, 1975-99

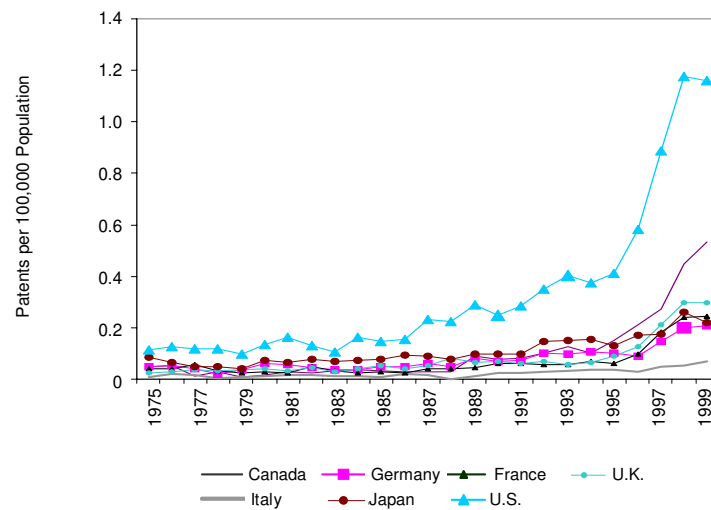
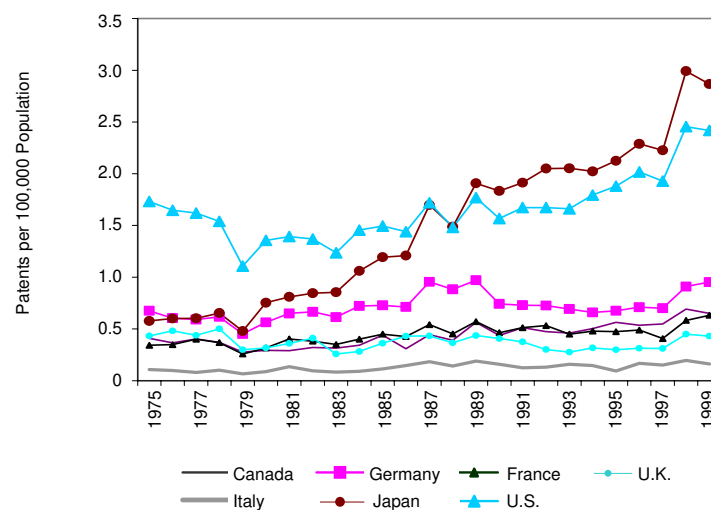


FIGURE 8c

U.S. PATENTS GRANTED TO G-7 COUNTRIES PER 100,000 POPULATION,
ELECTRICAL AND ELECTRONICS INDUSTRIES, 1975-99



In electrical and electronic industries, both Japan and the United States exhibit a pattern similar to that of the computer and communications industries. The United States produced consistently more electrical and electronics-related patents per capita, though at a declining rate, than any other G-7 country until the mid-80s. Japan shows an upward trend throughout the period 1975-1999. Again, one of the striking observations is that, on a per capita basis, the dominance shifts to Japan from the beginning of 1986, a dominance that is increasing throughout the 1990s. All other countries show an increasing trend throughout the study period, except Germany. The latter shows a declining trend during most of the 1990s and a sharp increase starting in 1997. Like the balance of the European countries, Canada shows an upward trend throughout that period and surpasses these countries in 1997.

OVERALL TRENDS IN THE QUALITY OF PATENTS

OUR QUANTITATIVE ANALYSIS OF PATENTS provides some interesting evidence on the volume of innovative activity of G-7 countries, particularly Canada. While the number of patents granted is a good overall indicator of the inventive output and related commercialization activity, it does not measure how valuable a patent is relative to other patents. Moreover, simple patent counts do not account for the large variations in the technical and economic qualities of patents.¹³ Assessing the quality of a patent, for example by measuring the number of citations, gives us an indication of the technological impact of the patent and of its commercial value. It is therefore important to investigate the quality of patents. Moreover, given the recent expansion of the patent system and the importance of managing intellectual property, it has become increasingly important to be able to analyze patent portfolios without sifting through thousands of individual patent documents. For this reason, patent citation analysis techniques have been developed to statistically assess the quality and strength of patent portfolios (Breitzman, Thomas and Cheney, 2000).¹⁴

However, the following analysis rests on the explicit assumption that patent citations reflect flows of knowledge, and that the number of citations tells us something about the technological significance of patents and of the underlying inventions.

There is a growing body of literature that considers the quality (value) of a country's patents to measure its technological strength (e.g. Albert, Avery, Narin and McAlliater, 1991; Harhoff, Narin, Scherer and Vopel, 1999). This literature assumes that the value of any patent is reflected in the number of times the patent is cited, or the length of its renewal, or the number of countries where it is taken (Lanjouw and Schankerman, 1999; Guellec and de la Potterie, 2000). Among these, the most popular quality indicator of patents is the number of times a patent document is cited in other patent documents.¹⁵

Patent citations have been widely used as an instrument for measuring the impact and fine structure of technological innovations. It has been argued that through citation counts, one can achieve a better approximation of the economic value of inventive activity than by using only patent counts or data on R&D expenditures (Harhoff et al., 1999). Work by Jaffe, Trajtenberg and Fogarty (2000) has also shown a significant positive correlation between patent citations and the economic and technological importance of a patent.

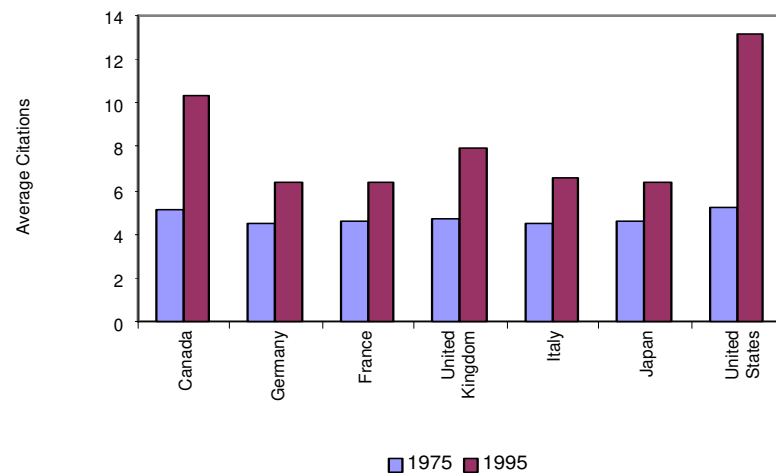
For the purpose of this study, we consider three measures of the quality or technological importance of patents: the average number of citations, the magnitude of the importance of U.S. patents originating from another country relative to U.S. patents originating from the United States (i.e. the extent of the *disadvantage* of patents from another country), and a quality index — based on the number of citations.

QUALITY OF PATENTS: CITATIONS

WE NOW COMPARE THE TECHNOLOGICAL significance of the patents of G-7 countries using the average number of citations received by a patent as an indicator of the patent's quality. We examine citations in a five-year moving window — the year the patent is issued and the four subsequent years — because patents typically receive few citations in the first few years after they are issued (Zucker and Darby, 1999). We track the number of patents and the number of citations from 1975 through 1999 for all G-7 countries and technologies. Our analysis of patent quality includes only patents granted up through 1995 in order to allow us to accumulate five years of citations for newly issued patents. In Figure 9, we present the number of citations, cumulated over five years, of patents issued in 1975 and 1995. A five-year moving window was selected to allow time for sufficient citations to accumulate for newly issued patents. Otherwise, our measure would be biased against recent patents since new patents have a low probability of being cited during the first few years following their issuance. There are two striking features in Figure 9. First, the average number of citations by country suggests that Canadian patents are technologically more significant than the patents of other G-7 countries, except the United States. Second, Canada has a patent *quality gap*, as measured by the *citation gap*, relative to the United States, though it leads all other countries in the number of citations per patent granted. This is due to the fact that U.S. patents awarded to foreigners are generally cited less frequently than those awarded to U.S. inventors, suggesting that U.S. patents are better in quality. In 1995, Canadian patents were *better* than Japanese patents by about 163 percent, Italian patents by about 157 percent, German and French patents by about 162 percent, and U.K. patents by about 130 percent.¹⁶ In the same year, U.S. patents were about 127 percent better than Canadian patents.

FIGURE 9

AVERAGE CITATIONS PER PATENT, BY YEAR AND BY COUNTRY,
1975 AND 1995



QUALITY OF PATENTS: DISADVANTAGE

IN THIS SECTION, WE MEASURE THE MAGNITUDE of the importance of U.S. patents awarded to Canada and other countries. We build upon Trajtenberg's work (2000), who measures the degree of importance of a U.S. patent issued to a country by estimating how much *disadvantage* the country's patent has over a U.S. patent of U.S. origin, that is, how much advantage a U.S. patent of U.S. origin has over a U.S. patent originating from another country. Trajtenberg postulates that the disadvantage of U.S. patents held by foreign nationals vis-à-vis those held by U.S. nationals is a function of the citation rates of both countries' patents.¹⁷ For example, the extent to which Canadian patents have lower citation rates than U.S. patents determines the disadvantage of Canadian patents relative to U.S. patents. Thus, the *disadvantage* of Canadian patents vis-à-vis U.S. patents is defined as the ratio of the number of citations per U.S. patent of Canadian origin to the number of citations per U.S. patent of U.S. origin minus one, expressed in percentage terms (see Trajtenberg, 2000, p. 28).

TABLE 7

DISADVANTAGE OF G-7 PATENTS RELATIVE TO U.S. PATENTS (PERCENT)

	1980	1990	1999
Canada	-8.97	-7.84	-22.23
Germany	-21.31	-40.70	-54.19
France	-20.90	-38.81	-53.03
United Kingdom	-18.47	-29.38	-40.67
Italy	-23.70	-39.14	-52.16
Japan	-21.60	-40.49	-53.96

FIGURE 10

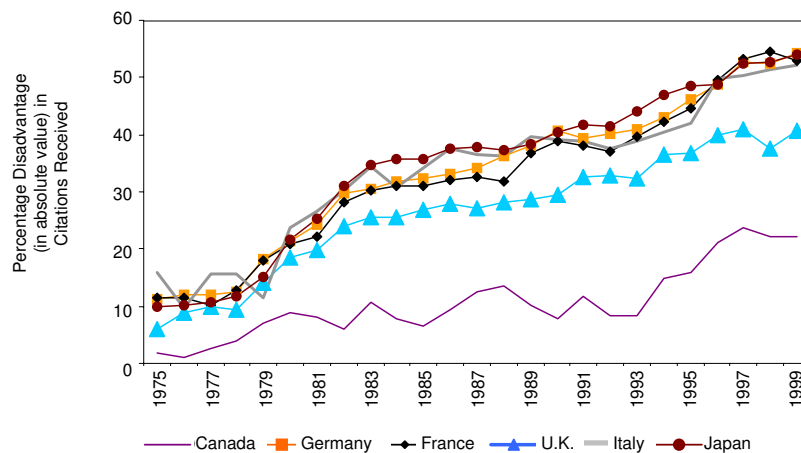
RELATIVE IMPORTANCE OF G-7 PATENTS VS. U.S. PATENTS,
1975-99

Table 7 shows the disadvantage of G-7 patents relative to U.S. patents for the years 1980, 1990 and 1999. Figure 10 illustrates the trends in the importance (the absolute value of the *disadvantage*) of all countries' patents relative to U.S. patents. From Figure 10, it is evident that U.S. patents of Canadian origin are far less disadvantaged than those originating from other countries, thereby suggesting that Canadian patents are more important relative to those of all other countries (except the United States). Figure 10 also illustrates that the relative importance of G-7 countries' patents, as measured by the absolute value of the disadvantage, has declined over time. This is primarily due to the fact that, on average, the rate of citation of the patents of other countries has

declined at an increasing pace compared to that of U.S. patents of U.S. origin. This disadvantage, however, has increased at a slower pace for Canadian patents than for other countries' patents, especially over the period 1997-99. This suggests that, in recent years, Canadian patents have been gaining in importance relative to all other countries' patents (except those of the United States), especially since Trajtenberg's study, which is an important finding.

QUALITY OF PATENTS: QUALITY INDEX

SO FAR, WE HAVE EVALUATED THE QUALITY of patents in terms of citation counts and in terms of the importance of G-7 countries' patents relative to U.S. patents, as measured by the *disadvantage* index. The latter is also based on the number of citations. Citation frequency, or the average number of citations per patent, is the most basic measure of the technological impact of a patent. A measure of technological impact based on citation frequencies has two important disadvantages. First, citation frequencies are calculated by dividing the number of observed citations of a patent by the number of potential citations associated with it (the latter is the product of the number of potentially citing and the number of potentially cited patents). Thus, citation frequency is not a reliable measure of technological impact for the first year or two after a patent is granted. Second, patent citation counts per patent issued can vary greatly across industries, countries and years due to skewed distributions and averaging over a small number of patents. Therefore, trend comparisons based on the number of citations may be misleading. Keeping this in mind, we now proceed to construct a quality index, which is a normalized citation indicator, to measure patent impact. The aim here is to investigate whether the conclusions presented above would differ using a quality index.

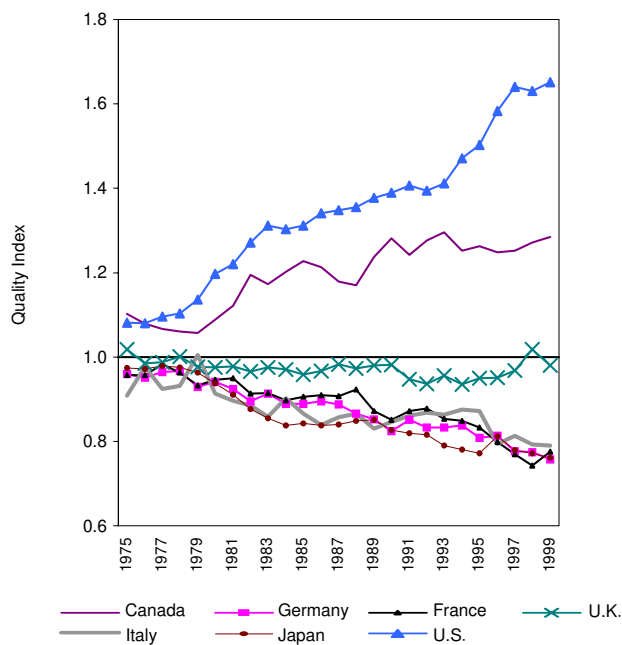
A number of indices — the Citation Index, the Current Impact Index, the Technology Cycle Time Index, the Science Linkage Index, and the Technological Strength Index — have been proposed to measure the technological importance of a patent (e.g. by Narin and others). All these indices are derived from patent citations.¹⁸ The use of these indices requires firm-level patent data. Because of data constraints, for the purpose of this study, we employ a variant form of the Current Impact Index — a quality index as adapted by Granstrand (1999). Following Granstrand, the quality index is defined as the ratio between the average citation intensity (that is, the number of citations per patent) for a country's firms in an industry and the average citation intensity in that industry across countries, so that a value above one indicates a patent quality higher than average. (A value of 1.0 represents an average citation frequency; so 1.4 would mean that a firm's patents were cited 40 percent more often than average, and so on.)

Figure 11 plots the quality index of patents of all G-7 countries over the period 1975-99. It shows that U.S. patents of U.S. origin are, by far, of the highest quality, and that the quality of the U.S. patents has substantially increased over time. The quality of U.S. patents of Canadian origin ranks next to the United States and has been well above average throughout the study period. Although U.S. patents of Canadian origin achieved second place compared to all other G-7 countries, a quality gap has always existed between Canada and the United States. That quality gap has widened over the period 1977-96. However, it has been narrowing since 1998. In 1977, the quality gap between Canada and the United States was about 2.9 percent. It then increased to reach 31 percent by 1997, but narrowed substantially afterwards to 22.2 percent in 1999. This is an important finding as it shows an improvement since Trajtenberg's study (2000).

By contrast, the other U.S. patents of G-7 country origin are cited at a below average rate, and the quality of these patents is declining over time, except for the United Kingdom. The quality of U.K. patents displays a flat trend

FIGURE 11

QUALITY INDEX BY COUNTRY, 1975-99



since 1977. Between 1977 and 1999, the quality of U.S. patents issued to U.S. inventors increased by 53 percent, while the quality of U.S. patents of Canadian origin increased by only 17 percent. Over the same period, the quality of U.S. patents issued to other G-7 countries declined. The largest decline was experienced by Japan (22 percent), followed by Germany (21 percent), France (19 percent), Italy (13 percent) and the United Kingdom (4 percent).

The statistics given above show that U.S. patents awarded to U.S. residents are far better in quality than U.S. patents awarded to nationals of other countries. Overall, Canada has a patent quality gap, as measured by the average number of citations per patent and a quality index. The lower rate of citation of U.S. patents held by nationals of all other G-7 countries has disadvantaged their patents compared to U.S. patents held by U.S. nationals. Although this disadvantage has increased for all G-7 countries' nationals over time, it has increased at a slower pace for Canadian patents than for other countries. The importance (disadvantage) of Canadian patents relative to the United States has increased (declined) considerably since Trajtenberg's study. Our quality index indicates that both Canada and the United States produce patents of above average quality. As indicated by the quality index, unlike other G-7 countries, the quality of both Canadian and the U.S. patents has been getting better and better over time, though the quality gap between the two countries' patents had been widening. However, that quality gap has been narrowing since 1998.

QUALITY OF PATENTS BY INDUSTRY SECTOR

QUALITY OF PATENTS BY INDUSTRY AND BY COUNTRY: DISADVANTAGE

IN THIS SECTION, WE INVESTIGATE whether the importance of patents for each industry group replicates the trends observed at the aggregate level. The questions posed are: (1) Does the technological importance of patents differ across industries or is there a similar impact in all industries? (2) Does the pattern differ across countries? To answer these questions, we compare the importance of G-7 countries' patents relative to the United States across all industry groups.

As indicated above, U.S. patents awarded to U.S. residents are more frequently cited than U.S. patents awarded to nationals of other G-7 countries, thereby creating a disadvantage for other-country patents relative to U.S. patents. Nevertheless, the rate of citation of Canadian-held U.S. patents has increased over time compared with other G-7 countries aside from the United States, thereby making Canadian patents relatively more important than those of other countries (again, except the United States). We now investigate whether a similar pattern is observed across all industries.

Figures 12a-f compare trends in the importance of patents of all G-7 countries relative to the United States. It can be seen that patent quality, as measured by the disadvantage of other-country patents relative to U.S. patents, for each industry and each country, follows a pattern similar to that observed for aggregated data (Figure 10). It is apparent from these figures that Canadian patents are far less disadvantaged than other-country patents (except the United States). The importance of Canadian-held U.S. patents has increased over time as their disadvantage relative to U.S. patents of U.S. origin has decreased in all industry groups, except mechanical, and computer and communications industries. In drugs and medicines, and in electrical and electronics industries, not only does Canada have a small patent disadvantage vis-à-vis the United States, but that disadvantage narrowed during the 1990s (Figures 12c and 12d). By 1999, the situation had completely reversed in the drugs and medicines industries for Canada and the United States: In 1999, U.S. patents of Canadian origin had a 10-percent advantage over U.S. patents of U.S. origin. For other countries, the patent disadvantage relative to the United States has generally widened over time across all industries.

FIGURE 12a

RELATIVE IMPORTANCE OF G-7 PATENTS VS. U.S. PATENTS,
CHEMICAL INDUSTRIES, 1975-99

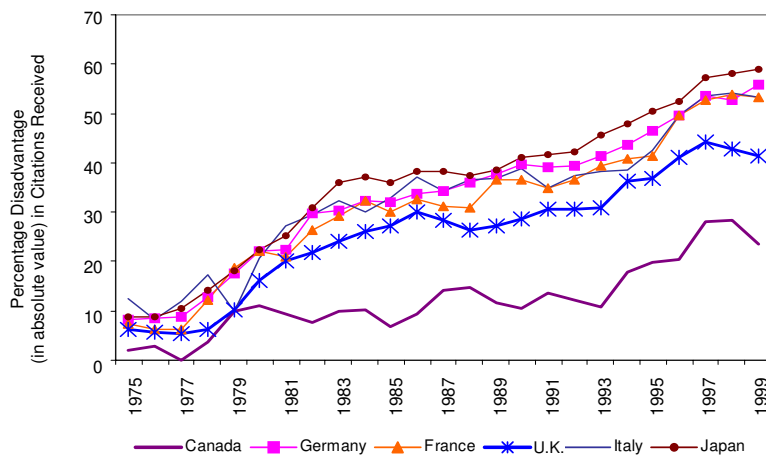


FIGURE 12b

RELATIVE IMPORTANCE OF G-7 PATENTS VS. U.S. PATENTS,
COMPUTER AND COMMUNICATIONS INDUSTRIES, 1975-99

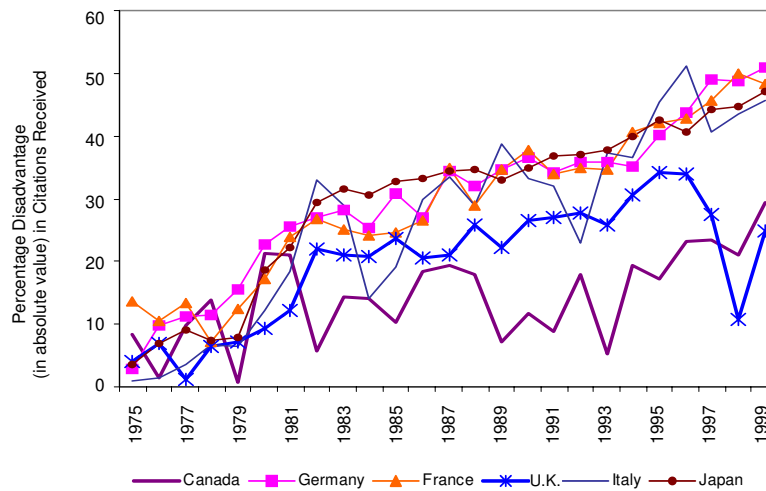


FIGURE 12c

RELATIVE IMPORTANCE OF G-7 PATENTS VS. U.S. PATENTS,
DRUGS AND MEDICINES INDUSTRIES (CANADA ONLY), 1975-99

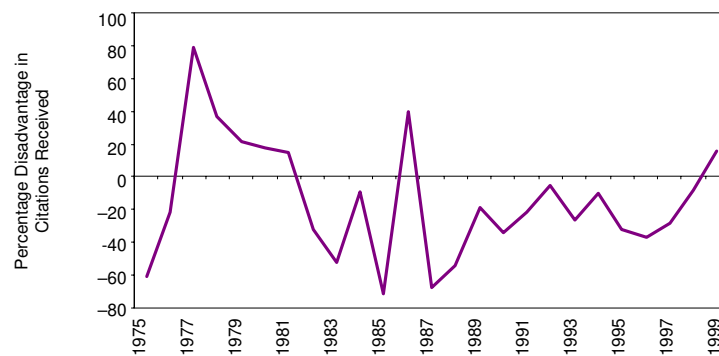


FIGURE 12d

RELATIVE IMPORTANCE OF G-7 PATENTS VS. U.S. PATENTS,
ELECTRICAL AND ELECTRONICS INDUSTRIES, 1975-99

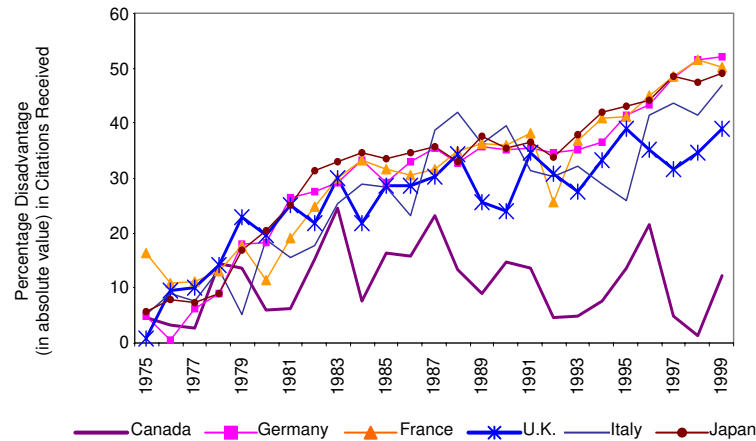


FIGURE 12e

RELATIVE IMPORTANCE OF G-7 PATENTS VS. U.S. PATENTS,
MECHANICAL INDUSTRIES, 1975-99

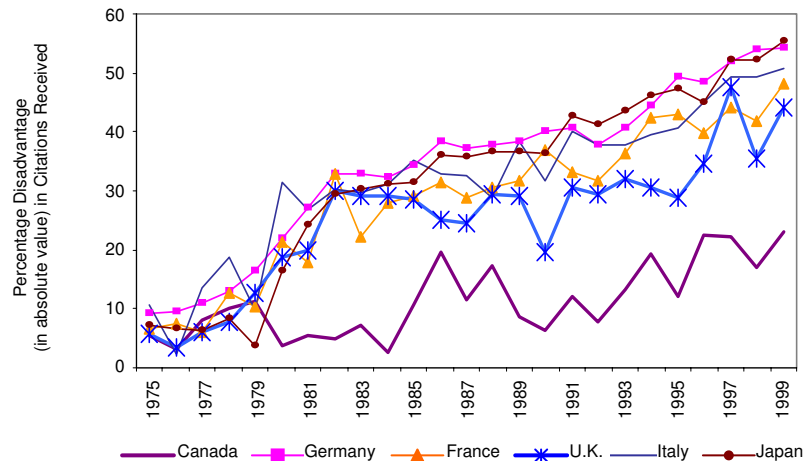
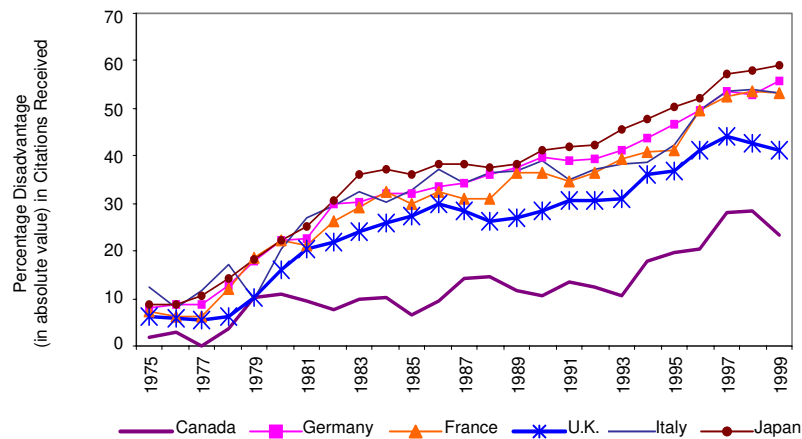


FIGURE 12f

RELATIVE IMPORTANCE OF G-7 PATENTS VS. U.S. PATENTS,
OTHER INDUSTRIES, 1975-99



QUALITY OF PATENTS BY INDUSTRY AND BY COUNTRY: QUALITY INDEX

THE LARGE NUMBER OF CITATIONS per U.S. patent held by U.S. nationals in all areas of technologies indicates that the United States produces higher quality innovations. Quality indices also confirm this.

Figures 13a-g plot the quality index of patents across all technologies for G-7 countries. They show time trends for average patent quality. Undisputedly, average patent quality for the United States is superior to that of any other G-7 country and has improved over time across all technologies. On average, for all G-7 European countries and Japan, the quality of patents has declined in most industries, except for the U.K. computer and communications industries. The quality of patents in the United Kingdom's computer and communications industry group has increased starting in the 1990s, but registered a decline since 1998. In general, except for the computer and communications industry group, Canada has upgraded the quality of its patents throughout the study period. While the overall quality of Canadian patents displays an upward trend over that period, it has been falling since 1998 across all industry groups, except chemical and *other* industries. Nevertheless, unlike Japan and all European G-7 nations, Canada has maintained an above average patent quality in each industry group, but has walked behind the United States at a declining pace.

FIGURE 13a

QUALITY INDEX, CHEMICAL INDUSTRIES, 1975-99

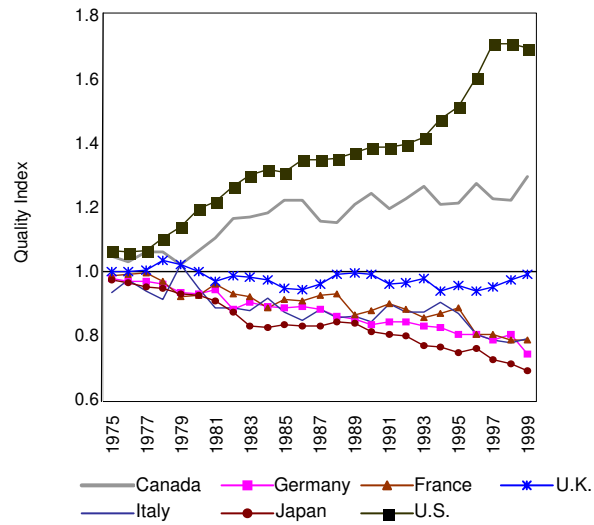


FIGURE 13b

QUALITY INDEX, COMPUTER AND COMMUNICATIONS INDUSTRIES, 1975-99

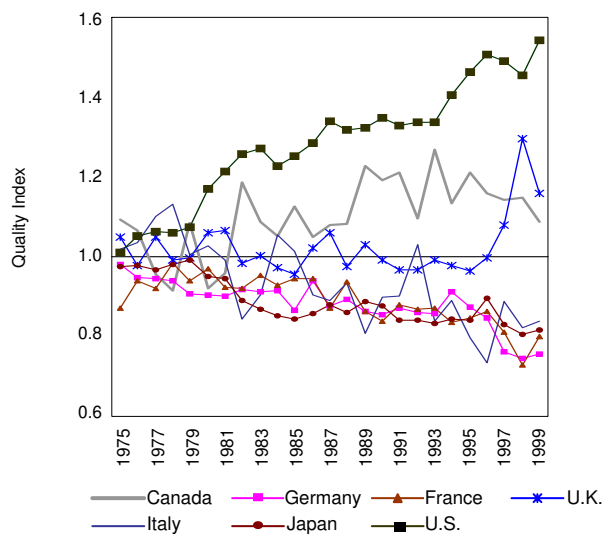


FIGURE 13c

QUALITY INDEX, DRUGS AND MEDICINES INDUSTRIES,
CANADA AND UNITED STATES, 1975-99

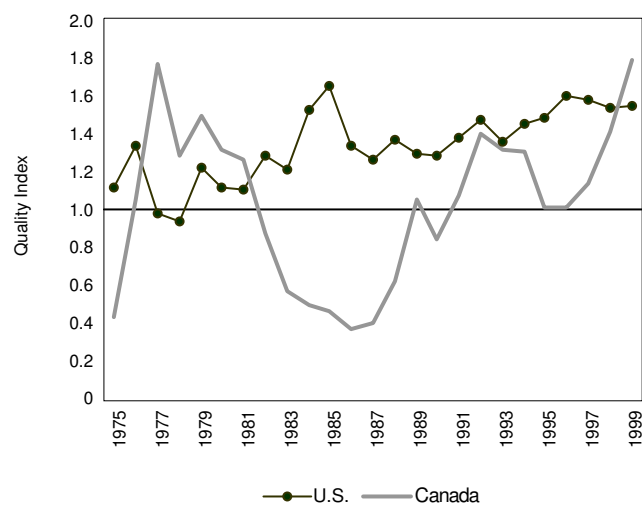


FIGURE 13d

QUALITY INDEX, DRUGS AND MEDICINES INDUSTRIES,
OTHER G-7, 1975-99

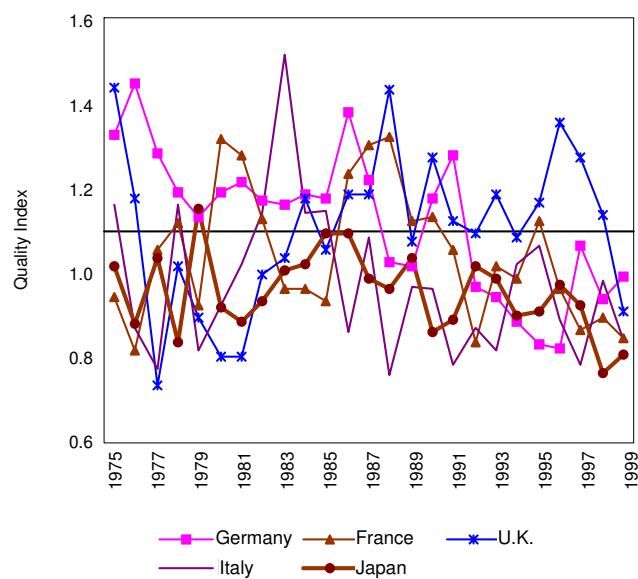


FIGURE 13e

QUALITY INDEX, ELECTRICAL AND ELECTRONICS INDUSTRIES, 1975-99

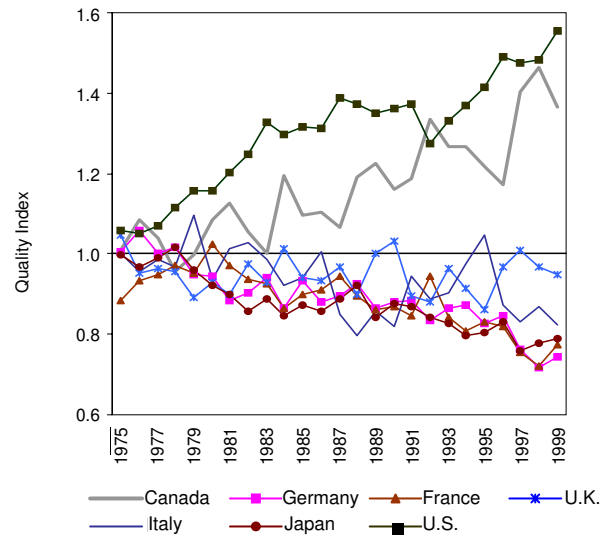


FIGURE 13f

QUALITY INDEX, MECHANICAL INDUSTRIES, 1975-99

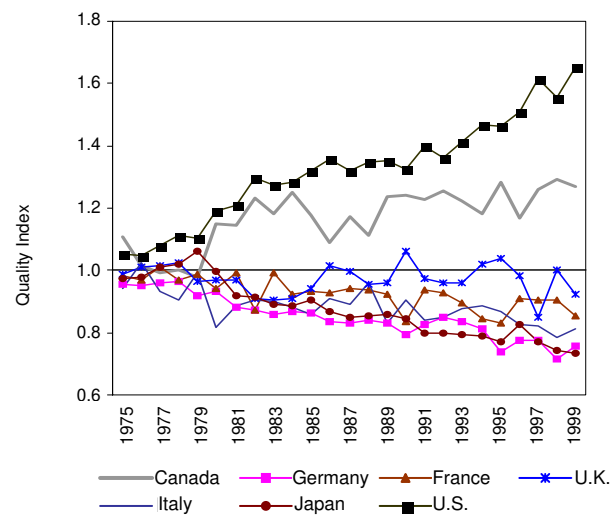
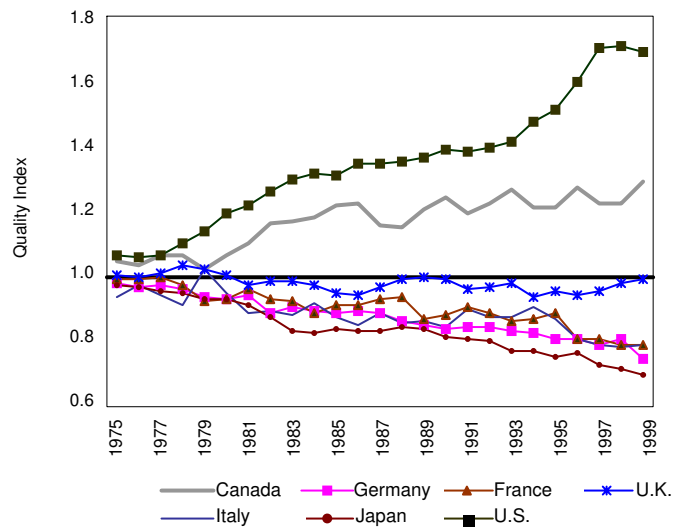


FIGURE 13g

QUALITY INDEX, OTHER INDUSTRIES, 1975-99



CONCLUSIONS

CANADA HAS BEEN LAGGING behind its industrial counterparts, especially the United States, in terms of productivity growth in recent years. Its poor innovation performance has traditionally been blamed as the principal cause of this situation. More recently, Canada's inability to innovate in the strategically important high-tech areas has been cited as the major contributing factor to its productivity problem. In particular, as pointed out by Trajtenberg (2000), Canada's missed opportunity to innovate in general purpose technologies, such as computer and communications — instead continuing to innovate in traditional fields — is perhaps responsible for aggravating the problem.

Over the past few years, it has become increasingly clear that participation in the *new economy*, driven by scientific and technological advances, would bring economic prosperity to Canadians in the 21st century. Canadians are increasingly participating in that potential prosperity through increased innovative activities in high-technology sectors. Their innovative activities in computer and communications industries have increased substantially in recent years, especially during the period 1997-99, which followed Trajtenberg's study. Therefore, the time is ripe to assess whether Canada's innovative performance

is better today than at the time of Trajtenberg's study, as compared with other G-7 countries' performance.

In this study, we present an analysis of the innovative performance of Canada vis-à-vis six other major industrial nations (the United States, France, Germany, Italy, the United Kingdom and Japan) using the most recent information on U.S. patents awarded to nationals of these countries. We have reasons to believe that patents issued in the United States to Canadian nationals are representative of the nature and patterns of technological trends in Canada as: (1) over the past few years, the number of U.S. patents obtained by a country has become a norm against which to evaluate its innovative capabilities; (2) patents are first sought in the United States in order to evaluate and learn about the legal quality of a technology; (3) if returns from innovations have to be quickly appropriated, it is the intellectual property in some target countries, such as the United States, that has to be protected; and, (4) U.S. patent data provide a more credible window into Canadian technology than Canadian patent data in that the propensity to patent by Canadians is much higher in the United States than in Canada.

We examine how the technological composition of Canadian innovations has changed in recent years in order to investigate whether Canada's innovative capability in strategically important — computer and communications, electrical and electronics, and drugs and medicines — technologies has changed over time by comparison with other G-7 economies. The purpose of this investigation is to ascertain whether Canada is still missing the technology boat by not being able to innovate more in strategically important technologies than in traditional areas. We focus on both the quality and quantity dimensions of innovation with the understanding that, to be a leader in science and technology, Canada must not only produce more innovations but also must have a strong base of high-quality innovations. Simple innovation counts, as measured by the number of patents, do not account for the large variations in technological and economic qualities of innovations. We therefore assess the quality of an innovation, based on a number of citation-based measures, in order to evaluate its technological impact as well as to get an indication of its commercial value.

Our analysis reveals that, overall, Canada's innovation performance has substantially improved over the period 1997-99. Instead of 'missing the technology boat', Canada has made impressive progress in innovating in strategically important technology sectors, such as computer and communications, electrical and electronics, and drugs and medicines. The technological capabilities of Canada are generally increasing with its growing strength, most evident in the computer and communications industries. This suggests that these high-technology sectors are, in fact, a source of both current and potential future strength for Canada's economy.

Our analysis of trends in innovative activity suggests room for considerable optimism. Canada has experienced one of the fastest rates of growth in R&D spending, second only to the United States. Its propensity to patent has increased in recent years — it ranks third after the United States and Japan in the production of patents per R&D dollar — and it has experienced explosive growth rates in patenting activity in the United States, along with Japan and the United States. Nevertheless, in terms of the absolute number of U.S. patents held and of U.S. patents per capita, Canada still remains well below most of its industrial counterparts.

The low number of U.S. patents held, as compared with other G-7 countries, may be a cause for some concern in that Canada is not able to generate more innovations. This raises the question of whether the quantity of innovations is more important than their quality. We assessed the quality of Canadian innovations vis-à-vis the quality of innovations of other G-7 countries. Canada leads most G-7 nations in the overall quality of innovations, as measured by the number of citations per patent, and is just slightly behind the United States on that indicator. Moreover, Canadian patents are far less disadvantaged than patents of other G-7 countries relative to the United States, and the importance of Canadian patents relative to all countries (except the United States) is rising. A similar trend is observed across all industries, except drugs and medicines where Canada has become the undisputed leader since 1997. Further, the gap with the United States with respect to the average quality of patents has been narrowing since 1998. The quality of innovations of other G-7 countries is generally below average.

The above observations have serious implications for small open economies, such as Canada, who produce a small number of higher quality innovations. The higher quality of Canada's innovations offers scope for considerable optimism. Studies of patent citations have shown that they do provide a reasonable proxy for both the quality and knowledge spillovers of a patent, because each time a new patent uses a piece of research from another patent, it must cite the previous patent. In addition, patent citations provide a measure for capturing the importance of the invention covered by a patent.

In this regard, we find no relationship between the quantity of patents held by Canada and the importance of these patents, as indicated by the number of citations received. In other words, there seems to be an equal chance that a given Canadian patent will turn out to be a major discovery regardless of whether Canada holds a greater or lesser number of U.S. patents. This suggests that patents are much like lotteries, where the probability of winning goes up with the number of tickets held, but not the probability of a given ticket being the winner — a finding consistent with that of Barham, Foltz and Kim (2001).

Despite all the progress made by Canada in recent years, measured in terms of the number of U.S. patents held, the United States remains the undisputed

technological leader, with Japan a distant second. The United States also has a strong lead in all three strategically important technology areas. Its innovations are better in overall quality across all industries; on all quality measures, Canada is behind the United States. Nevertheless, it has made gains relative to all other G-7 countries in producing higher quality innovations.

APPENDIX

DEFINITION OF INDUSTRY GROUPS IN THE UNITED STATES PATENT SYSTEM

THE DATA USED WERE OBTAINED primarily from the PATSIC file maintained by the Trade and Forecast Branch (TAF) of the USPTO.

The patent count data originated from the PATSIC file, which includes patents in the TAF database granted during the period 1963 to December 1999. U.S. patents are classified by industry sector, with each patent fractionally assigned according to the number of industry-related product fields to which it is most relevant. The classification information reflects the U.S. Patent Classification (USPC) System as of December 31, 1999. In this classification system, each patent is associated with the Standard Industrial Classification (SIC) industry that would produce that class's product or apparatus or carry out its process steps. The USPC to SIC concordance is a very general concordance between the USPC and 42 unique product fields based on the 1972 SIC. The concordance is updated annually by TAF.

Each entry in the PATSIC file and the corresponding citation data are arranged according to country code and industry code. The citation data were extracted from the weekly electronic data files that contain the text of issuing patents.

The six broad industry areas based on 42 product fields are as follows:

Chemicals Industry

- Industrial Inorganic Chemistry
- Industrial Organic Chemistry
- Plastics, Materials, and Synthetic Resins
- Agricultural Chemicals
- Soaps, Detergents, Cleaners, Perfumes, Cosmetics and Toiletries
- Paints, Varnishes, Lacquers, Enamels, and Allied Products
- Miscellaneous Chemical Products

Computer and Communications Industry

Office Computing and Accounting Machines
Electronic Components and Accessories and Communications Equipment

Drugs and Medicines Industry

Drugs and Medicines

Electrical and Electronics Industry

Electrical Transmission and Distribution Equipment
Electrical Industrial Apparatus
Household Appliances
Electrical Lighting and Wiring Equipment
Miscellaneous Electrical Machinery, Equipment and Supplies
Radio and Television Receiving Equipment except Communication Type
Electronic Components and Accessories and Communications Equipment

Mechanical-related Industry

Engines and Turbines
Farm and Garden Machinery and Equipment
Construction, Mining and Material Handling Machinery and Equipment
Metal Working Machinery and Equipment

Other Industries

Food and Kindred Products
Textile Mill Products
Petroleum and Natural Gas Extraction and Refining
Rubber and Miscellaneous Plastics Products
Stone, Clay, Glass and Concrete Products
Primary Ferrous Products
Primary and Secondary Non-ferrous Metals
Fabricated Metal Products
Special Industry Machinery, except Metal Working
General Industrial Machinery and Equipment
Refrigeration and Service Industry Machinery
Miscellaneous Machinery except Electrical
Motor Vehicles and Other Motor Vehicle Equipment
Guided Missiles and Space Vehicles and Parts
Ship and Boat Building and Repairing
Railroad Equipment

Motorcycles, Bicycles and Parts
 Miscellaneous Transportation Equipment
 Ordnance except Missiles
 Aircraft and Parts
 Professional and Scientific Instruments
 All other SICs.

ENDNOTES

- 1 The Conference Board of Canada (2000) research also confirms this. The study stresses that the widening income gap between Canada and the United States — now about US\$8 000 per person — must be reversed and innovation is the way to close this gap.
- 2 A patent is generally considered as an indicator of technological invention. The number of patents constitutes the quantity of inventions produced by an inventor, a company or institution (e.g. university), or country or other regions. With *quantity* measures, the volume of inventive activity of an individual, firm or a country can be assessed. With *quality* measures based on, for example, the number of citations of a patented innovation, the technological impact or *technological innovation* introduced by a patent can be assessed, as well as give an indication of its potential commercial value (Lanjouw and Schankerman, 1999).
- 3 With nearly half of all U.S. patents being granted to foreign inventors, the U.S. system is considered to be the most level playing field for comparing international patenting (Pavitt, 1985).
- 4 A country's patenting activity in the United States is also highly correlated with its exports to the United States (Putnam, 1996).
- 5 The explosive increase in the number of U.S. patents issued to Canadians in the period 1990-99 is also attributable to the changes in the Canadian patent regime (1989 and 1992) which, among other things, made patent examination optional. This change automatically reduced the number of patents granted in Canada. Thus, the use of U.S. patent counts is more credible, because the rules for granting patents have not changed as markedly as they have in Canada during this period. In other words, the number of U.S. patents held by a country is a stable measure of technological capability. We are grateful to Jonathan Putnam for suggesting this point.
- 6 Putnam (1996) shows that, in 1974, U.S. inventors filed only 36 percent of their applications abroad, which would be the apples-to-apples comparison here.
- 7 A hiring freeze at the USPTO was coupled with a 40-percent increase in workload from 1993 through 1998. This freeze created long delays in patent processing by USPTO until approximately 700 additional examiners were added in 1998, about a 25-percent increase. With more examiners and a large backlog created by the increasing number of patent applications, the rate of patents granted between 1997 and 1998 increased by 31.5 percent (Zucker and Darby, 1999).

- 8 Not only is there a strong correlation between the extent to which inventors patent in the U.S. patent system and the gross domestic product of their home countries; patenting is also highly correlated with export to the United States (Putnam, 1996). In this regard, the high level of patenting between Canada and the United States reflects the fact that these countries already have by far the largest bilateral trade relationship of any country-pair in the world. The inferential problem is that NAFTA has further stimulated trade between Canada and the United States, which would be expected to result in greater Canadian patenting in Canada, independently of any change in Canadian R&D spending or technology policy. So one should interpret with caution the sharp increase in Canadian patenting in the United States.
- 9 This inference should be taken with caution in that Canadian patenting activity in the United States may not have to grow significantly faster than at present. Figures 3 and 4 suggest that if Canadian patenting in the United States continues to grow at its current rate, Canada will very shortly rank 4th in total patenting and 3rd in per capita patenting. Given the problems with interpreting U.S. and Japanese patent counts (both overstate the comparable number of patents), it seems that Canada is doing just fine in patenting in the United States, and may be roughly on par with the two leaders on a per capita basis if patents could truly be compared without any national biases. On the other hand, there are reasons to think (NAFTA, etc.) that Canadian patenting in the United States may be biased upwards as well. We thank Jonathan Putnam for pointing this out to us.
- 10 The classification information reflects the U.S. Patent Classification (USPC) System, which can be mapped to the Standard Industrial Classification (SIC). The USPC to SIC concordance is a very general concordance between the USPC and 42 unique product fields (see the Appendix for the 42 product fields and the six broad industrial categories comprising these product fields). Kortum and Putnam (1997) also discuss the concordance derived from classifications performed by the CIPO from 1978-92 based on the International Patent Classification system, which applies to all countries, not just the United States. They also critique the USPTO's concordance, which does not distinguish between the industry of origin of the technology and the industry of use.
- 11 This shift in patenting abroad may reflect changes in the U.S. market (such as responding to the U.S. shifts to these sectors), in addition to any purely domestic changes in the comparison of R&D.
- 12 One of the reasons behind the surge of Canadian drugs and medicines patents is associated with the reform of Canadian patent policy vis-à-vis pharmaceuticals (in particular, the removal of the compulsory licensing provision).
- 13 In discussing the quality of patents, three distinctions are made — *legal quality*, *economic quality* and *technical quality*. The study of the legal quality of a patent focuses on the legal quality of the application in terms of formulating its wording, supporting it with evidence of novelty and aligning it with the legal framework. The economic quality of a patent is expressed in terms of the potential economic value to the rights holder. The *technical quality* of a patent is roughly expressible in terms of level of invention.

- 14 For example, in 1999, 169,154 patents were issued in the United States, twice the number issued a decade ago. Moreover, patents are not only important in old economy industries, such as chemicals and automotive manufacturing. Some of America's largest technology firms, including IBM, Texas Instruments and Lucent, have become very aggressive about making money directly from their patented technologies. IBM alone had in excess of \$1 billion in licensing revenue in 1999 from its stable of patents (Wysocki, 2000).
- 15 Apart from variations and arbitrariness in citing behaviour, the assumption is that the more a patent is cited by subsequent patents, the higher its technical quality, analogous to the use of citation counts in the scientific literature (Granstrand, 1999, p. 174).
- 16 If the average number of citations per patent of country A is C_A and that of country B is C_B , then the country A patents are $(C_A/C_B) \times 100$ percent better than country B patents.
- 17 See Trajtenberg, 2000, for details.
- 18 The Citation Index measures the quality of the innovation as a count of the number of times a patent document is cited in other subsequent patent documents. The Current Impact Index is designed to capture the impact of a country's patents on the technological community and the extent to which its patents contain important technological information to produce further innovations and patents. The Technology Cycle Time Index identifies countries that are inventing in rapidly changing technology fields. The Science Linkage Index measures the extent to which a country's innovation is linked to science through the citation of the number of references to the scientific literature indicated on the front pages of the patent. The Technological Strength Index is determined by multiplying the number of patents by the Current Impact Index.

ACKNOWLEDGMENTS

PART OF THIS STUDY was prepared during a visit to the Department of Economics and the Centre for Innovation Law and Policy, Faculty of Law, both at the University of Toronto. We gratefully acknowledge the financial support received from the Centre for Innovation Law and Policy. We are grateful to Jon Putman, Ajay Agrawal and Hollis Whitehead for their detailed comments and suggestions. We are also thankful to Jim Hirabayashi of the U.S. Patent and Trademark Office for providing the data and for his help in its interpretation. The usual disclaimer applies. The study represents the views of the authors and does not necessarily reflect the opinions of Industry Canada.

BIBLIOGRAPHY

- Albert, M.B., D. Avery, F. Narin and P. McAlliater. 1991. "Direct Validation of Citation Counts as Indicators of Industrially Important Patents." *Research Policy* 20: 251-259.
- Barham, B., J. Foltz and K. Kim. 2001. "Trends in University Ag-Biotech Patent Production." Paper presented at the AAEA 2001 Meetings. Chicago, IL. (August).
- Breizman, A., P. Thomas and M. Cheney. 2000. "Technological Powerhouse or Diluted Competence: Techniques for Assessing Mergers via Patent Analysis." Paper presented at the Society of Competitive Intelligence Professionals' *Competitive Technical Intelligence 2000 Conference*. San Francisco, CA. (June 8).
- Conference Board of Canada. 2000. *Performance and Potential 2000*. Ottawa.
- Granstrand, O. 1999. *The Economics and Management of Intellectual Property: Toward Intellectual Capitalism*. Cheltenham, U.K.: Edward Elgar.
- Guellec, D., and B. de la Potterie. 2000. "Applications, Grants and the Value of Patents." *Economic Letters* 69: 109-114.
- Harhoff, D., F. Narin, F.M. Scherer and K. Vopel. 1999. "Citation Frequency and the Value of Patented Inventions." *The Review of Economics and Statistics* 81, 3 (August): 511-515.
- Helpman, E. 1998. *General Purpose Technologies and Economic Growth*. Cambridge, Mass.: MIT Press.
- Jaffe, A., M. Trajtenberg and M. Fogarty. 2000. *The Meaning of Patent Citations: Report on the NBER/Case-Western Reserve Survey of Patentees*. NBER Working Paper No. 7631 (April).
- Lanjouw, J.O., and M. Schankerman. 1999. *The Quality of Ideas: Measuring Innovation with Multiple Indicators*. NBER Working Paper No. 7345.
- Kortum, S., and J. Putnam. 1997. "Assigning Patents to Industries: Tests of the Yale Technology Concordance." *Economic Systems Research* 9, 2: 161-175.
- Narin, F. 1991. "Globalization of Research, Scholarly Information and Patents-Ten Year Trends." Proceedings of the North American Serial Interest Group 6th Annual Conference. *The Serial Librarian* 21 (June 14-17): 2-3.
- National Science Board. 1996. *Science and Engineering Indicators – 1996*. Washington, D.C.: U.S. Government Printing Office.
- Pavitt, K. 1985. "Patent Statistics as Indicators of Innovative Activities: Possibilities and Problems." *Scientometrics* 7: 1-2.
- Pavitt, K., and L.L.G. Soete. 1982. "International Differences in Economic Growth and the International Location of Innovation." In *Emerging Technologies: Consequences for Economic Growth, Structural Changes and Employment*. Edited by H. Giersch. Germany: J.C.B. Mohr.
- Putnam, J. 1996. "The Value of International Patent Rights." Ph.D. Thesis. Yale University.
- Rao, S., A. Ahmad, W. Horsman and P. Kaptein-Russell. 2001. "The Importance of Innovation for Productivity." *International Productivity Monitor*, No. 2 (Spring): 11-18.

- Trajtenberg, M. (2000). *Is Canada Missing the 'Technology Boat'? Evidence from Patent Data*. Ottawa: Industry Canada, Micro-Economic Policy Analysis Branch. Discussion Paper No. 9.
- . (2001). "Innovation in Israel 1968-97: A Comparative Analysis Using Patent Data." *Research Policy* 30, 3: 363-389.
- Trefler, D. 1999. *Canada's Lagging Productivity*. Canadian Institute for Advanced Research. Paper No. ECWP-125.
- Wysocki, B. 2000. "In U.S. Trade Wars, Brain Outguns Brawn." *The Wall Street Journal* (Monday, April 10): 1.
- Zucker, L.G., and M.R. Darby. 1999. "California's Inventive Activity: Patent Indicators of Quantity, Quality and Organizational Origins." Los Angeles, CA.: University of California (October 11). Memo.



Keith E. Maskus
University of Colorado

11

Canadian Patent Policy in the North American Context

INTRODUCTION

NATIONAL INTELLECTUAL PROPERTY (IP) SYSTEMS continue to evolve everywhere as countries seek to find the most appropriate means of encouraging technological innovation and information dissemination in an increasingly globalized and knowledge-based economy. The pressures underlying this evolution are many. For some countries, changes are mandated externally by such accords as the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs) of the World Trade Organization (WTO), which requires a considerable movement toward multilateral harmonization of intellectual property (IP) standards. Many regional integration agreements have extensive provisions covering minimum IP standards, with the European Union (EU) nations moving decisively toward full harmonization. Most fundamentally, national authorities are increasingly coming to the view that an appropriate definition and protection of intellectual property rights (IPRs) are central to advancing innovation, learning and productivity growth.

Canada experiences all of these pressures. In implementing the TRIPs Agreement into domestic law, the country updated a number of regulations covering patents and copyrights. For example, the notion of non-obviousness was introduced as a distinct statutory requirement for the first time and clarified rules on the one-year priority period for Canadian patent applications following disclosure.¹ The rights of the federal and provincial governments to use patented inventions were restricted, while the definitions of abusive patent use were curtailed and local working requirements were abolished. Canada also made provision for the deposit of biological material as part of claim specifications and disclosure and it acceded to the Budapest Treaty in 1996.

The 1997 amendments to the *Copyright Act*, contained in Bill C-32, introduced neighbouring rights for performers and phonogram producers, and implemented a levy on blank audio recording media to compensate copyright owners for home copying, which remains a fair-use activity.² Canada is also a signatory of WIPO's (World Intellectual Property Organization) Copyright Treaty and Performers and Phonograms Treaty.

Under its WTO obligations, Canada's regulations permitting generic drug companies to stockpile pharmaceuticals for six months prior to a patent's expiry were found inconsistent with the TRIPs Agreement following a dispute launched by the EU. However, the dispute-resolution panel found in favour of permitting work on a competitor's patent in preparation for a regulatory filing.³ Similarly, Canada's failure to extend its patent term to 20 years for patent applications filed before October 1, 1989 — which were awarded 17 years of protection — was found inconsistent with the Agreement.⁴

In acceding to the North American Free Trade Agreement (NAFTA), Canada abolished all pharmaceutical compulsory licensing provisions, placing drugs on an equal footing with other inventions.⁵ As a safeguard, Canada created the Patented Medicine Prices Review Board (PMPRB) to monitor drug prices. The PMPRB has authority to control prices based on such factors as reference prices in other industrialized nations and increases in drug prices relative to overall inflation.⁶

Despite such externally driven changes, the ultimate questions for Canadian policy-makers stem from an assessment of the balance of national interests in further reforms. As noted in the next section, Canada's system of IP protection retains features that are distinctive from that of the United States. It is conceivable that such differences, while seemingly appropriate for a small open economy historically positioned as a technology follower, operate to limit the acquisition of technology and product innovation.

This study seeks to consider Canada's options in the context of a regulatory harmonization with the United States. Canada's economy is extensively affected by its trade and investment relations with the United States, which relations are influenced to some degree by the IP regimes of the two countries. Thus, Canada remains a net importer of intellectual property, largely from its Southern neighbour, raising questions as to whether the current system enhances or impedes technology inflows. At the same time, Canada's economic activity increasingly reflects domestic development and use of innovative technology, suggesting that IPRs, as incentives to innovate, will take on greater importance as the economy evolves.

Therefore, an important question is whether Canada would be better served by moving closer to the U.S. system or by retaining, or even emphasizing, its distinctiveness in technology protection. This is a difficult question to answer with any certainty. Much depends on the assumptions made about how

patents operate in markets for innovation, diffusion and competition among imperfectly competitive firms. Ultimately, the central issues are empirical in nature given the second-best nature of such markets. As will be discussed later, available quantitative measures of distinctiveness among patent regimes are crude and cannot readily reveal associated growth effects. In such an environment, one is forced to rely on indirect evidence and informed judgment, which is what I attempt to do here.

The study is organized as follows. The following section discusses important differences between the Canadian and U.S. patent systems. The focus is on patents because the thrust leading to this study related to prospects for revising technology protection systems. Extending the analysis to issues of copyright and trade-mark protection would be interesting but lies beyond the scope of this project, except where those devices have important interactions with patents. The third section provides a perspective on the basic issues by reviewing the importance of encouraging innovative activity in Canada. The fourth section sets out a framework for thinking about the impacts of regional harmonization. I attempt to buttress the discussion by presenting new evidence on the relationships between patent regimes, foreign direct investment (FDI) and productivity growth. Concluding remarks are provided in the final section.

DIFFERENCES IN PATENT PROTECTION

THE CANADIAN AND U.S. PATENT SYSTEMS are similar in their broad aspects. Both share the goals of promoting innovation and encouraging disclosure and use of new patented products and technologies. Both provide patents following examination for novelty, non-obviousness and utility, with protection extended for 20 years in the general case. Both regimes award proprietary rights to exclude others from making, using and selling patented processes or products of claimed subject matter. These rights are national in scope, and the regime recognizes that such rights are exhausted upon the first sale in the domestic market while permitting patentees to preclude parallel imports through contract provisions.⁷ The Canadian and U.S. systems also define similarly infringing activities. Neither country recognizes utility models or petty patents. Patents are available for biotechnological inventions and microbiological life forms. Both countries adhere to the Paris Convention and the Patent Cooperation Treaty.

However, there are significant differences between the two systems. Taken together, these variations reveal that the U.S. approach strongly favours the interests of inventors while the Canadian regime is more cautious in its attempt to strike a balance between inventors and users of new information.

One important difference is that Canada follows the global standard in awarding patents to the first person to file for protection, while the United States

uniquely grants a patent to the first to invent a technology or product. In both cases, protection must be extended for at least 20 years from the date of filing under the TRIPs requirements. The U.S. policy is based on the view that the *first-to-invent* rule promotes early discussion of research results through conferences and publications without fear of losing patent eligibility during a defined grace period. Indeed, one group that actively opposed switching to a *first-to-file* rule in the U.S. legislation implementing the TRIPs Agreement was the community of university scholar-inventors, who place a considerable premium on the ability to disclose new research results in professional meetings and publications. Such dissemination can also serve to discourage others from engaging in duplicative research and development (R&D). However, this system may encourage costly litigation over the identity of first inventors and introduce some uncertainty into the patent process. In contrast, the *first-to-file* rule reduces this uncertainty, albeit at the potential cost of inducing firms to race to be first to apply to the patent office. Unfortunately, there is no evidence upon which to assess which system is better suited to promoting innovation.

A second important difference lies in the exclusions from patentable subject matter. The United States takes a liberal view of patentability and recognizes few exceptions, going well beyond the average practice among industrial countries. For example, the United States has recognized patents on higher-order life forms developed for scientific and commercial purposes since the awarding in 1987 of a patent to Harvard University for its *oncomouse*, which was genetically engineered to be susceptible to cancer. Canadian authorities did not recognize the validity of the application made by Harvard University for protection in Canada on the theory that multi-cellular life forms were not “identically reproducible” under section 2 of the *Patent Act*. This decision was upheld in a ruling by the Federal Court in 1998, which explicitly distinguished between patentable lower-order life forms and non-patentable higher-order life forms. However, the Federal Court of Appeal ruled in August 2000 that the *oncomouse*, and by extension other transgenic non-human mammals, fall within the definition of “invention” in Canadian law.⁸ If this ruling survives a threatened appeal to the Supreme Court, it will considerably expand the scope of patentability in Canadian practice.

There are other important areas where the two countries do not yet agree. First, the United States now routinely awards patents for computerized methods of doing business. The legal impetus for encouraging the patenting of business methods was the *State Street* case, in which the Federal Circuit upheld a patent awarded to Signature Financial Group on its *hub and spoke* system for making financial resource allocations and managing mutual funds.⁹ In dismissing *State Street Bank*’s claim that that the system, as a mathematical abstraction, should not have been patented, the Court clarified that computerized business-management programs met all general patentability criteria and could

be protected. The Court also limited the terms under which mathematical algorithms could be excluded. Many legal observers consider this decision to have expanded radically the scope of patentability.¹⁰ Others consider it a natural clarification of the fact that business methods achieve industrially useful purposes and should always have been patentable.¹¹ This approach implies that the issue is not one of subject-matter excludability but rather one of meeting the particular criteria for obtaining a patent.

For its part, Canada has not yet recognized patents on software for implementing methods of doing business. This stems from the principle that patents are granted only for the physical embodiment of an idea or for a process that produces something tangible or sellable.¹² Thus, computer programs generally are not eligible for patents; rather, they are protected by copyright as literary works. In contrast, both the United States and the European Union explicitly recognize that the functional aspects of computer programs may meet patent criteria and be protected. Japan also grants patents for computer software, though in the area of business methods its new guidelines sets out an inventive step that greatly exceeds the U.S. standard.¹³

A final important area where patentability standards differ is in surgical methods and medical treatments. If such procedures may be shown to be novel, inventive and useful, they may be patented in the United States but not in Canada.

The United States may also be characterized as more protective of inventors' rights than Canada in that the U.S. Patent and Trademark Office (USPTO) is more willing to authorize broad claims in patent applications than is the Canadian Intellectual Property Office (CIPO). This issue takes on considerable importance in such areas as biotechnology and business methods, where specific techniques may find broad application. Thus, awarding a broadly written patent on a single research tool or software for implementing any form of electronic transaction could extend protection to numerous applications in fields beyond that for which the original tool or program was developed.

The two patent regimes are distinguished further by disclosure and opposition procedures. The United States has weaker standards for what must be disclosed in the patent application. Canada lays open patent applications for public inspection within 18 months of filing. The United States went partially toward this rule in its patent reform of 1999, but the new law permits inventors to prevent disclosure after 18 months if they choose not to file abroad.¹⁴ Perhaps more significantly, it is possible in Canada for any interested party to challenge the validity of a patent before it is granted by submitting prior art to CIPO examiners. The U.S. system discourages pre-grant opposition. Finally, while procedures exist in both countries to oppose the validity of a patent after it is granted, the U.S. courts have recently moved to make such challenges difficult to sustain. Specifically, the Federal Circuit imposed a high bar for such

contests by ruling that issued patents are presumed valid unless the challenger presents clear and convincing evidence of an error. That is, complainants must consider it quite likely that a patent is invalid, which raises their litigation costs. The U.S. Supreme Court solidified this rule in *Dickinson v. Zurko*, holding that the Federal Circuit may reverse USPTO's factual findings only when those findings are "...arbitrary, capricious, an abuse of discretion, or unsupported by substantial evidence."¹⁵

Next, the United States takes a stronger view than Canada on the fact that the patent term should not be reduced by regulatory delays. The *Waxman-Hatch* Act of 1984 provided authority for extending patent terms for pharmaceutical products in light of the long delays associated with clinical testing and obtaining the approval of the Food and Drug Administration. Further, under terms of the *American Inventors Protection Act* of 1999, "diligent applicants" are guaranteed a minimum protection term of 17 years, with extensions made possible to compensate for delays due to USPTO processing delays, interference proceedings, secrecy orders and appellate review. There appears to be no such provisions in Canadian patent legislation or regulations.

While both countries define infringement and impose civil and criminal penalties in similar fashion, the United States has taken the additional step of dedicating a specific Federal Circuit Court to hear appeals involving IP protection. The rationale for this specialized court is that, because appeals of district court decisions are heard by regional circuit appellate courts, the scope of patent protection had de facto become variable across circuits. Therefore, patent standards varied from circuit to circuit, encouraging forum shopping by parties that perceived particular courts to be advantageous. Thus, the Federal Circuit Court was an effort to impose a uniform set of rules across the country and to ensure that all district courts applied a common set of precedents. However, many observers argue that this specialized tribunal has been captured by IP developers and that it is unreasonably friendly toward patentees.¹⁶ Again, Canada has not established a similar court.

Another important legal difference is that the United States permits jury trials of civil litigation involving IP cases while Canada does not. U.S. plaintiffs usually opt to have their case tried before a jury, suggesting that they perceive juries to be predisposed in favour of patent rights. This characteristic adds complexity to U.S. legal findings and forces parties to simplify their evidentiary presentations.¹⁷

Two other significant differences pertain to regulations that affect the value of patents. First, as noted earlier, Canada has put in place an extensive system of administrative price controls and monitoring for patented medicines, while the United States has not. Second, there are different approaches underlying the authority for, and uses of, compulsory licences of patented technologies. In part, Canada's policy takes the view that compulsory licences are a

component of industrial policy and may be used to induce technology transfer and build a domestic industry in areas where patents are insufficiently worked on the local market.¹⁸ It should be noted that such licences have been used sparingly in Canada.¹⁹ In contrast, the United States does not tie its compulsory licensing regime to local working. However, both countries feature compulsory licences as a central element of their anti-monopoly policy. The United States has frequently issued such licences as part of disciplinary orders in cases of patent abuse.²⁰ Finally, the two countries differ in the rules governing compensation for compulsory licences.

While the following points are not considered further here, it is worth noting that Canada and the United States also differ in important ways in the protection given to copyright, internet transmissions and databases. For example, Canada protects software under standard copyright doctrine, implying that reverse engineering is a legitimate fair use.²¹ However, the United States allows firms to preclude reverse engineering by issuing licences with no-decompilation clauses.²² Further, under the *Digital Millenium Copyright Act* of 1998, the United States imposed conditions that restrict fair use of copies by libraries, educational institutions and educators.²³ In both countries, these systems are evolving currently toward stronger protection.

ECONOMIC ASPECTS OF REGIONAL IP PROTECTION

IT IS USEFUL TO PROVIDE A PERSPECTIVE on Canada's evolving interests by reviewing broadly its economic performance in certain high-technology industries that may be especially sensitive to IP protection. Some theoretical discussion is then provided on the role of IPRs in technological development generally, and in the context of regional trade and regulatory integration.

MACRO AND SECTORAL INDICATORS OF INNOVATION AND IP USE

NEW PRODUCT AND PROCESS INNOVATION is an important source of economic growth, particularly in mature industrial countries at the technological frontier. This point has been made in numerous studies. For example, the Organisation for Economic Co-operation and Development (OECD) discusses the nature and meaning of the *knowledge-based economy* and demonstrates that within industrialized nations, the output mix has shifted toward high-technology industries.²⁴ This shift toward growth based on the development and acquisition of knowledge is a key source of cost reductions and efficiency gains in the use of new information. Indeed, new technical information has become an increasingly important component of production technologies, both in disembodied form and incorporated into capital inputs and human capital. Information is

also widely embodied in consumer goods and services. Thus, effective management of knowledge is a critical component of job growth and wealth creation.

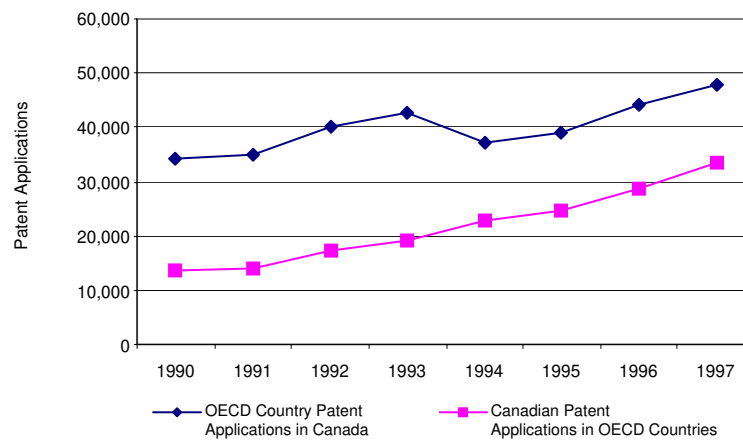
Moreover, there is a strong correlation between knowledge creation and use, on the one hand, and international economic performance, on the other. There is persuasive econometric evidence that exporting firms display markedly higher levels of productivity and growth than do non-exporters, and that the degree of exports is positively related to productivity growth.²⁵ In addition, the international exploitation of knowledge capital, created through investments in information and dependent on an abundance of skilled labour, appears to be the primary determinant of FDI among developed economies.²⁶

Original invention within a firm is by no means the only source of productivity growth. Efficient management re-organization, adoption of new business systems, reallocation of inputs to obtain cost reductions, and the attainment of economies of scale are significant factors as well. Firms also increase efficiency by learning and absorbing technological information from other firms. This transfer can be purposeful and mediated through market transactions, in the form of technology licensing, joint ventures and FDI. It can also be achieved by using available information sources, including trade shows, publications, patent disclosure documents and reverse engineering. As will be discussed later, IP protection affects these possibilities.

It is useful to consider existing indicators of the shifts underway in Canada toward an economy that relies increasingly on knowledge and information.²⁷ For example, Figure 1 shows trends in Canadian patent applications since 1990 in both directions. As may be seen, both applications in Canada from OECD countries and Canadian applications abroad increased in the 1990s. However, the relative increase in Canadian applications was far sharper, and their mutual ratio declined from approximately 2.4 in 1990 to 1.44 in 1997. On this measure, Canada is both an increasingly attractive place to patent new technologies and a rapidly growing source of technical information that is worth patenting abroad. Figures on patenting in NAFTA countries are shown in Table 1. Applications from U.S. residents in Canada rose sharply, going from 16,832 to 23,434 between 1990 and 1996, an increase of 39 percent. This may be compared with the 29 percent rise in total applications, suggesting that the United States is taking a larger share of Canadian patent applications over time. Applications from Canadian residents in the United States increased by 33 percent over the same period. Both Canada and the United States registered enormous relative increases in patent applications in Mexico, which surely reflects both the strengthening of Mexico's patent system in the early 1990s and that country's entry into NAFTA. This finding underscores that the willingness of foreign firms to patent in a particular country is a function of that country's openness to trade, among other factors.

FIGURE 1

TRENDS IN PATENT APPLICATIONS FOR CANADA, 1990-97



Source: OECD, *Basic Science and Technology Indicators*, 2001.

TABLE 1

PATENT APPLICATIONS IN NORTH AMERICA, 1990-96

	TOTAL	CANADA	UNITED STATES	MEXICO
1a. Applications in Canada by Residency				
1990	37,917	2,782	16,832	8
1994	41,462	3,043	19,629	13
1996	49,254	3,316	23,434	27
1b. Applications in the United States by Residency				
1990	176,100	3,683	91,410	76
1994	209,691	4,574	109,981	105
1996	223,419	4,888	111,883	114
1c. Applications in Mexico by Residency				
1990	5,289	71	2,893	750
1994	9,944	186	6,191	498
1996	30,694	758	15,492	389

Source: World Intellectual Property Organization, *Industrial Property Statistics*.

Figure 2 plots the relative growth of business enterprise R&D in the manufacturing sector and certain high-technology industries in Canada and selected OECD countries. It is evident that the rate of increase of Canada's private R&D stands out among the OECD countries. Canada had the largest increase in total manufacturing R&D, which rose by over 50 percent between 1990 and 1997. It ranked second in R&D growth in chemicals and third in office and computing machinery and professional goods (instruments). Most remarkable is the substantial relative increase in R&D in the Canadian drugs and medicines industry, which rose by a factor of 2.4 over the period. This increase reflects in part the agreement between the Canadian government and local branches of global pharmaceutical companies to increase their local R&D efforts to a target proportion of their Canadian sales.²⁸ In fact, these targets have been significantly exceeded, suggesting that they do not bind the decisions of pharmaceutical companies, who are now choosing to conduct more R&D in Canada. At the same time, the share of basic R&D performed in this industry fell from 27 percent in 1990 to 21 percent in 1997. Thus, although there was a rise in the absolute levels of both types of R&D, the relative increase in applied work, such as clinical testing, was larger. At the same time, it should be noted that Canadian generic drug companies increased their ratio of R&D to sales from 7 percent in 1988 to 13 percent in 1993, reflecting in part an effort to obtain patents on their own discoveries.²⁹

The fact that Canada has been increasing its relative share of R&D is brought out in Figure 3, which plots Canada's share of business enterprise R&D undertaken in Canada and the United States. Canada's share of total manufacturing R&D rose by approximately 26 percent over the period, despite the fact that its share of the two countries' total manufacturing output declined marginally. Canada experienced similar rises in R&D shares in chemicals (including drugs and medicines) and in non-electrical machinery. In each case, the shares remain well below Canada's share of the two countries' sectoral output, so the research intensity of Canadian industry remains behind that of the United States. However, the trend is toward convergence.

Figure 4 plots the technology balance of payments for Canada, the United States and Mexico. It measures net receipts from royalties and licence fees under technology contracts.³⁰ Canada's performance is striking in that there was a rapid increase in the technology balance of payments surplus from zero in 1990 to \$350 million in 1996. Clearly, this is not an artefact of exchange rate movements since such movements would affect receipts and payments equally. On this score, Canada is increasingly becoming a source of internationally used technologies.

FIGURE 2

BUSINESS ENTERPRISE R&D IN HIGH-TECHNOLOGY INDUSTRIES, 1990-97

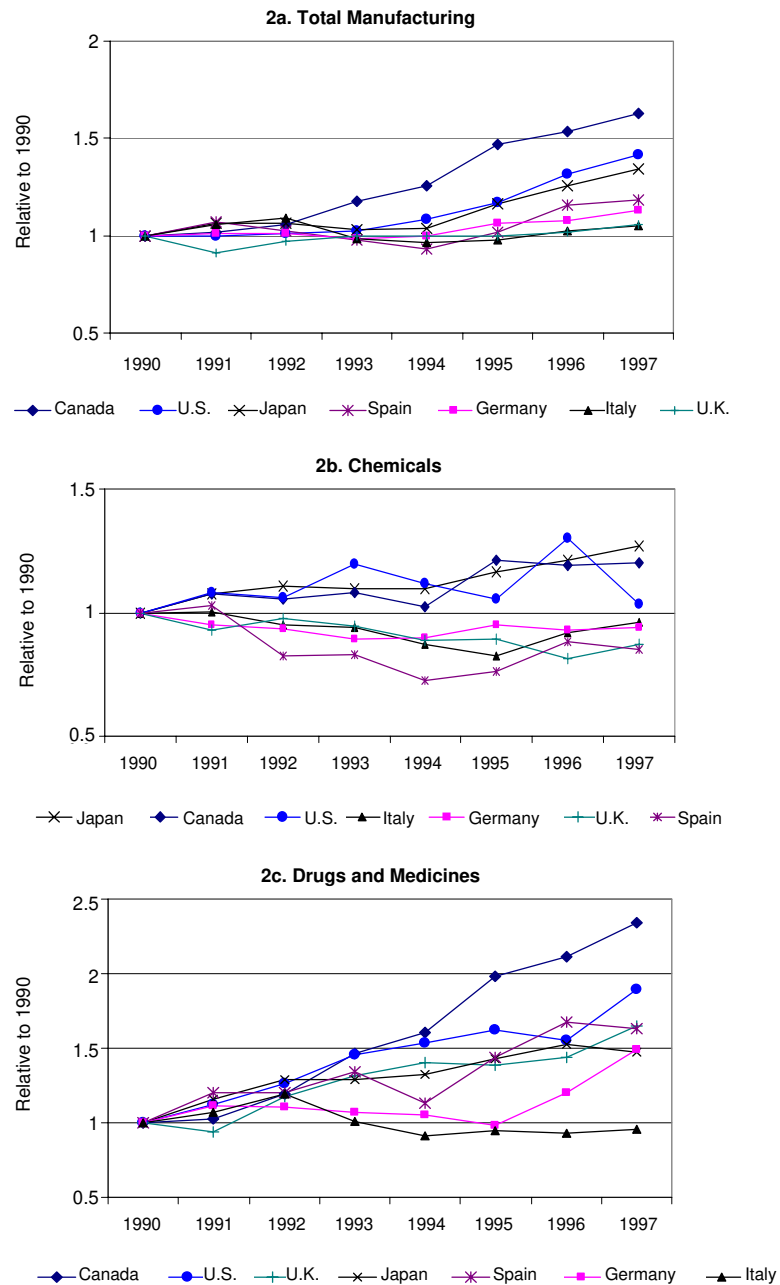
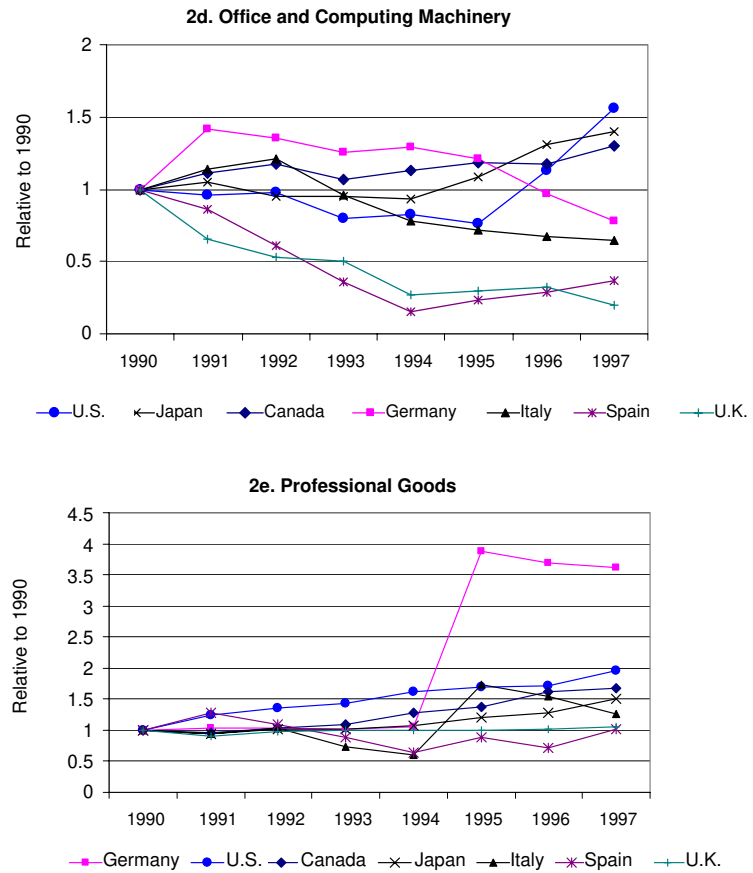


FIGURE 2 (CONT'D)

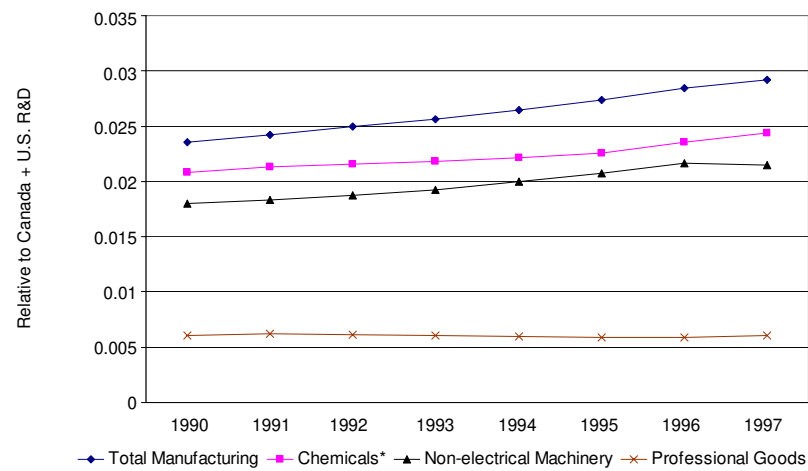
BUSINESS ENTERPRISE R&D IN HIGH-TECHNOLOGY INDUSTRIES, 1990-97



Source: OECD, *Basic Science and Technology Indicators*, ANBERD, Rev. 2, 2001.

FIGURE 3

CANADA'S R&D SHARES, 1990-97

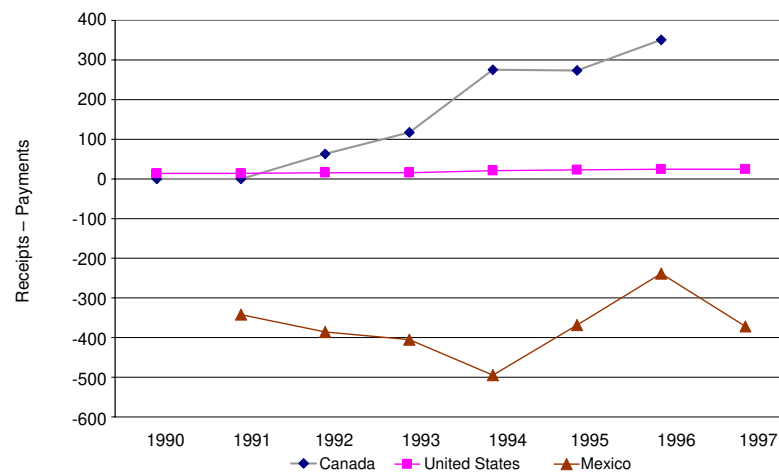


Note: * Includes drugs and medicines.

Source: OECD, *Basic Science and Technology Indicators*, ANBERD, 2001.

FIGURE 4

TECHNOLOGY BALANCE OF PAYMENTS, 1990-97 (IN US\$ MILLIONS)



Source: OECD, *Basic Science and Technology Indicators*, 2001.

TABLE 2			
REVEALED COMPARATIVE ADVANTAGE INDEXES FOR HIGH-TECHNOLOGY GOODS, 1990, 1994 AND 1998			
	1990	1994	1998
Canada			
Chemicals, Excluding Drugs	0.66	0.67	0.66
Drugs and Medicines	0.15	0.18	0.23
Office and Computing Machinery	0.56	0.63	0.55
Professional Goods	0.28	0.32	0.38
United States			
Chemicals, Excluding Drugs	1.13	1.09	1.02
Drugs and Medicines	0.87	0.75	0.66
Office and Computing Machinery	1.76	1.55	1.45
Professional Goods	1.30	1.29	1.38
Mexico			
Chemicals, Excluding Drugs	1.32	0.63	0.43
Drugs and Medicines	0.45	0.24	0.27
Office and Computing Machinery	0.80	0.90	1.31
Professional Goods	0.38	0.68	0.82

This finding is reinforced by the calculations presented in Table 2, which shows indexes of revealed comparative advantage (RCA) for our set of high-technology manufactured goods. The RCA index is the share of Canada's exports in an industry relative to OECD exports in that industry, divided by Canada's share in global (OECD) manufacturing exports. Thus, a figure over unity indicates that the industry has a relatively high export orientation in comparison with other industries, suggesting the existence of a comparative advantage.³¹ The figures in Table 2 suggest that, despite Canada's overall comparative disadvantage in these industries, the RCA indexes are increasing over time. This is consistent with a shift in Canada's output and export mixes toward such goods, in comparison with the rest of the OECD. At the same time, however, Canada's trade balances in these goods have tended toward larger deficits with the world and the United States, as depicted in Figure 5. Thus, despite the increase in relative export shares, Canadian high-technology imports have risen faster than high-technology exports. Canada remains a net importer of technology through the trade channel.

FIGURE 5

CANADA'S TRADE BALANCE IN HIGH-TECHNOLOGY INDUSTRIES, 1990-98

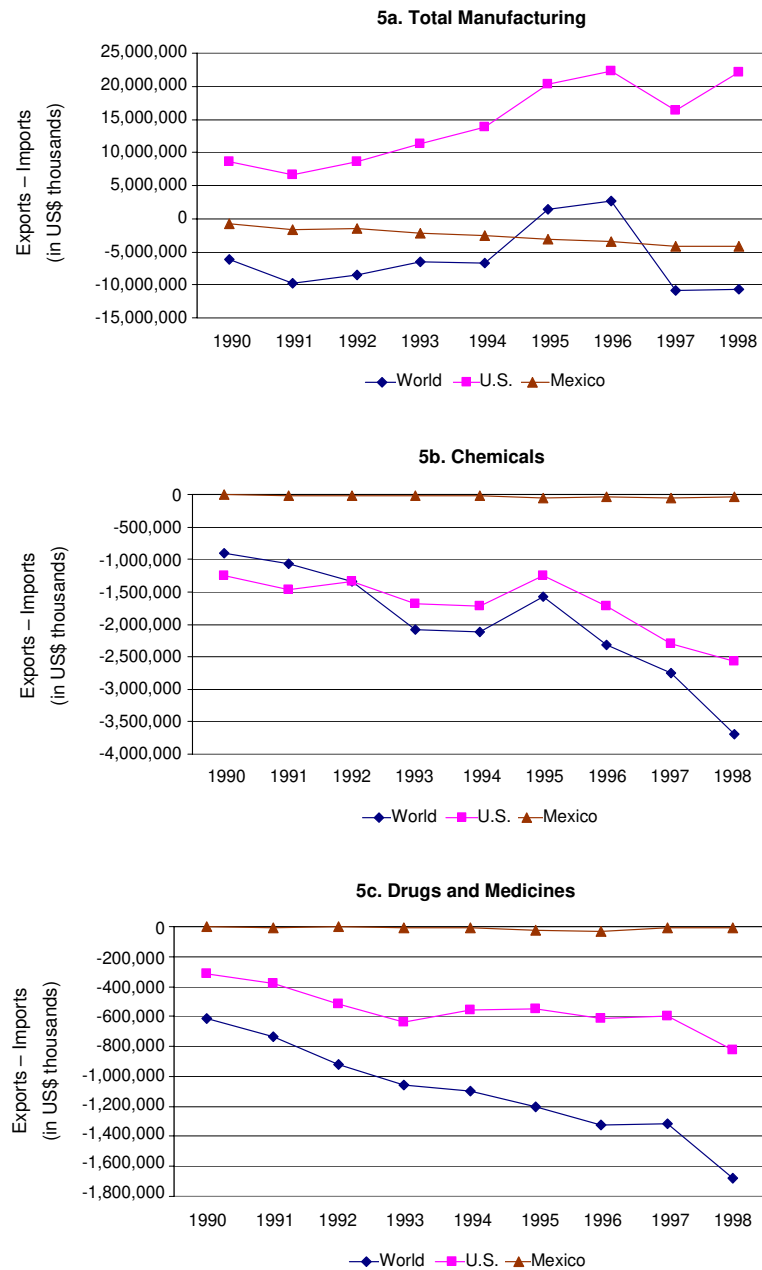
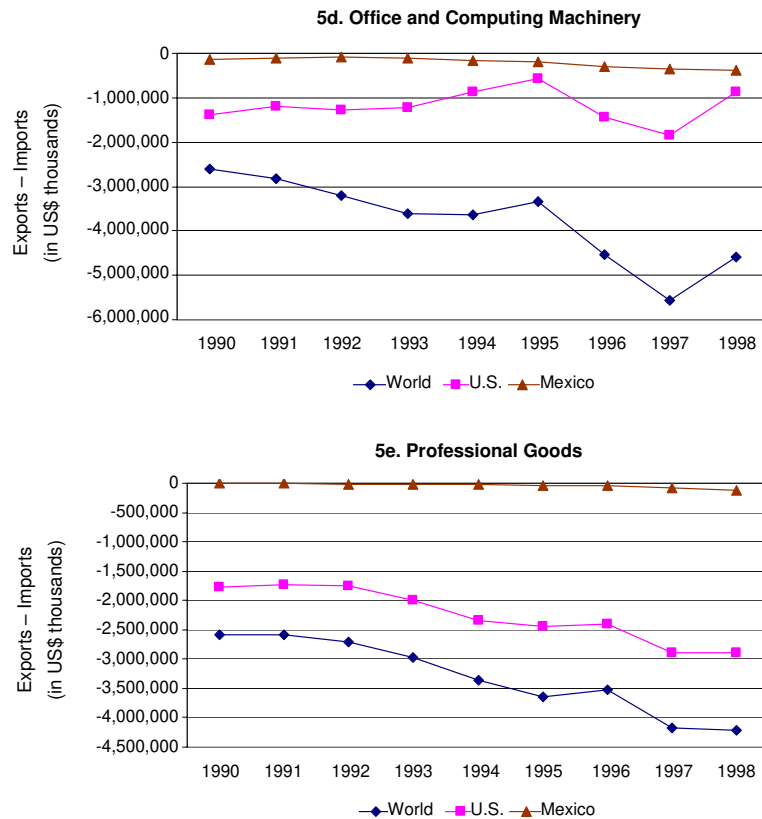


FIGURE 5 (CONT'D)

CANADA'S TRADE BALANCE IN HIGH-TECHNOLOGY INDUSTRIES, 1990-98



Source: OECD, Bilateral Trade Database.

GENERAL PERSPECTIVES ON PATENTS, INNOVATION AND DIFFUSION

THE MATERIAL IN THIS SUBSECTION IS FAMILIAR and requires only a brief overview.³² Most societies employ IPRs as an imperfect, or second-best, solution to the appropriability problem inherent in creating new information. It is costly to invent and because the techniques or products of that invention may often be copied by second-coming rivals who need not undertake as costly an investment, ex ante incentives to innovate could suffer in the absence of protection. This protection comes in the form of a temporary right to exclude others from

using the invention, thereby permitting the inventor to mark up the price over marginal cost and recoup his investment. However, that protection exacerbates the static distortion of insufficient user access associated with temporary market power.

In this regard, there are three primary justifications for awarding patents. First, they provide an incentive to incur the costs of inventing new technologies and products and bringing them to market. Encouraging commercialization is important, for a patent that is not *worked* through production or local sales provides little gain to consumers.

A second motivation is that patents help expand the stock of technical knowledge available to the public. In return for providing market exclusivity, society requires compensation in the form of disclosed technical information that may be used in subsequent innovation. Thus, patent applications make known technical aspects of new information that others are free to incorporate into new works that legitimately *invent around* the patent claims. The narrower these claims, the easier it is to develop follow-on inventions and competing products, but the thinner is the incentive for initial R&D. Similarly, the sooner the patent application is laid open to the public, the faster its technical advances become known.

A third justification is that patents could reduce the transaction costs of licensing, helping to develop markets for creating and exchanging new information (such as patent exchanges, patent pooling, licensing agreements, and the like). Without such exclusive rights these markets may fail to develop or operate efficiently.

Despite these potential gains, society also recognizes that the market power associated with patents may impose social costs. Therefore, governments render some technologies ineligible for patents, limit the duration and breadth of patents, permit opposition proceedings and challenges to validity, define conditions under which compulsory licences may be issued, and regulate the exercise of market power through competition rules. These limitations vary across countries and may be selected to affect the competitive conditions associated with the patent regime. Indeed, it is these terms and limitations of protection that are the subject of harmonization efforts.

The essential question, which is difficult to answer confidently, is to what extent various patent regimes contribute to the development of new knowledge, its conversion into marketable products and technologies and its diffusion into broader competition. A brief review of available evidence is in order.

As regards the necessity of patents for stimulating invention, survey data send mixed messages. Other sources of market power could provide sufficient return on investment even in the absence of patents, including imitation costs and lags, imperfect information flows, entry barriers associated with market concentration, and reputation advantages from being first on the market.

Two surveys of U.S. R&D managers conducted in the 1980s display consistent findings.³³ Across the manufacturing sector, the pharmaceutical and chemical industries considered the promise of patent protection to be essential as more than 30 percent of the inventions would not have been developed in its absence. Somewhat less reliant were the petroleum, machinery, and fabricated metal products industries. In all other manufacturing industries, patents were viewed as unimportant or only marginally important in inducing R&D. Despite this result, firms do register for protection: the percentage of patentable inventions that were patented ranged from 50 percent in primary metals to 86 percent in machinery. The remaining inventions were protected through trade secrets and other private actions. These findings were complemented by similar results in a recent survey on U.S. innovation.³⁴

This evidence suggests that the responsiveness of R&D to patent protection in the United States is fairly low, except in sectors where investment costs are high and imitation is relatively easy. However, these surveys are dated and developers of newer technologies, including biotechnological processes, plant genetics, and software, find patent protection important for safeguarding their inventions.³⁵ With the emergence of these new technologies, there has been an increase in both the absolute number of patent applications and the propensity to patent in the United States. Unfortunately, it is difficult to sort out the channels of causation at work here. Recent legislative, administrative and judicial practice in the United States has strongly increased the scope and exclusivity of patents, both generally and in areas such as business methods, drugs and biotechnology. Whether this policy is a consequence of growing demands for protection as R&D rises or is itself a stimulus to innovation cannot easily be assessed, though presumably these influences operate in both directions.³⁶ The rising propensity to patent may further reflect the need to acquire patent portfolios for strategic and defensive purposes in the marketplace. In that regard, patent litigation is also rising sharply in the United States.³⁷

This lack of formal evidence makes it problematic to draw any firm conclusions. In my judgment, however, a fair summary of the R&D-inducing value of patents in the United States would read as follows. First, patents seem to play a significant role in encouraging risky, long-term R&D that produces major technological breakthroughs which ultimately support the development of entire industries and complementary uses.³⁸ Second, patents have taken on increasing importance as the average length of product and technology cycles in many industries has fallen because of lower costs of imitation and reverse engineering. Third, patents remain a necessary stimulus to invention in the pharmaceutical industry, where average R&D costs per new chemical entity have increased markedly in recent years. Fourth, some critical new technologies, such as biotechnology, seem equally dependent on the promise of patent protection as an incentive for R&D. However, it is less evident that patents are

necessary, or even appropriate, for protecting new software. Fifth, the rising propensity to patent points out that, independent of their stimulative value, patents are viewed by firms as important mechanisms for bringing goods to market, defending market positions and acquiring a strategic advantage. All of these claims are heavily conditioned on the broader environment that strongly supports invention and commercialization in the United States.

The primary evidence on these aspects for Canada comes from an analysis of Statistics Canada's 1993 Survey of Innovation and Advanced Technology. It provides deep and detailed information on the relationship between IPRs and innovation in Canadian manufacturing firms.³⁹ Here are the essential conclusions from this analysis. First, innovation in small- and medium-sized enterprises is an important determinant of productivity and output growth. Second, relatively few Canadian firms rank patents as an important inducement to their innovation programs, finding instead that market lead time, trade secrets and complex designs are more significant. Put another way, appropriability is critical for innovation, but patents matter less than other methods of protection and business strategies. However, as firm size increases the *ex ante* importance of patents rises. Third, even though patents are not widely viewed as important for innovation, firms that innovate do take out patents extensively, supporting the view that patents are important for market-building and strategic purposes. In this context, a firm's IP management is an important source of productivity growth. The management of IP requires legal, administrative and design skills. But other things being equal, firms with higher propensities to patent are not more likely to be innovative. Fourth, large firms tend to be more innovative and to use patents more. However, other things being equal, foreign-controlled firms are not more likely to innovate than are domestically-controlled firms, though subsidiaries of foreign multinationals may have better access to international technologies.

Fifth, for purposes of innovation it is important to have in-house R&D capabilities in order to develop new products and to more readily learn and adapt new technologies from other firms. Sixth, survey results underscore the importance of developing numerous innovation competencies, including R&D in new products and process technologies, marketing, and logistics. Finally, access by firms to an effective and complementary science and technology infrastructure has a positive and significant impact on innovation. Institutions such as private and public technical services (testing laboratories and standards organizations) and research institutes with capabilities to share information do make a difference. Also critical are the availability and quality of universities, which both create new information and facilitate its absorption by private enterprises. Further, higher education generates an effective skill base for innovative activity.

Returning to general notions, patents are a factor in information dissemination. To the extent that new information spreads into wider innovative uses in the economy and the original inventor cannot appropriate all the related value, the social gains from R&D exceed the private gains, a point on which there is ample economic evidence in the United States and elsewhere. While patents may limit this information diffusion by providing strong exclusionary rights, they can play a positive role on several dimensions.⁴⁰ First, if innovation itself is restricted by a weak patent system, there will be less information to spread around. Second, as firms undertake more innovation they may become more capable of successfully adopting and improving the knowledge of others into productive uses, suggesting that there is a strong complementarity between a firm's own R&D, potentially supported by IPRs, and its ability to learn from others. Studies of total factor productivity growth for a number of countries at varying levels of economic development support this view and indicate that competitive diffusion is enhanced by firm-specific R&D programs.⁴¹

Patents should have a direct positive impact on diffusion through their disclosure rules, which require that the information about a new technology be described in sufficient details that someone skilled in that particular art may reproduce it. Thus, laid-open patent applications are potentially a rich source of learning and allow rivals to develop non-infringing versions and follow-on inventions that improve the technology.

There is little systematic evidence showing that patent disclosure requirements have this effect in the United States.⁴² Survey data in Canada suggest that examining patent applications is considered by high-technology firms to be among the least important sources of new information, though it is moderately important for firms in medium- or low-technology sectors.⁴³ The difference is likely that technical advance is so rapid in high-technology sectors that information found in patent applications tends to be outdated before it may be read and absorbed. In this connection, liberal rules about patent disclosure may not be important, and could be counterproductive if they discourage patenting, in nations such as Canada that seek to build additional competence in advanced technologies.

In assessing this inference, attention should be paid to recent findings indicating that the highly liberal rules on patent disclosure and opposition which characterized the post-war Japanese patent system served as a significant source of technological progress in Japan.⁴⁴ In particular, rapid disclosure of inventions described in patent applications encouraged extensive filing of applications for utility models, representing follow-on innovation, as well as cross-licensing agreements that diffused information across firms and industries. While such standards may be sensible for a technology *follower* nation with competent engineering skills, they become increasingly inappropriate for countries seeking to

develop new technologies based on advanced R&D. Indeed, Japan abandoned this system in 1994, albeit under pressure from the United States.

The final means by which patents (and related devices) can support information diffusion is by providing the legal foundation for market transactions in knowledge. Difficulties inherent to writing contracts for selling and sharing information include, among others, an unwillingness to reveal technical secrets and tacit knowledge to licensing and production partners without guarantees against defection and rival entry.⁴⁵ In turn, partners may be hesitant to accept a contract without understanding the particulars of the invention and its potential commercial value. Patents can provide the legal certainty required to underpin both sides of such contract. Some recent empirical evidence suggests that patent rights play a positive role in encouraging licensing.⁴⁶

In this context, it is worth reviewing briefly the evidence available on information spillovers as they relate to patenting. Using a translog cost specification covering 12 Canadian manufacturing industries in the 1970s and 1980s, one study found that payments for foreign technologies and an industry's own R&D spending are strongly complementary.⁴⁷ This is an important finding, for it demonstrates that firms need to have active R&D programs in order to make productivity gains (here, lower costs) through foreign technology licences, arm's-length contracts or FDI partners. Put another way, it is important to have a significant R&D capability in order to stay abreast of foreign technology and be able to adapt it to local uses. Further, using rate-of-return calculations the study found that Canadian R&D in certain sectors, including chemicals, non-electrical machinery, and instruments, generates large and positive domestic spillovers in the form of lower costs in other sectors.

A recent study used data on bilateral patent applications to construct patent-weighted and R&D-weighted measures of domestic and foreign technologies available to Canadian firms.⁴⁸ Recognizing that there is a high level of foreign control and ownership in Canadian industries, the author distinguished between domestic R&D stocks (knowledge) and foreign R&D stocks with learning mediated through FDI. He found that domestic interindustry spillovers in the form of total factor productivity (TFP) growth are higher in Canada than spillovers emanating from FDI, though both are positive and significant.⁴⁹ Moreover, domestic interindustry spillovers of new technology have larger impacts on TFP growth than do industry's own R&D expenditures. Finally, the contribution of own-industry R&D to TFP is much higher for process-related R&D than for product-based R&D. Overall, patenting in Canada by domestic and international firms bears a positive relationship to external learning economies, indicating a positive social return to the patent system, at least within the manufacturing sector.

Another recent study, using data from 19 OECD economies, considered the joint determination of decisions made by inventors in one country to patent in

another country (and in their own) and relative levels of productivity.⁵⁰ Patents are direct albeit imperfect measures of the value of technology firms wish to exploit in various markets. The authors estimate patent decisions as functions of home residency, bilateral distance, home human capital, and bilateral import flows. In a second stage, they relate productivity to these patent measures, finding strong international spillovers, with over 50 percent of productivity growth (measured by the growth of real gross domestic product per worker) in each country deriving from innovation in the United States, Japan and Germany. Because of its close proximity and intensive trade relationship with the United States, Canada achieves between 62 percent and 82 percent of its productivity growth from U.S. research. Another noteworthy fact was that Canada's high proportion of educated labour makes the country especially productive in absorbing foreign technological information.

HARMONIZATION AND THE REGIONAL DIMENSION

WHILE INFORMATIVE ABOUT THE IMPACT OF PATENTS (and patent rights) on innovation, learning, and technology transfer, the material just reviewed cannot address the central question posed in our study. Specifically, none of the studies mentioned discusses the role of patent harmonization in a setting of regional trade preferences. Unfortunately, there appears to be little evidence on how patent harmonization or regional trade agreements bear on these processes. This section discusses the relevant issues in general terms.

One obvious point is that Canadian firms already have access to the U.S. patent system because it does not discriminate based on the country of residence of the applicant or the complainant. In that regard, arguments for harmonization presumably rest on the view that Canadian firms are less innovative than they would be under identical standards, rather than being a plea for more legal access in the United States. Put another way, perhaps Canadian inventors fail to take full advantage of the both systems because they are not identical.

POTENTIAL BENEFITS AND COSTS OF HARMONIZATION

IT IS EVIDENT THAT DIFFERENCES in standards and procedures matter for economic decisions in the area of patents.⁵¹ Differences in effective patent duration, scope, eligibility rules, standards for non-obviousness and novelty, and opposition procedures make a difference in firms' patenting behaviour. It is less clear that such differences are inappropriate across countries, or that nations suffer in dynamic terms from failing to adopt standards that replicate those of other countries.

This situation raises the question of what the prospective gains and losses might be for Canada if it were to harmonize its patents rules and procedures

with those of the United States. Again, this is not a question that can be answered with much confidence, given the complexity of the subject, the weakness of available data and the uncertainty about how firms would respond. However, following are some relevant points to consider.

Let's begin with potential benefits. First, borrowing a page from standard trade theory, one could argue that, as a small country, Canada would gain from tighter linkages with the United States, the large country. The thrust of this argument in international trade theory is that small countries enjoy a disproportionate share of gains from trade when they remove their tariffs and quotas, thereby permitting domestic relative prices to converge with those set by the large nation. This change, which involves harmonization based on a policy of free trade, should result in a more efficient resource allocation, with both static and dynamic welfare gains. This argument rests on the presumption that prices are set efficiently by the large country and that there are not other market imperfections that would be exacerbated by trade liberalization.

In the context of patent rights, if Canada's somewhat weaker protections were inefficiently reducing innovation and capital accumulation relative to what they would be under U.S. standards, there would be a strong case for harmonization. However, this claim raises at least three problems. First, patent regulations are not trade taxes. Whereas elimination of the latter may be expected to generate aggregate benefits under most circumstances, harmonization of the former may not. Patent standards operate on the complex interplay of innovation, learning, imitation and market power, all of which involve departures from the competitive ideal. Indeed, even if one could show that a common set of regulations were appropriate for two countries engaged in limited trade and FDI, it would not necessarily follow that they would be jointly optimal in a situation of mutual free trade.

Second, and what amounts to the same point, for Canada to gain from adopting U.S. standards there must be a presumption that the U.S. regulations are themselves optimal or at least sensibly efficient. I will argue in a later subsection that this notion is questionable and that a number of U.S. rules are excessively strong, even in the context of a large, competitive economy with extraordinary innovation and invention capabilities. Third, as will be discussed below, available evidence and econometric analysis cannot find support for the efficiency-enhancing aspects of harmonization.

Returning to potential gains, one should distinguish between an increase in the overall level of patent protection and a *convergence* of patent systems through equalization of particular standards. By employing the Ginarte-Park (GP) aggregate index of patent protection across countries, a number of authors have analyzed the level effects of stronger patent protection on such processes as international trade, FDI, licensing, international patenting (as a measure of innovation and diffusion) and productivity growth.⁵² This literature

may be briefly summarized as follows. First, stronger aggregate patents have a significantly positive impact on manufacturing imports into middle-income and higher-income countries with strong imitative and absorptive capabilities.⁵³ This tendency is moderated at high levels of protection, suggesting that the ability to attract more technology through trade is subject to diminishing returns as countries become wealthier.

Second, as patent protection increases, there is a significant stimulus to inward FDI from technologically advanced countries, as suggested by survey data and econometric work.⁵⁴ However, two interesting substitution properties qualify this result. As middle-income developing countries raise their protection levels, U.S. multinationals tend to shift their location decisions at the margin toward those nations and away from developed countries where standards are already strong. For example, rough calculations suggest that as Canada and Mexico raise their patent indexes to levels anticipated under the TRIPs Agreement (which are not much different than those under NAFTA), the stock of U.S.-owned FDI assets in Canada could fall by perhaps \$7.9 billion in the long run, while it could rise by \$4.1 billion in Mexico.⁵⁵ This result suggests that substantially stronger patent rights, which served as a locational advantage for Canada, are likely to be eroded by the relatively stronger upgrade of rights in Mexico and elsewhere. Indeed, between 1990 and 1997, Canada's share of total inward FDI stock in North America (Canada, the United States and Mexico) fell from 20.9 percent to 14.5 percent, while Mexico's rose from 6.0 percent to 9.2 percent. While these trends are due to many factors, it is conceivable that the IPR effect played a role. In that context, additional increases in protection could be in order for Canada if it is concerned about this relative reduction in inward FDI. Another substitution proposition is between modes of entry rather than locational choices. Evidence suggests that as patents get stronger overall, especially among higher-income developing economies and developed economies, multinational enterprises shift away at the margin from majority-owned affiliate activity toward increasing use of arm's-length licensing.⁵⁶

One study has used the index of patent rights to examine the impact of a uniform increase in patent rights across countries on international patenting decisions, taken as a measure of technology diffusion.⁵⁷ The author found that a rise in the GP index from its 1990 levels by one-half the sample standard deviation had a positive impact on decisions to patent everywhere. But the impact is relatively stronger among industrialized economies than between that group and developing economies. Econometric simulations suggest that, for its part, Canada would apply for 5,962 additional patents in foreign countries, an increase of approximately 17 percent over the 1997 level. However, 85 percent of that increase would be registered in other industrialized countries and 69 percent of the remaining applications would go to Spain, Korea and Greece.

Foreign residents would apply for 15,750 more patents in Canada, an increase of nearly 30 percent over the 1997 level, virtually all of them from developed economies. Thus, uniformly stronger global rights will do little to narrow the patenting gap between rich and poor nations but should assist nations such as Canada in attracting technology and registering innovations abroad.

Again, however, while such evidence seems to favour a policy of raising the average strength of patent rights toward those in the most innovative countries, it says little about specific standards, the proper subject of inquiry about harmonization. It is possible that differential standards impose nation-specific fixed costs for finding information, designing appropriate products and technologies, working with patent agents and examiners, and selecting and litigating patent claims. These costs have a strong impact on decisions regarding locations in which to patent.⁵⁸ They may be compared to international variations in technical standards regarding product characteristics, which can strongly reduce trade flows.⁵⁹

More generally, they could be a component of international friction costs that have been identified in recent literature as major barriers to trade, investment, and technology transfers.⁶⁰ While poorly understood, such costs relate to differences in legal environments, business cultures and preferences. To the extent that Canadian inventors are less familiar with U.S. patent rules, they may produce fewer products and technologies that could meet both standards. Such differences could also lead firms to develop process and product variants that are differentiated by scope of claim and marketed for specific national uses. This would raise fixed costs of innovation on international markets, which could be relatively more damaging for small countries.

The inherent distortions created by differential standards are both static, in terms of where and how to exploit patents, and dynamic, in that R&D investment decisions could be oriented toward sub-optimal product and market differentiation. Based on these arguments, Canada could become more innovative, and reduce its per-unit costs of innovation by moving toward harmonized standards with the United States.

However, there are potential costs involved here as well. Under the presumption that Canada-U.S. harmonization means making Canadian standards more protective, one would expect Canadian firms to pay more in licensing fees and royalties for subsequent U.S. inventions. For example, updated estimates from a recent study suggest that if Canada had met patent standards in 1988 that were subsequently required under the terms of the TRIPs Agreement, Canadian firms could have been expected to pay an additional \$1.2 billion (in 1995 prices) in net fees on patent rights then in force.⁶¹

More fundamentally, the distinctiveness in patent rules reflects differences in preferences, business environments, technological capacities, and approaches to regulation. Presumably, the Canadian system reflects both Canadian values

and the implicit bargain struck within the political economy about how to balance the interests associated with creation and dissemination. Just as one would not ordinarily expect countries to adopt common standards in such areas as product regulation, environmental safety and working conditions, neither would one expect them to do so for IPRs. Indeed, even within tightly integrated economic areas there remain substantive differences in intellectual property protection. Individual U.S. states retain specific rules covering trademarks, unfair competition and trade secrets, while the EU remains a considerable distance from effective harmonization in the patent area.

TENTATIVE EMPIRICAL EVIDENCE

THUS, FOR CANADA TO HARMONIZE ITS STANDARDS with those of the United States would involve sacrificing policy discretion and foregoing national preferences in the interest of stronger innovation possibilities. Ultimately, it is an empirical question whether harmonization would yield such innovation gains.

One way of addressing this question is to return to the Ginarte-Park patent index and focus on its sub-components. As noted above, harmonization is about removing differences in particular standards, such as patent eligibility and enforcement mechanisms. The GP aggregate index for each nation is the sum of five individual components that differ across countries. In principle, it is possible to investigate the effects of equalizing specific components. These five components, which have existed for every five years from 1960 to 1995, are as follows. First, which products and technologies are excluded from patentability? The more exclusions the lower is the coverage (COV) sub-index. Second, how long is the duration (DUR) of patents? Third, what legal mechanisms, such as preliminary injunctions and a doctrine of contributory infringement, are available for enforcing (ENF) patent rights? Fourth, is a country a member (MEM) of key international industrial-property conventions? Fifth, what procedures exist for revocation of patent rights (RIG)?

On the basis of these components, Canada has been gradually increasing the strength of its patent regulations relative to those existing in the United States. A simple t-statistic test showing whether the average score differs between the two nations fell from 4.43 in 1985 to 3.61 in 1990 and to 2.65 in 1995. Thus, while there remained statistically significant differences in 1995 — especially in coverage and revocation of rights — Canada had, by that time, achieved a considerable degree of convergence.

An obvious question is whether international variations in these component scores, relative to those of the United States, have detectable effects on productivity. In order to consider this issue, the OECD STAN data set was used to develop measures of employment, capital stocks, R&D stocks and TFP in 13 major manufacturing sectors of 10 industrialized countries in 1985, 1990

and 1995. These TFP levels were then regressed on country, sector and year dummy variables, own-country R&D stocks and distance-weighted R&D stocks, using ordinary least squares with a consistent estimator of standard errors subject to heteroskedasticity. The regressions were run both with and without the GP index itself, along with ratios of each country's COV, ENF and RIG measures relative to the United States. In principle, these components are the most significant for incentives to innovate (the others vary little among industrial countries) and are, in any case, the most relevant for considering harmonization between Canada and the United States. If harmonization with the United States were to raise TFP performance, one would expect positive coefficients on these variables.

The results from this regression exercise, some of which are reported in Table 3, were not conclusive. Briefly, most of the variation in sectoral and national TFP measures are explained by the country, year, and sector effects, suggesting considerable heterogeneity in productivity sources. To summarize results for the variables of main interest, the aggregate GP index of patent rights has a positive but insignificant effect on TFP levels. With GP included or excluded, none of the coverage, enforcement or rights ratios had coefficients significantly different from zero. On this measure, there is little indication that adopting patentability standards and enforcement mechanisms that mirror those of the United States would raise productivity.

We are also interested in discovering whether these patent rights components affect the international distribution of sales and R&D activity by U.S.-majority-owned manufacturing affiliates abroad. Using data from the Bureau of Economic Analysis for a sample of 36 developed countries and middle-income developing countries in 1992 and 1997, affiliate sales and R&D figures were

TABLE 3

TOTAL FACTOR PRODUCTIVITY (TFP) REGRESSION, CENTRAL CASE

DEPENDENT VARIABLE: LOG (TFP)

VARIABLE	COEFFICIENT	Z-STATISTIC	PROBABILITY
Log GP	0.512	0.938	0.348
Log RD	0.096	2.212	0.027
Log WTRD	0.002	0.012	0.991
Log COV Ratio	-0.354	-1.521	0.128
Log ENF Ratio	-0.302	-1.551	0.121
Log RIG Ratio	0.015	2.004	0.045
Observations	390		
Adj. R ²	0.34		
Log Likelihood	-146.9		

Note: The regression method used is ML-GARCH.

regressed on gross national product (GNP), GNP per capita, distance from the United States, the GP index and the component indexes. In both cases, the coefficient on COV was negative but not significant, placing doubt on the ability of harmonized patentability criteria to expand affiliate activity and technology creation. The coefficients on both ENF and RIG were positive but not significant. Interestingly, an interaction term between RIG and a dummy variable for North America (Canadian or Mexican affiliate locations) was significantly positive in both equations. Thus, it seems that there may be some innovation gains to make from a tighter integration of rules governing revocation of rights. However, this conclusion needs further corroboration.

This evidence provides a modicum of support for the view that harmonization of certain components of patent standards can have a positive effect on productivity, but this inference cannot be considered definitive. The available measures are simply not sharp enough to sort out this question. Based on this evidence, I am reluctant to formulate any policy conclusions.

REGIONAL HARMONIZATION PRESSURES

ONE QUESTION POSED FOR THIS STUDY is whether North American harmonization of patent regimes is likely. There seems to be little political pressure within the United States for making its own standards less protective, so any such harmonization presumably would have to come from domestic interests in seeking more rigorous standards in Canada and Mexico.

Such pressure could emerge if trade liberalization under NAFTA were to blunt the increased incentives to innovate resulting from stronger patents adopted in the 1990s. In the context of this study, it is only possible to indicate channels under which trade liberalization could interact with IP protection. Unfortunately, there is not much empirical evidence available to examine these channels.

By cutting tariffs on a preferential basis, NAFTA has expanded the market sizes facing Canadian firms, but it also increased competition from U.S. firms on the home market. The former effect should raise incentives for Canadian firms to engage in more innovation and quality improvements, processes that are assisted by stronger patents. Moreover, because Canadian exports may be expected to target the U.S. market, such firms would have an additional interest in harmonizing patent rules between the two countries in order to reduce costs. But at the same time, increased import competition threatens higher-cost Canadian firms with little innovative capacity, suggesting that the latter would prefer liberal Canadian patent standards.

Trade liberalization under NAFTA might also be expected to reduce incentives for horizontal FDI as Canadian and U.S. multinational enterprises find it more economic to supply Canada through exports rather than branch production.

If true, Canadian affiliates could find it advantageous to support stronger and more-harmonized patent standards. However, a recent study showed that the effect of bilateral tariff cuts between Canada and the United States had the opposite effect.⁶² U.S. multinationals integrated their North American production such that Canadian affiliates significantly increased their sales to the United States while there was little impact on U.S. parent sales in Canada. Thus, bilateral tariff cuts have been trade-creating in this sense. For our purposes, it suggests that the effects of trade liberalization on FDI should not raise much pressure for offsetting changes in IPRs. This finding is consistent with broader studies indicating that NAFTA has created considerably more trade than it has diverted.⁶³

It is possible to place these effects of trade and investment preferences into sharper focus by defining the concepts of *intellectual property creation* (IPC) and *intellectual property diversion* (IPD). The former notion refers to decisions made by firms located in NAFTA countries to create more innovations and to register and exploit more patents, trade-marks and trade secrets within the region by virtue of more tightly integrated economic relations. The latter refers to decisions made by firms located outside the NAFTA area to register and exploit fewer IPRs within the region. To the extent that IPC dominates IPD, given the existing patent regimes, one would not expect much pressure from Canadian firms to push for greater harmonization. Given the results just reviewed and the earlier data showing Canada's shift into innovative activities, it is difficult to argue that IPD dominates in NAFTA. Indeed, as shown in Table 4 there is little indication that residents of other countries, except Japan, are reducing their patent applications in Canada and Mexico in the wake of NAFTA. For these reasons, it is unlikely in my view that competitive effects associated with NAFTA will greatly increase pressures among Canadian firms to move toward the U.S. patent system.

TABLE 4

SHARE OF PATENT APPLICATIONS IN CANADA, THE UNITED STATES AND MEXICO, 1990/92 AND 1997

	ORIGIN					
	CANADA		UNITED STATES		MEXICO	
	1990	1997	1990	1997	1992	1997
Canada	0.068	0.063	0.021	0.022	0.018	0.024
United States	0.447	0.467	0.517	0.519	0.566	0.488
Mexico	0.001*	0.001	0.001*	0.001	0.073	0.012
Japan	0.118	0.065	0.204	0.190	0.035	0.033
United Kingdom	0.066	0.065	0.040	0.031	0.041	0.079
Spain	0.003	0.005	0.002	0.003	0.007	0.007

Note: * 1992 shares.

Source: OECD, *Basic Science and Technology Indicators*, 2001.

EXCESSIVE PATENT PROTECTION IN THE UNITED STATES

IN SOME DIMENSIONS, U.S. PATENT POLICY has become *protectionist* in the sense that it strongly favours the interests of inventors over those of users and potential rivals, thereby threatening to stifle innovation and competition. Such protection may be seen as excessive, even in the context of the highly innovative U.S. economy. It is unlikely that Canada would gain from emulating these standards.

Under current practice, the United States recognizes virtually no exceptions to patent eligibility. Applicants must demonstrate only that the invention bears novelty, an inventive step, and has commercial utility, without concern for the area of technology. Such standards raise weak bars to patentability, suggesting that protection is achieved at low cost. This weakness could be offset by awarding narrow patent claims, but U.S. practice often recognizes broad claims on inventions with limited novelty or inventiveness. One area in which this is problematic is biotechnology, where broad patents have been awarded for research tools, supporting exclusivity claims in a large range of potential uses.⁶⁴

Nowhere is this tendency more evident or more controversial than in the patenting of business methods, which has given rise to a heated debate in the United States. Some critics wonder whether these methods should be patentable at all. There are two other essential objections. First, some patents ensue on ideas that could not reasonably be considered novel, in that similar methods have existed in unprotected form earlier. For example, Priceline.com's *reverse auction*, in which purchasers list a maximum price and the software auctioneer finds a willing supplier, has antecedents in Dutch auctions and other selling methods.⁶⁵ Similarly, Barnes and Noble contested the validity of Amazon's *one-click* patent on the grounds that other techniques involving a single operation by the consumer, contingent on the seller being able to identify the consumer uniquely, had been in operation prior to the issuance of this patent in 1999. This situation arises because the United States Patent Office is limited in its ability to explore prior art, while oral prior knowledge cannot be considered in a patent application. Second, patents awarded often cover remarkably broad claims that could allow patentees to exclude competition in a wide swath of Internet applications. One example is the patent issued to Sightsound.com, which claims to own the rights to all electronic means for distributing digital audio or video recordings over the Internet.

An unfortunate outcome of these weak standards is that the United States often issues patents of low *quality* that provide exclusive rights to inventions and products which have little originality and may also lack clarity in the true scope of claims.⁶⁶ Furthermore, as discussed earlier, the *Dickinson v. Zurko* case has made it difficult for courts to overturn patent grants. These problems are a factor in the rising tide of patent litigation in the United States.

CONCLUSIONS AND RECOMMENDATIONS

DESPITE THE EXTENSIVE REVIEW OF THEORY and evidence provided here, it is difficult to reach firm conclusions about the wisdom of harmonizing the Canadian patent regime with that of the United States. The reasons for this ambiguity are that economic theory provides little guidance about the net benefits from harmonization, while empirical evidence, though suggestive, is far from definitive. As a result, I will simply provide narrative statements about the tradeoffs involved by each aspect and try to draw a recommendation that is sensible if not always supported by data.

First, Canadian innovation indicators are improving rapidly as the economy shifts further into the development and exploitation of advanced technologies. While it is not easy to sort out the reasons for this increase, it does not suggest that Canadian innovative activity would be markedly improved by a decision to adopt U.S. patent standards.

Second, it seems unlikely that significant private pressure will emerge to completely harmonize North American patent rights.

Third, harmonization of Canadian standards with U.S. standards would have mixed effects on inward FDI and technology transfer. The scale effect of stronger patents could be expected to increase such flows, albeit at a higher cost per unit of technology. If inward technology trade is an important consideration for Canadian policy, some movement toward the U.S. system could offset the lower incentives to operate in Canada resulting from the convergence from low standards in Mexico and other middle-income countries. However, there are diminishing returns to stronger patents in this regard in the developed countries.

Fourth, harmonization with the U.S. system would surely be sub-optimal in a case where U.S. standards are themselves overly protective of inventor interests. Canada could consider adopting rules from other countries that seem more appropriate to promoting competition. For example, it is likely that, ultimately, Canada will provide patents for software in general and business methods in particular, for such items may be shown to meet standard patentability criteria in many circumstances. However, rather than awarding such patents with cursory examination for prior art, which is often non-existent, Canada could follow Japan's lead regarding business methods patents. While it clearly recognizes the patentability of business-methods inventions, the Japanese Patent Office proposes to enforce a higher inventive step than does the USPTO. Specifically, this inventive step would be denied when the invention may be easily conceived through combining publicly known methods with common techniques in business and knowledge of standard computer technology.⁶⁷

In this context, we may return to the set of Canadian practices that are in question and provide commentary on each.

- Given the global standard, it makes little sense for Canada to shift to the U.S. system of awarding patents to the first to invent rather than the first to file.
- There is an increasing interest on the part of Canadian firms and affiliates to engage in R&D to develop patentable inventions in medicine and biotechnology. Thus, it is worth considering a mechanism ensuring that such R&D is not disadvantaged by a patent term that is made unreasonably shorter than in the United States by regulatory procedures. One model to consider might be the EU's supplementary protection certificate, which provides automaticity, a maximum effective patent life that nevertheless accounts for regulatory delay, and diffusion incentives.⁶⁸
- At the same time, Canada's ability to compete in new and incremental inventions could be harmed by shifting toward recognition of broad claims that would extend exclusivity to a wide range of potential applications.
- The practice in the United States of strongly discouraging challenges to patent validity is questionable even in the context of the U.S. economy. There is little to recommend it in terms of Canadian policy.
- The introduction of a special court devoted to IPR issues is worthy of consideration, so long as its decisions are keyed more toward a balance of Canadian interests than conditioned by the needs of inventors.
- Given the strong linkages between intellectual property protection and anti-monopoly policy, it is advisable for Canada to consider a more competition-based approach to regulating the exercise of patent rights, as does the United States.

ENDNOTES

- 1 See McKhool and Erratt (1996) at www.gowlings.com.
- 2 See Hore, 2000.
- 3 "Canada: Patent Protection of Pharmaceutical Products," WT/DS114/1, discussed in World Trade Organization, *Overview of the State-of-Play of WTO Disputes*, March 23, 2001.
- 4 "Canada: Patent Protection Term," WT/DS170/1, discussed in World Trade Organization, *Overview of the State-of-Play of WTO Disputes*, March 23, 2001.
- 5 McKhool and Erratt, *supra*, note 1.
- 6 Patented Medicine Prices Review Board, 1998.

- 7 Anderson, Feuer, Rivard and Ronayne, 1998.
- 8 *President and Fellows of Harvard College v. Canada (Commissioner of Patents)* F.C.J. 1213, 2000.
- 9 United States Court of Appeals for the Federal Circuit, *State Street Bank and Trust Co. v. Signature Financial Group, Inc.* 149 F. 3d 1368, 47 U.S.P.Q. 2d 1596, 1998.
- 10 Rochelle Cooper Dreyfuss, "Testimony before the Subcommittee on Courts and Intellectual Property of the House of Representatives Committee on the Judiciary Oversight Hearing on the United States Patent and Trademark Office," March 9, 2000, at www.house.gov/judiciary/drey0309.htm.
- 11 See Grusd, 1999.
- 12 Canadian Intellectual Property Office, 2000.
- 13 Japanese Patent Office, *Policies Concerning 'Business Method Patents'*, November 2000, at http://www.jpo.go.jp/tetuzuki_e/t_tokkyo_e/tt1211-055.htm (accessed April 22, 2005).
- 14 *American Inventors Protection Act of 1999*, Pub. L. 106-113.
- 15 Dreyfuss, *supra*, note 10.
- 16 See Kahin, 2000.
- 17 I am grateful to Jonathan Putnam for making this point.
- 18 McFetridge, 1998, p. 78.
- 19 *Idem*, p. 79.
- 20 See Scherer and Watal, 2001.
- 21 Church and Ware, 1998.
- 22 Maskus, 2000.
- 23 Maskus, 2001.
- 24 Organisation for Economic Co-operation and Development, 1996.
- 25 See Bernard and Jensen (1997) for the United States, and Head and Ries (2001) for Japan.
- 26 Carr, Markusen and Maskus, 2001.
- 27 Gera and Mang (1998) demonstrate a shift in Canada's manufacturing output mix toward higher-technology sectors with much of the rise in demand for these goods coming from exports.
- 28 See Pazderka (1999) and Patented Medicine Prices Review Board (1998).
- 29 Pazderka, *supra*, note 23.
- 30 See OECD, *Basic Science and Technology Indicators*, 2001.
- 31 There are numerous problems with RCA indexes but they are informative for looking at comparative advantage across industries, especially for open economies. Richardson and Zhang (2001) provide further discussion.
- 32 See Maskus (2000) and Mazzoleni and Nelson (1998) for further discussion.
- 33 See Mansfield (1986) and Levin, Klevorick, Nelson and Winter (1987).
- 34 Cohen, Nelson and Walsh, 1996.
- 35 Maskus, 2000.
- 36 A recent attempt to apply causality analysis to this question failed to find much evidence of a relationship in either direction (McDaniel, 1999) but the issue remains open.
- 37 See Somaya, 2001.
- 38 See Scherer (1980) and Bresnahan (1986).

- 39 Baldwin (1997) and Baldwin, Hanel and Sabourin (2000).
- 40 See also McFetridge, 1998.
- 41 Maskus, 2000.
- 42 Mansfield (1986) suggests that it is an important factor but provides little documentation.
- 43 Industry, Science, and Technology Canada (1989), cited in McFetridge (1998).
- 44 Maskus and McDaniel, 1999.
- 45 See Gallini and Wright (1990), Horstmann and Markusen (1987) and Yang and Maskus (2001a).
- 46 Yang and Maskus, 2001b.
- 47 Mohnen and Lépine, 1991. Maskus, Dougherty and Mertha (1998) achieve a similar result for Chinese manufacturing firms, while an important additional reference is Cohen and Levinthal (1989).
- 48 Hanel, 2000.
- 49 This finding is consistent with those of Branstetter (2001) for Japan and the United States.
- 50 Eaton and Kortum, 1996.
- 51 Maskus (2000) overviews a large literature, while Park (1998a) discusses this question in the context of APEC.
- 52 See Ginarte and Park (1997) for details on the index and Maskus (2000) for a comprehensive review.
- 53 See Maskus and Penubarti (1995) and Smith (1999).
- 54 See Mansfield (1995), Lee and Mansfield (1996) and Maskus (1998).
- 55 See Maskus, 2000, Table 6.2.
- 56 See Maskus (1998), Nicholson (2001), Smith (2001) and Yang and Maskus (2001b).
- 57 See Park, 1998b. Gould and Gruben (1996) find that stronger patent protection significantly raises growth performance in economies that are open to trade.
- 58 See Park, 1998b, *supra*, note 51.
- 59 See the papers in Maskus and Wilson, 2001.
- 60 See Anderson and van Wincoop, 2000.
- 61 See updates by Maskus (2000) of McCalman (2001).
- 62 See Feinberg and Keane, 2001.
- 63 See Krueger, 2000.
- 64 Barton, 1995.
- 65 Grusd, *supra*, note 9.
- 66 Somaya, *supra*, note 37.
- 67 Japanese Patent Office, *Policies Concerning 'Business Method Patents'*, November 2000, at http://www.jpo.go.jp/tetuzuki_e/t_tokkyo_e/tt1211-055.htm (accessed April 22, 2005), p. 2.
- 68 See Parker, 1993.

ACKNOWLEDGMENTS

I AM GRATEFUL TO Bronwyn Hall, Jonathan Putnam and other participants at the conference for comments.

BIBLIOGRAPHY

- Anderson, Robert D., Paul M. Feuer, Brian A. Rivard and Mark F. Ronayne. 1998. "Intellectual Property Rights and International Market Segmentation in the North American Free Trade Area." In *Competition Policy and Intellectual Property Rights in the Knowledge-Based Economy*. Edited by Robert D. Anderson and Nancy T. Gallini. Industry Canada Research Series. Calgary: University of Calgary Press, pp. 397-441.
- Anderson, James E., and Eric van Wincoop. 2000. "Gravity with Gravitas: A Solution to the Border Puzzle." Boston College. Manuscript; Published in 2001 as NBER Working Paper No. 8079, Cambridge (Mass.): National Bureau of Economic Research.
- Baldwin, John. 1997. *Innovation and Intellectual Property*. Statistics Canada. Cat. No. 88-515-XPE.
- Baldwin, John, Petr Hanel and David Sabourin. 2000. *Determinants of Innovative Activity in Canadian Manufacturing Firms: The Role of Intellectual Property Rights*. Statistics Canada. Research Paper. Cat. No. 11F0019MIE2000122.
- Barton, John H. 1995. "Patent Scope in Biotechnology." *International Review of Industrial Property and Copyright Law* 26: 605-618.
- Bernard, Andrew, and J. Bradford Jensen. 1997. "Exceptional Exporter Performance: Cause, Effect, or Both?" *Journal of International Economics* 47: 1-26.
- Branstetter, Lee G. 2001. "Are Knowledge Spillovers International or Intranational in Scope? Microeconomic Evidence from the U.S. and Japan." *Journal of International Economics* 53: 53-80.
- Bresnahan, Timothy F. 1986. "Measuring the Spillovers from Technical Advance: Mainframe Computers in the Financial Services." *American Economic Review* 76: 742-755.
- Canadian Intellectual Property Office. 2000. *A Guide to Patents*. Ottawa: CIPO.
- Carr, David L., James R. Markusen and Keith E. Maskus. 2001. "Estimating the Knowledge-Capital Model of the Multinational Enterprise." *American Economic Review* 93 (June): 995-1001.
- Church, Jeffrey, and Roger Ware. 1998. "Network Industries, Intellectual Property Rights and Competition Policy." In *Competition Policy and Intellectual Property Rights in the Knowledge-Based Economy*. Edited by Robert D. Anderson and Nancy T. Gallini. Industry Canada Research Series. Calgary: University of Calgary Press, pp. 227-286.
- Cohen, Wesley M., and Daniel A. Levinthal. 1989. "Innovation and Learning: the Two Faces of R&D." *The Economic Journal* 99: 569-596.

- Cohen, Wesley M., Richard R. Nelson and John P. Walsh. 1996. "Appropriability Conditions: Why Firms Patent and Why They Do Not." Yale University. Manuscript.
- Eaton, Jonathan, and Samuel Kortum. 1996. "Trade in Ideas: Patenting and Productivity in the OECD." *Journal of International Economics* 40: 251-278.
- Feinberg, Susan E., and Michael P. Keane. 2001. "U.S.-Canada Trade Liberalization and MNC Production Location." *Review of Economics and Statistics* 83: 118-132.
- Gallini, Nancy T., and Brian D. Wright. 1990. "Technology Transfer under Asymmetric Information." *RAND Journal of Economics* 21: 147-160.
- Gera, Surendra, and Kurt Mang. 1998. "The Knowledge-Based Economy: Shifts in Industrial Output." *Canadian Public Policy* 24: 149-184.
- Ginarte, Juan C., and Walter G. Park. 1997. "Determinants of Patent Rights: A Cross-national Study." *Research Policy* 26: 283-301.
- Gould, David M., and William C. Gruben. 1996. "The Role of Intellectual Property Rights in Economic Growth." *Journal of Development Economics* 48: 323-350.
- Grusd, Jared Earl. 1999. "Internet Business Methods: What Role Does and Should Patent Law Play?" *Virginia Journal of Law and Technology* 4 (Fall).
- Hanel, Petr. 2000. "R&D, Interindustry and International Technology Spillovers and the Total Factor Productivity Growth of Manufacturing Industries in Canada, 1974-1989." *Economic Systems Research* 12: 345-367.
- Head, Keith, and John Ries. 2001. "Sources of Variation in the Productivity of Japanese Manufactures." University of British Columbia. Manuscript.
- Hore, Ed. 2000. "Legal Update: Patent and Copyright Law." *Canadian Lawyer* (February).
- Horstmann, Ignatius, and James R. Markusen. 1987. "Licensing versus Direct Foreign Investment: A Model of Internalization by the Multinational Enterprise." *Canadian Journal of Economics* 20: 464-481.
- Industry, Science and Technology Canada. 1989. "Appendices for the Survey of Intellectual Property Rights in Canada: Final Report." Ottawa. Manuscript.
- Kahin, Brian. 2000. "The Expansion of the Patent System: Politics and Political Economy." *First Monday* (December 31).
- Krueger, Anne O. 2000. "NAFTA's Effects: A Preliminary Assessment." *The World Economy: The Americas Edition* 23: 761-776.
- Lee, Jeong-Yeon, and Edwin Mansfield. 1996. "Intellectual Property Protection and U.S. Foreign Direct Investment." *Review of Economics and Statistics* 78: 181-186.
- Levin, Richard C., Alvin K. Klevorick, Richard R. Nelson and Sidney G. Winter. 1987. "Appropriating the Returns to Industrial Research and Development." *Brookings Papers on Economic Activity Special Issue*: 783-820.
- Mansfield, Edwin. 1986. "Patents and Innovation: An Empirical Study." *Management Science* 32: 173-181.
- . 1995. *Intellectual Property Protection, Foreign Direct Investment and Technology Transfer: Germany, Japan, and the United States*. International Finance Corporation. Discussion Paper No. 27.
- Maskus, Keith E. 1998. "The International Regulation of Intellectual Property." *Weltwirtschaftliches Archiv* 134: 186-208.
- . 2000. "Intellectual Property Rights in the Global Economy." Washington (D.C.): Institute for International Economics.

- . 2001. "Intellectual Property Protection and Capital Markets in the New Economy." Paper prepared for the 27th Pacific Trade and Development Conference. Canberra.
- Maskus, Keith E., Sean M. Dougherty and Andrew Mertha. 1998. "Intellectual Property Rights and Economic Development in China." University of Colorado. Manuscript; Published in 2005 in *Intellectual Property and Development: Lessons from Recent Economic research*, edited by Carsten Fink and Keith Maskus, Co-publication of the World Bank and Oxford University Press, pp. 295-331.
- Maskus, Keith E., and Christine McDaniel. 1999. "Impacts of the Japanese Patent System on Productivity Growth." *Japan and the World Economy* 11: 557-574.
- Maskus, Keith E., and Mohan Penubarti. 1995. "How Trade-Related Are Intellectual Property Rights?" *Journal of International Economics* 39: 227-248.
- Maskus, Keith E., and John S. Wilson (ed.). 2001. *Quantifying the Impact of Technical Barriers to Trade: Can It Be Done?* Ann Arbor (Mich.): University of Michigan Press.
- Mazzoleni, Roberto, and Richard R. Nelson. 1998. "Economic Theories about the Benefits and Costs of Patents." *Journal of Economic Issues* 32: 1031-1052.
- McCalman, Phillip. 2001. "Reaping What You Sow: An Empirical Analysis of International Patent Harmonization." *Journal of International Economics* 55, 1: 161-186.
- McDaniel, Christine. 1999. "Legal and Institutional Features of a Patent System and Impacts on Technology Diffusion: Evidence from Japanese and U.S. Aggregate and Industry Data." University of Colorado. Unpublished Ph.D. dissertation.
- McFetridge, Donald G. 1998. "Intellectual Property, Technology Diffusion, and Growth in the Canadian Economy." In *Competition Policy and Intellectual Property Rights in the Knowledge-Based Economy*. Edited by Robert D. Anderson and Nancy T. Gallini. Industry Canada Research Series. Calgary: University of Calgary Press, pp. 65-104.
- McKhool, Eli J., and Judy A. Erratt. 1996. "Canadian Patent Act and Rules: Changes October 1, 1996," at www.gowlings.com.
- Mohnen, Pierre, and Normand Lépine. 1991. "R&D, R&D Spillovers and Payments for Technology: Canadian Evidence." *Structural Change and Economic Dynamics* 2: 213-228.
- Nicholson, Michael W. 2001. "Intellectual Property Protection and Internalization: An Econometric Investigation." University of Colorado. Manuscript.
- OECD. 1996. *The Knowledge-Based Economy*. Paris: Organisation for Economic Co-operation and Development.
- Park, Walter G. 1998a. "Patent Systems in APEC: Role in Nontariff Trade Barriers and Strategic Trade Policy." American University. Manuscript.
- . 1998b. "International Patenting and Patent Protection." American University. Manuscript.
- Parker, John. 1993. "Patent Term Restoration in Non-Drug Developing Nations." *PharmacoEconomics*.
- Patented Medicine Prices Review Board. 1998. *Trends in Patented Drug Prices*. PMPRB Study Series No. S-9811, Ottawa (September).
- Pazderka, Bohumir. 1999. "Patent Protection and Pharmaceutical R&D Spending in Canada." *Canadian Public Policy* 25: 29-46.

- Richardson, J. David, and Chi Zhang. 2001. "Revealing Comparative Advantage: Chaotic or Coherent Patterns across Time and Sector and U.S. Trading Partner?" In *Topics in Empirical International Economics: A Festschrift in Honor of Robert E. Lipsey*. Edited by Magnus Blomstrom and Linda Goldberg. Chicago (Ill.): University of Chicago Press.
- Scherer, Frederick M. 1980. *Industrial Market Structure and Economic Performance*. 2d ed. Chicago (Ill.): Rand-McNally.
- Scherer, Frederick M., and Jayashree Watal. 2001. "Post-TRIPs Options for Access to Patented Medicines in Developing Countries." World Health Organization. Commission for Macroeconomics and Health. Manuscript.
- Smith, Pamela J. 1999. "Are Weak Patent Rights a Barrier to U.S. Exports?" *Journal of International Economics* 48: 151-177.
- . 2001. "How Do Foreign Patent Rights Affect U.S. Exports, Affiliate Sales, and Licenses?" *Journal of International Economics* 55, 2: 411-439.
- Somaya, Deepak. 2001. "My Strategy Says: 'See You in Court!' Determinants of Decisions not to Settle Patent Litigation in Computers and Research Medicines." University of Maryland. Manuscript.
- Yang, Guifang, and Keith E. Maskus. 2001a. "Intellectual Property Rights, Licensing, and Innovation in an Endogenous Product-Cycle Model." *Journal of International Economics* 53: 169-187.
- . 2001b. "Intellectual Property Rights and Licensing: an Econometric Investigation." *Weltwirtschaftliches Archiv* 137: 58-79.



Jonathan D. Putnam
University of Toronto

12

The Economics of Digital Copyright in the Knowledge-Based Economy

INTRODUCTION

THIS STUDY HAS THREE AMBITIONS: to describe the economic implications of the copyright system; to distinguish digital copyright regimes from the more general copyright regime based on analog or other media; and to apply the distinctive features of the digital copyright regime to the Canadian policy-making context. While I generally hold the view that there is nothing new under the sun — old legal regimes are usually adequate to manage new technology — I observe that digital technology has altered the economic and legal relationships between producers and consumers of goods. In other words, digital technology does not eviscerate copyright law, but the application of current law to new digital goods does fundamentally shift the terms of trade between parties. Overall, the new terms favour copyright owners over consumers, but they increase the efficiency with which new goods are created and traded. Whether their interests are shared or conflicting, consumers and producers increasingly enter into new forms of exchange that transcend the one-time consumption of a single good. In effect, intellectual *property* has been augmented by a pervasive new intellectual *contract*. Across all consumers, this new contract redefines not only the individual buyer-seller bargain, but also such economic aggregates as measured productivity and the external balance of trade. Because productivity and trade growth are central to current Canadian economic concerns, these changes directly affect the approach that policy-makers take to the macro-economic future even as they attempt to absorb the micro-economic lessons of the past.

In particular, digital copyright facilitates price discrimination by copyright holders. Price discrimination potentially increases the efficiency of economic transactions. While producers are better off with the option to price discriminate, consumers may be worse off or better off when price discrimination increases. Much of the study is devoted to the empirical and theoretical implications of increased price discrimination as the key new feature of copyright in the knowledge-based economy.

THE ECONOMIC PARADIGM

ALTHOUGH THE CLAIM IS OFTEN MADE that intellectual property rights are just like other property rights,¹ there are several dimensions in which this statement is false. One difference between intellectual property and real or personal property is that intellectual property rights come into existence on the condition that a creator makes a successful investment, where *success* is defined according to the statutory criteria for property protection. In other words, the right is a reward for a successful investment. This view of intellectual property is inherently retrospective: the law looks backward to what the creator has done, and rewards him accordingly.

Of course, the particular reward — the right to exclude others — must be exercised prospectively, as others develop similar works of authorship. It is in the exercise of this reward that the copyright holder controls the subsequent creation and development of related works. Only when his work passes into the public domain does his influence over subsequent authors cease. Even then, authorship of complex composite works — which are increasingly common in the digital economy — may occur over a long period.² The parts that pass into the public domain first may be impossible to distinguish from those that remain copyrighted, so the effective economic life of a work may exceed the simple statutory definition.³

Unfortunately, the economic analysis of copyright has not modeled the effects of different regimes on the sequence of downstream creation as rigorously as has begun to occur in the analysis of sequential patenting (which remains a murky and non-robust area of the literature).⁴

We do not attempt in this study to model sequential copyrights. Aside from the difficulty inherent in defining the *breadth*⁵ of protection offered by a copyright regime, there are two further difficulties. First, copyright protects against a fundamentally different economic activity — copying — than that protected by patent law. Patent law encourages imitators to read a patent's disclosure as an aid in inventing around its claims. Copyright law, by contrast, lacks any analogue to the division between the disclosure and claims of a patent document — there is only the copyrighted work itself. Copyright law implicitly penalizes those who use an original work to attempt a non-infringing

imitation of it: access to the original work coupled with substantial similarity creates a presumption of copying. In sum, the search algorithm for *inventing around* a copyright is inherently different from that employed in the case of patents, so the applicability of the sequential innovation literature is questionable.

A second difficulty with extending the sequential innovation literature to copyright lies in the comparatively sparse set of rights created under patent law. A patentee acquires the right to exclude others from making, selling or using an invention — three discrete stages in the distribution chain through which an invention passes. As it moves through the chain, an invention may be combined to form a larger system, but the distribution process does not create subsidiary rights. Copyright, on the other hand, envisages both a richer distribution chain (which may include adapters, performers, recorders and broadcasters of the work), as well as an explicit recognition that the work may be transformed into a *derivative work* at each stage of distribution. Being in effect *jointly invented* by the original creator and one of the subsequent links in the copyright distribution chain, these derivative works are protected by different and more complex reward structures for their authors than those typically created under patent law.

The present study has a more modest goal. It takes the economic complexities of copyright law as given. Onto this black box of incentives and restrictions is overlaid a discussion of the aspects on which the economic analysis of *digital* copyrighted works differs from that of traditional works. However, I wish to characterize digital copyright for policy-makers who must grapple — here and now — with its implications. If this grappling creates further demand for a finer analysis of all types of copyright, then the truth (which must include an acknowledgment of our relatively limited state of knowledge) will have been well served.

THE SHIFT IN TECHNOLOGY

COPYRIGHT HAS FACED TECHNOLOGICAL CHALLENGES with increasing frequency over the past century. The most important of these have likely revolved around new subject matter (such as the extension of copyright protection to software⁶) and the application of copyright or copyright-like protection to new categories of agents in the distribution chain (such as broadcasters). Although these debates are not without controversy, they have been resolved using relatively tried-and-true principles of copyright protection (and of property law more generally), aimed at preserving the balance between reward and distribution. Among the most important of these principles is the doctrine of exhaustion: once a copyright owner sells a copy of his copyrighted work to a user, that user is free to consume the work basically as he wishes, without restrictions. For example, the purchaser of a book may read the book as many

times as she wants; she may resell it; and she may use both the ideas and (within certain limitations) the expression it contains for her own further creation, whether private or public. The purchaser's rights are impinged only to the extent that her use contemplates making a copy, which most uses do not. Broadly speaking, the user is restricted from activities that place her in competition with the copyright holder.⁷ Speaking in the more precise terms of copyright law, the user is restricted from *copying*, which includes transformative uses of the underlying work. In general, such uses can be identified with production, not consumption.

With the advent of digital works, the commonplace division between the purchaser as user and as potential competitor has broken down. This breakdown occurs for technological reasons: in order to use any work embodied in a digital medium, the user must himself make a copy. Unlike the reader of a traditional book, the reader of an electronic book — or the creator of a spreadsheet, or the viewer of a digital photograph — must, by the nature of the technology, engage in an act that is proscribed under copyright laws.⁸ Obviously, the contract between the copyright holder and the user must take into account such infringing activity, and it is the nature of this contract, not the nature of copyright law, that the digital revolution has altered fundamentally.

There are two legal routes out of the difficulty in which creators and users of digital copyrighted works find themselves. First, the law can declare that the use contemplated by the user is a “fair use,” meaning that although it is an infringement, the law exempts that infringement from liability. Fair use resembles an easement across the copyright holder's property. Even in the United States, where fair use is explicitly codified under the *Copyright Act*,⁹ the courts must weigh several competing interests in order to determine whether a use is fair. This balancing leaves a great deal of room for *ex ante* uncertainty, which is costly to resolve *ex post*.

Second, the law may provide that the user holds an implied licence to make a copy — how else could the parties have executed a valid contract if, in exchange for consideration, the copyright holder could exclude the purchaser from making the copy which effects the purchaser's use? But if the sale of a copy implies a licence to use, the scope of permissible uses is broad and its boundaries are vague.¹⁰

Given the incomplete nature of the implied contract between the parties, the vast majority of creators of digital copyrighted goods have preferred to specify explicitly the nature of their licence. The significance of this shift in the basic terms of the exchange cannot be overstated. Over the entire market economy, the predominant form of contractual exchange between parties takes the form of a one-off trade of goods or services for money.¹¹ When a relationship between parties persists beyond the transaction date, this relationship is usually (a) conditional on the statement of a future claim, which (b) generally

involves a claim by the buyer against the seller. For example, warranty terms often require purchasers to register their purchase with the manufacturer, who can then verify eligibility in the event of a defect or liability claim.¹² There are significantly fewer contract terms that contemplate future claims by the seller against the buyer (except in his capacity as a potential reseller).¹³

The need to specify the terms of the post-sale relationship between the seller and buyer greatly enriches the potential interaction between the parties. Relative to a non-licence world, this arrangement also shifts bargaining power from buyers to sellers. This shift occurs for several reasons.

Tying over time. To the extent that licensing increases the interdependence between consumption decisions over time, the buyer/licensee is more vulnerable to *lock-in* in the stream of future purchases. Conditional on making an initial sale, the seller need not work as hard to earn the buyer's continuing goodwill by price competition or by investing in the quality of its subsequent products and reputation.¹⁴

Tying across products. To the extent that licensing increases the interdependence between consumption decisions across product categories, the buyer is more vulnerable to *tying* by the seller.¹⁵

No secondary markets. The terms of the licence may restrict the buyer from reselling even his own licensed copy, which implies that (unlike sellers of unlicensed goods) the seller of a licensed good need not compete with its own products in a secondary market.¹⁶ High-value buyers whose uses are temporary (including those who consume the good relatively early in the product cycle) cannot resell in a competitive market of prospective buyers, which makes them worse off; low-value buyers (including those who demand the good relatively late in the product cycle) cannot purchase it in a competitive market from early buyers/resellers, which makes them worse off.

Monitoring. Perhaps most importantly for our purposes, when there is no post-sale relationship, buyers remain anonymous. Anonymity inhibits the ability of the seller to identify high-value buyers. Licensing facilitates monitoring, by which the seller can discriminate between high- and low-value buyers.

According to elementary industrial organization theory, tying (whether across time or products), the prevention of resale and monitoring are all key ingredients in the time-honoured practice of price discrimination¹⁷ — charging different prices for the *same* good to different buyers, based on their valuations.¹⁸ Price discrimination is expressed in degrees. Third degree discrimination occurs when the seller observes a characteristic about the buyer that is correlated with the buyer's willingness to pay, and charges a different price based on that characteristic.¹⁹ Cheaper prices for senior citizens at the movies or for air travellers staying over a weekend are classic examples.²⁰ These transactions require that the buyer disclose (or that the seller observe) the buyer's type prior to setting the price.

Second-degree price discrimination occurs when the seller cannot observe the individual buyer's type, but can observe the distribution of *types* within the population. In that case, the seller can offer a menu of prices that induces buyers to self-select according to their type. To take another classic example, the seller of a fast-food hamburger may *bundle* the burger with complementary products: high-value buyers purchase the bundle, while low-value buyers purchase the burger only. The seller earns a greater profit on the bundle than on the burger alone. Again, the seller declares the price of the bundle in advance.

Another example of menu pricing is the *two-part tariff*, under which the seller charges both an *access* (fixed) fee²¹ and a *metering* fee. The metering fee permits the seller to evaluate the buyer's willingness to pay after the sale. For example, a seller of telephone service may offer a low-use plan at \$20 per month and \$0.10 per minute, and a high-use plan at \$30 per month and \$0.05 per minute.²² These examples illustrate important opportunities and constraints facing sellers and buyers. Intuitively, the seller is generally better off if he has information about the buyer's type. But buyers themselves may not know their type at the time of purchase. In other words, the act of consumption is also an investment in *learning*. Since the consumer's gains from learning are shared with the seller, it is in the seller's interest to subsidize that learning, usually in the form of a lower access fee ("try before you buy"). Thus, the seller may care less about knowing the buyer's type in advance of the sale, and more about metering the buyer according to his revealed preferences *after* the sale. Moreover, a buyer's type may not be exogenous, but may depend endogenously on the seller's post-sale efforts to manipulate that type.²³ Thus, the capacity to meter usage is generally a good thing for sellers.

On the other hand, for some products that have a high optional component, the seller may maximize profits by charging a single price in advance; metering simply reveals the absence of value to most sellers.²⁴ Moreover, many information goods are *experience goods* (those whose — possibly subjective — quality cannot be verified in advance). The exchange of information is subject to the general problem that, prior to purchase, the buyer cannot verify the quality of the information. But quality cannot be verified unless the information is exchanged, at which point the buyer has no reason to pay. Thus, post-sale metering of the *willingness to pay* must measure some kind of ongoing or future use, not the lasting benefit to the consumer of the initial consumption.

First-degree price discrimination focuses not on the means by which the seller sets different prices, but on the end: the seller is able to identify each buyer's individual valuation, and to make a take-it-or-leave-it offer to each buyer at a price that is close to his valuation. While third-degree price discrimination may appear to represent only the unrealistic extreme of economic theory, there are, in fact, instances in which sellers have essentially perfect information about the buyer's willingness to pay. For example, notwithstanding

their non-profit status, universities practice very fine-grained price discrimination through the use of detailed financial disclosure forms to set the effective level of tuition for each student.

This example illustrates a further building block in our characterization of the changes wrought by the digital economy: the more information the seller acquires about the buyer, the more he is able to discriminate in his pricing. In the extreme, the seller is able to capture all of the gains from all the trades. As a result — and as in the case of perfect competition — all socially efficient transactions (those where buyers are willing to pay more than the seller's marginal cost) take place. Thus, third-degree price discrimination has the same desirable efficiency properties as perfect competition, but the opposite distributional implications.²⁵

All degrees of price discrimination depend on one essential feature: the absence of buyer arbitrage. In other words, price discrimination only works when low-value buyers cannot act as agents for high-value buyers — buying at the low price to which they are eligible, then reselling to high-value buyers, in effect competing with the seller. If such arbitrage is permitted, the seller cannot segment the market; the price-discriminating equilibrium collapses to the single-price equilibrium. As we have seen, it is exactly this no-reselling condition that the seller, as the licensor of a digital copyrighted good, seeks to impose on the buyer-copier. In effect, the seller makes a take-it-or-leave-it offer to the buyer of a bundle: the price of the good may be negotiable, but the terms of consumption are not. Under traditional circumstances, the seller's bargaining power would be limited by competition from sellers of similar products. But in the digital world, all sellers must treat buyers as copiers (whether they copy only to effect their own consumption or *pirate* for others), so that every offer takes the form of a licence rather than a sale. In this case, buyers have no choice but to accept the licence restrictions on their use and resale.²⁶ In the context of a dynamic relationship with the seller, buyers may indeed support these restrictions to the extent that they guarantee the future supply of technical support, upgrades and complementary products from the seller, and thereby protect their initial investment.²⁷ Licensing thus facilitates price discrimination in a way that the sale of individual copies fundamentally cannot.

Given that seller and buyer have contracted to form a relationship based on licensing rather than on an outright sale, the presence of a licence makes possible two closely related techniques of price discrimination: metering and monitoring. Metering means charging the user according to the level or intensity of current use. When using a taxi, for example, a passenger pays a two-part tariff: the access fee (the meter drop), and the per-kilometre metering charge. While this form of metering may seem uncontroversial (perhaps because both the price and the taxicab's incremental cost of operation have approximately a linear relationship with the distance traveled), other forms of metering are

driven by the buyer's revealed demand characteristics, not the seller's marginal cost.²⁸ Monitoring exists when the seller asserts the right to determine whether a buyer's copying exceeds the terms to which the parties agreed. One can think of a licence as an incomplete contract, in which metering is a bargain over observable usage. Monitoring, on the other hand, is a contract over unobservables, like impermissible copying and other unforeseen usage that provides value to the buyer. Although monitoring may not incur per-unit charges, it may provide information about the buyer's preferences that can serve to structure future deals to the seller's advantage.

In the copyright licensing context, both metering and monitoring assist the price-discriminating seller in tailoring its pricing schemes to the valuations of individual buyers. For example, a per-station charge to install a software program on a company's network is a form of metering.²⁹ Metering may, in turn, facilitate monitoring through tracking usage and predicting the benefits of network economies of scale³⁰ based on (say) the size of the customer's installed base. The data can then be used to structure the price of future upgrades, etc.

Thus, the fundamental economic problem here is not that copyright law is inadequate for the task of creating property and protecting investments in the digital economy. Copyright law has actually adapted quite well to new technology. In fact, the central point of this study is that *there may be no economic problem at all*: the rising proportion of transactions that are controlled by licence and, therefore, subject to price discrimination implies *increasing economic efficiency*. Some transactions that would not have taken place under a selling regime — because the seller could not offer the good to the buyer at a low enough price, and because the buyer could not credibly promise not to resell — will in fact take place under a licensing regime. Economists routinely interpret this shift as producing a net welfare gain. In particular, consumers may be better off under the new terms.

THE CONSUMER AS AGENT

GIVEN THE POTENTIAL INCREASE IN EFFICIENCY, it is important also to observe the changing status of the consumer in the digital economy. In the language of real property, the digital economy has facilitated the rise of consumer *tenancy* and the decline of ownership in fee simple. To the extent that consumption of a digital good involves some labour or other input, the consumer is no longer the presumptive residual claimant of the gains that result from combining labour with the intellectual inputs of others. Like other landowners, the licensor of a digital good views buyers less as consumers and more as tenants or agents.³¹ Once again, the significance of this change cannot be overstated, because it implies that the linear model of production — from raw material supplier to manufacturer to distributor to final consumer — does not

stop with the final consumer. The final consumer is not, in fact, *final*, because the price-discriminating seller seeks to identify the consumer's true valuation, which in turn is likely to depend in part on the contribution of the digital good to the consumer's productivity as a supplier of human capital, not merely his utility as a consumer. Unlike a transactional relationship in which the consumer and seller are engaged in a zero-sum bargain over the price, the new relationship implies that the seller should seek to align the buyer's interests with his own, by offering the buyer better terms in exchange for post-purchase decisions that benefit the seller.

For example, like players of analog games, purchasers of software games (say *Myst*) use the game as an input into personal entertainment. Being digital, software games require the creator's permission to make copies, whether of the game itself or of the user's interaction with it. Part of the appeal of these games is that they require a substantial investment of time and skill in order to perfect the player's knowledge base and technique. The creator facilitates the acquisition of such game-specific human capital by permitting players to save the game in a permanent storage device at particular junctures for resumption later. The more interactive the game and the more discretion the player has regarding choices among the game's (possibly infinite) outcomes, the greater the independent creativity supplied by the player in the version of the game he saves. This form of copying, unlike the simple copying of the executable file into the computer's volatile memory, likely constitutes the creation of a derivative work under copyright law.

The complex economic problem facing the game's creator is how to discriminate between low- and high-value users of the game, and how to extract a higher price from the latter. This problem is complex because the user himself may not know his valuation at the time of purchase and his final valuation may depend on his initial learning of the game. Thus, the copyright holder must gauge how best to subsidize initial learning about the game, while extracting rents from users whose subsequent investment (and valuation) is high. The solution to this problem in any given situation obviously lies beyond the scope of this study. For purposes of demarcating the digital economy from the *old* economy, the innovation resides in the ability of the copyright holder to use built-in restrictions on copying (and derivative creation) under the terms of the user licence to monitor or meter the player's use, and thus price discriminate.³²

It should be noted that the value to the user may depend on his interaction with other users. The user may form part of a network of actual or prospective users, each of whom must license the game from the copyright holder. By virtue of these licences, the copyright holder may exert control over the interaction among users. Consumption decisions that increase the value of the network will be rewarded. Again, the nature and extent of this control will vary depending on the interaction among users and the dynamics of market

competition, but the point is the same: the *final* consumer has been transformed into the monopolist's agent.

So-called "reach-through" licences are nothing new, but their scope has heretofore been limited by the general doctrine that a seller's rights are exhausted by sale.³³ Even in an intellectual property context, the purchaser of a patented invention or a copyrighted work generally retains the right to resell his particular copy: contractual restrictions on resale have been held unenforceable. For this reason, one should view the evisceration of the first-sale doctrine in the copyright context as an important practical shift of bargaining power between creators and users.³⁴

From an economic perspective, two types of welfare problems arise when a consumer is viewed as an agent of the monopolist. The first is a pricing problem while the second is an agency problem.

The pricing problem arises to the extent that the monopolist's per-use pricing decision (by which he effects price discrimination) enters the consumer's own pricing decision. It is well known that when a supply chain consists of a first monopolist who supplies an intermediate good to a second monopolist, the final price of the good is too high, because the first monopolist does not take into account the effect of his privately optimal price on the second monopolist's pricing decision. Social efficiency would be increased if the two monopolists were integrated into a single monopolist; the price of the final good would be lower and total output would rise.³⁵

When the vertical relationship between the two monopolists involves a pioneer and an improver (or a first author and a derivative author), an additional wrinkle appears. There is generally no way to divide the total profits available from the combined sale of the two goods so as to induce both monopolists to invest efficiently in the creation of their respective goods.³⁶ No matter how profits are divided *ex ante*, one or the other monopolists has insufficient incentives to create, again because the first monopolist's pricing decision maximizes his profits, not the joint profits.

In the present context, this social pricing problem implies that the price-discriminating monopolist of a digital good will systematically price that good too high relative to the social optimum if his pricing distorts the consumer's subsequent *per-use optimization* function, and the consumer in turn acts as a monopolist in supplying the transformed digital good.³⁷ A lump-sum fee for passing the digital good from the monopolist to the consumer would not have this effect; neither would different lump-sum fees to different consumers. But a running royalty, facilitated by monitoring the consumer's usage and charging for each additional use, would distort the usage decision.

It is important to emphasize that social inefficiency is not the same as a redistribution of the gains from trade from consumer to producer. In the former case, the size of the pie is smaller and the producer gets more of it, as a result of

his pricing decision. In the latter case, the size of the pie is fixed and the producer gets more of it as a result of his pricing decision. Therefore, the justification for a policy that reduces the ability of the monopolist to reach through to the consumer's usage decisions would rest on productive efficiency grounds (about which economics has much to say), and not on redistributive grounds (about which economics has less to say).

The second welfare problem raised by the *consumer as agent* is that, like all agents, the consumer maximizes his own interests, not those of the monopolist-principal. When the interests of the monopolist diverge completely from those of the consumer, as they do in the case of a one-shot final consumer, the parties simply engage in a zero-sum bargain. The presence of an agency relationship opens up the possibility of a positive-sum game that depends on, among other things, the price charged by the monopolist, which in turn depends on the consumer's usage, which in turn depends on the *effort* exerted by the consumer on behalf of the monopolist. The classic solution to this problem is to align the consumer's interests with those of the monopolist. Again, the optimal design of this contract depends on the nature of the consumer's usage. The basic point is that the monopolist's attempt to capture some of the consumer's utility may increase productive efficiency if the consumer can be induced to produce in the monopolist's interest.³⁸ The welfare question is: Under what conditions does total welfare increase if the monopolist practices price discrimination in the context of this agency contract?

CHANGES IN THE DISTRIBUTION CHAIN FOR DIGITAL GOODS

COPYRIGHT HYPOTHESIZES AND OFFERS PROTECTION to a potentially highly differentiated distribution chain: from author to adapter to performer to recorder to broadcaster to "communicat[or] to the public by telecommunication."³⁹ The latter extended this distribution chain to other economic entities beyond the public: those to whom a consumer sells a transformed version of a digital good. While the focus remains on this topic, the present section sets it in the context of a larger spectrum of observations on chains of monopoly rights.

As stated previously, economists have long recognized the inefficiency that results from granting monopoly rights to successive entities in a distribution chain: the problem of so-called "double marginalization."

By conferring separate reproduction rights at each stage, the copyright regime exacerbates this chain-of-monopolies fragmentation of the distribution process. The potential bottlenecks can be contracted around, by assignment of intermediate distribution rights, so that a single entity managing the chain can reap greater benefits than individual rights holders operating independently.

However, sequential monopolies create the potential for information asymmetries and inefficient bargaining, which may result in the failure to execute contracts that all parties would deem to be efficient if information were perfect.⁴⁰

By converting the public into an agent of an upstream copyright holder, digital copyright extends the fragmented distribution chain one step further: the consumer is no longer the end of the chain, but an intermediate link between the copyright holder and some consumer further downstream (who buys a transformed version of the copyrighted digital good).⁴¹

An argument sometimes made in favour of granting broad control to a *pioneering* creator is that, like a prospector who stakes his claim to an unexplored tract of land, the creator is in the best position to control the subsequent exploitation and improvement of the created good.⁴² Proponents of this theory argue that a pioneering monopolist can prevent inefficient rivalry in the downstream market, both by avoiding a *tragedy of the commons*-type over-exploitation of a common resource (the first-stage discovery or initially copyrighted work) and by preventing inefficient *racing* (over-commitment of resources) to make the next downstream discovery or transformation. In other words, the prospect theory implies that, other things being equal, copyright should be broad as well as (or perhaps instead of) long, to efficiently organize downstream use and follow-on discovery.

This line of reasoning has two obvious weaknesses. First, it hinges critically on two assumptions: (1) low transaction costs between the pioneer and follow-on improvers; (2) superior information on the part of the pioneer (or, at least, information asymmetries that do not thwart negotiations between the pioneer and improvers) as to the value of his invention. In the digital world, there may be significant, if not pervasive, violations of these assumptions. Second, there is no particular reason to assign the role of *monopolist downstream organizer* to the pioneering creator, unless (1) such a reward is necessary to induce the pioneering creation, or (2) once again, the pioneer has better information than other actors for assuming the role of downstream organizer.

First, let's consider the underlying assumptions. The extremely low cost of distribution over digital networks ensures a wide diffusion in the new economy, which implies that, within the universe of possible consumers, the monopolist faces a large set of prospective negotiating partners. A wide distribution increases the cost of finding the best matches and of articulating consistent screening and negotiating rules. Moreover, prospective consumers are likely to have quite heterogeneous valuations of the good (which is why the monopolist practices price discrimination in the first place). This heterogeneity implies that (1) cheap and simple rules may not capture the monopolist's bargaining position vis-à-vis any particular consumer, and (2) heterogeneity in the consumer's valuation of the good as a *consumption good* is likely to be imperfectly correlated with the consumer's valuation of the good as an *input* to his future production.

A high-income individual with no interest in the good beyond consuming it should be offered a different contract from that offered to a low-income individual having the capacity to add value. But contracts that identify and restrict a consumer's capacity for subsequent transformation generally have high transaction costs.

Second, the monopolist of a digital good may not, in fact, have superior information about its potential uses. Like paintings in a museum, the value of individual goods may depend in part on their arrangement and combination with other goods. And like good museum curators, those who are skilled in arranging such combinations are unlikely to be the same people as those who created the paintings. The broad dissemination of digital copies by monopolists increases the demand for the services of those who organize these copies helpfully. Often, it is precisely because the organizer acts as an information aggregator, in providing *organization* rather than *creation*, that his information set is superior to that of any individual creator.⁴³

A potentially important variant of the information aggregator model is that of decentralized (sometimes called "peer-to-peer") distribution. The first broad application of a peer-to-peer distribution model was Napster, the Internet music service. Users who logged on to Napster were provided with a list of other users who had copies of digital songs available for copying.⁴⁴

The Napster case illustrates several important points from the present discussion: (1) users acted simultaneously as consumers and suppliers; (2) users practiced a form of price (actually quality) discrimination, in that the sound quality of an MP3 digital recording obtained from other users through Napster was typically lower than that supplied by the copyright owner; (3) the price charged by suppliers (zero) was non-distortionary; (4) Napster organized suppliers so as to provide users with better information about access to, and demand for, digital music, including obscure and out-of-print recordings, than was provided by the owners of the copyright themselves; (5) transaction costs among users were low, almost certainly lower than with copyright owners. Of course, each of these points must be viewed in light of the basic fact that Napster was found to have contributed to copyright infringement.⁴⁵ But even though that finding is central to the particular case, it is irrelevant to the economics of peer-to-peer digital goods distribution. As peer-to-peer distribution enables further decentralization,⁴⁶ the network becomes that much *better informed* about consumer demand than are individual nodes, which places any individual creator at a greater information disadvantage and weakens the argument for granting him a broad prospecting claim.

For a larger set of reasons, the monopolist of a digital good may not be in the best position to organize the downstream creation and innovation that depends on it. Most obviously, the monopolist will skew the set of downstream goods that he licenses away from those that substitute most closely for his own,

in order to avoid cannibalization of his work.⁴⁷ Of course, that is a property owner's right. But there is a more subtle distinction at work here: between the pioneer's desire to avoid substitutionary cannibalization and his desire to extract maximum gains from complementary creation. When the pioneer is less than fully informed about the quality of the downstream transformation (perhaps because the downstream consumer/creator has not yet created it), the asymmetry of the two parties' information sets may cause them to fail to reach an efficient agreement.⁴⁸ Thus, granting broad copyright protection to the pioneer may deprive society of goods that all parties — upstream pioneers, downstream transformers, as well as final consumers — agree should be produced.

In sum, there are two competing forces at work in the distribution of digital goods: the demand for centralized, aggregating services that organize, combine and transform digital goods and condition their price and quality on the aggregated consumption decisions (the Yahoo portal model), and the demand for decentralized, or individualized, distribution of digital goods (the Napster model). While these forces may lead to different network configurations and pricing models, they share an important property: both represent value-added transformations or combinations of underlying digital goods. Moreover, the creator of such value-added transformation may be better informed about consumer demand than any individual creator of the pioneering digital goods.

An example of the conflict between downstream information aggregators and upstream creators surfaced in *Tasini et al. v. The New York Times*.⁴⁹ In this case, a group of freelance authors sought to prevent the *New York Times* from repackaging articles originally written for the newsstand version of the newspaper into electronic volumes to be resold later, despite the fact that their contract called for an assignment of copyright for republication in "books". The authors prevailed. Presumably, the *New York Times* must either renegotiate with them to obtain additional rights at an additional cost, or not publish their articles at all. Arguably, the newspaper is in a better position to market the articles, once created, than the authors. Phrased in welfare terms, the question raised by *Tasini* is: What productive losses does the monopolist impose by price discriminating in the supply of digital goods to these value-added resellers?

VOTING FOR PRICE DISCRIMINATION

IN ARTICULATING THE POLITICAL ECONOMY of digital copyright, it is important to identify the winners and losers created by expanded price discrimination. Conditional on the set of goods offered by the seller, the interests of buyers depend on their particular type. High-value buyers prefer to keep their valuations private; price discrimination works to their disadvantage since they would prefer that the seller offer his product at a single (relatively low) price. On the other hand, low-value buyers prefer price discrimination; they will not

purchase if the seller can only sell at a single price, but they may purchase if the seller can identify them and charge them (and only them) a lower price. In the aggregate, price discrimination may increase or decrease the consumer surplus, depending on whether the transfer from high-value consumers to the seller is outweighed by the gain accruing to low-value consumers. The seller gains unambiguously from price discrimination, both because of the transfer from high-value buyers and because of the new segment opened up for low-value buyers. Total welfare increases because the additional transactions between the seller and low-value consumers reduce the deadweight monopoly loss.

One apparently neglected area of research concerns the aggregation of consumer preferences for and against price discrimination within markets and across potential markets. In other words, suppose that consumers within a given market are offered the choice of voting for or against price discrimination — how would they vote? If voting is proportional to the amount of consumer surplus lost or gained, one can show that, for certain distributions of consumer valuations, the loss incurred by high-value consumers outweighs the gains made by low-value consumers. Hence, consumers would vote against price discrimination.⁵⁰ This is true, for example, in the market for a copyrighted digital good where consumer valuations follow an exponential distribution.

Matters become much less clear when one tries to generalize this conclusion to multiple monopolized markets or multiple time periods. In the case of multiple markets, the probability that a consumer purchases any particular digital good at the monopoly price decreases with the number of goods.⁵¹ When there are a large number of markets, any given consumer participates in only a small fraction of them. Thus, most consumers stand to gain from price discrimination: paying more in the relatively few markets to which they already participate, but receiving acceptable offers at much lower prices in markets where they currently do not purchase. It is easy to construct a set of markets in which the median consumer votes in favour of price discrimination under these conditions.

Even if the number of markets is not large relative to those in which consumers participate, a consumer might prefer price discrimination over his consumption life cycle if sellers' learning about his preferences is not too fast relative to his discount rate. In the early years of a consumer's life, sellers who could not distinguish the consumer's preferences from the mean would offer him the mean price. In markets to which the consumer does not participate, sellers would offer him a menu of prices and bundles to try to elicit his preferences, while in markets where the consumer already purchases, sellers would attempt to raise effective prices, again through a menu of prices and bundles. Over time, as the consumer's preferences become better known, sellers could price discriminate more accurately. Depending on the sellers' relative effectiveness at discriminating between high- and low-value consumers, an individual

consumer might prefer a regime of price discrimination, even if by the end of the consumption life cycle sellers are able to extract all the consumer surplus. Viewed over the consumption life cycle, the present discounted value of the additional surplus generated by imperfect price discrimination early in the consumer's life may outweigh the loss of consumer surplus caused by more perfect price discrimination, which occurs later.

The politics of price discrimination are important to an analysis of the knowledge-based economy because they point to another transformation in the relationship between consumers and producers. If, in the aggregate, consumers prefer price discrimination, they will tend to favour institutional arrangements that facilitate it. These institutions obviously promote the explicit association of a consumer's economic behaviour with his identity, as a means of more efficiently characterizing that identity. In other words, far from considering their economic privacy invaded by sellers, consumers may rationally choose to for-sake anonymity in the consumption of digital goods.

THE DECLINE OF PRIVACY

IT IS NO SECRET THAT THE SAME BASIC DEVICE — the Internet — that facilitates the distribution of copyrighted digital goods also facilitates the aggregation of individual consumption decisions into comprehensive profiles of consumer types.

The possibility that consumers of digital goods would rationally favour (some forms of) non-privacy over privacy has not been dealt with adequately in the privacy literature, which takes as its point of departure concerns over privacy violations. A second problem, perhaps more closely related to traditional privacy concerns, is the implicit externality involved in permitting the seller of a digital good to monitor post-purchase consumer behaviour, and thereby to draw inferences about consumer preferences. This externality concerns (1) inferences drawn across individuals, who may share certain other observable characteristics (even though they differ strongly in the degree of privacy they prefer), (2) inferences to be drawn by the same seller at different points in time, and (3) inferences to be drawn by one seller based on information provided by another seller. So far, only problems associated with (3) seem to have attracted significant attention.

From an economic standpoint, the aggregation of digital consumption data creates a resource which has the potential to augment subsequent creative and marketing efforts. Such potent information is typically gathered and analyzed in large consumer databases. Given the role of databases in facilitating price discrimination, it is therefore somewhat paradoxical that the one area in which copyright over digital goods has actually proved weaker with time is in the protection of databases. Both the Canadian⁵² and U.S.⁵³ Supreme Courts

have rejected once and for all the so-called “sweat of the brow” rationale for copyright protection, which would protect purely economic investment in the creation of databases, in favour of the traditional notion that a minimum degree of creativity is required in the selection and arrangement of facts (which cannot be copyrighted).⁵⁴ Records of prior consumer transactions are, in principle, no more creative than are listings of their phone numbers. Because databases generally derive value from the accuracy of their contents rather than the creativity of their organization, and because “the creative is the enemy of the true,”⁵⁵ copyright protection for most databases is thin or non-existent. A review of legislative and other efforts to extend non-copyright protection to goods whose protection is deemed inadequate is provided in the next section.

Since we are primarily interested here with digital copyright, rather than with more fundamental notions of identity and privacy, the contours of various privacy paradigms lie beyond the scope of the present investigation. However, as the preceding discussion makes clear, the widespread move toward the provision and consumption of digital goods implies a greatly expanded role for copyright in defining the relationship between consumer and producer, in reaching through the consumption decision to control the consumer’s post-purchase use, and in laying the legal foundation for an ongoing monitored relationship between the parties. These consequences cannot be said to be part of the traditional domain where copyright law has historically operated. The interaction among the economic incentives for price discrimination, copyright’s facilitation of price discrimination, and the consequent shape of institutions that govern the disclosure and use of consumer information, deserves further review.

INFRINGEMENT AND THE NON-COPYRIGHT PROTECTION OF DIGITAL GOODS

THIS SECTION REVIEWS EFFORTS to prevent copying of digital goods under circumstances where (1) the quality of copies is inferior in some dimension; (2) sellers of digital goods have mixed incentives to prevent or ignore copyright protection; (3) the cost of enforcing copyright is high relative to the gain; (4) copyright protection is thin or non-existent for digital goods that nevertheless require substantial economic investments to create.

Wholesale copyright infringement tends to occur (1) at the retail consumer level (as in the *ripping* of compact discs for conversion to other playback formats), or (2) in jurisdictions where the enforcement of intellectual property rights is systematically lax (as in some parts of Asia).

It should be emphasized that although copyright infringement has persisted in some jurisdictions for long periods of time, the relatively recent move to distributing copyrighted goods in digital form leaves authors and distributors particularly vulnerable to infringement, because digital goods can be reproduced without any degradation of quality over successive generations of copying. Some forms of copying (for example, from a compact disc to MP3 format) create inferior copies due to the compression of digital information in the copy.

The economic analysis of infringement differs depending on whether the quality of the copy is the same or lower. When copying results in lower quality copies, it arguably serves a different market than the high-quality original. To the extent that the combination of price and quality in the market for inferior copies results in transactions that would not have occurred at the price-quality combination offered by the copyright owner, the availability of inferior copies increases consumer welfare without reducing that of the copyright holder.

Of course, the legal definition of infringement is independent of whether the copy has the same or an inferior quality; generally, the creator of an inferior copy is just as liable of infringement as the creator of a perfect copy. However, this liability is not absolute; certain derivative uses may be considered “fair.” But copyright liability and its defences derive from a legal distinction that a purely economic approach cannot easily justify.

Under current copyright law, liability may be excused based on a combination of various factors, such as (1) the purpose and character of the infringing use; (2) the amount of the original work taken; (3) the degree of transformation of the original work; (4) the effect of the use on the original work’s market value.⁵⁶ In effect, fair use defences attempt to discriminate between the creation of substitutes (which deprive the original author of sales) and the creation of (certain types of) complements (which do not); the former are more likely to incur liability.⁵⁷

It should be observed that infringing acts that have the same underlying economic effect on the original work may or may not incur liability depending on other factors. For example, suppose that digital goods have two dimensions: quantity and quality. An infringer who makes an exact copy of a small portion of the original work (a chapter of a book), to be used in an entirely different work (a compilation of essays), for certain non-commercial purposes (a bundle of classroom materials) is likely to defend successfully against a charge of infringement. The underlying economic rationale is that it is unlikely that the student who purchased the compilation would have purchased the entire book that contained the copied chapter. The original author has not been harmed, while the student has gained; consumer welfare is improved, but the reward to creators has not diminished. This is an efficient result.

On the other hand, suppose that the student acquires a complete, but inferior, copy of the original work at a price of zero. Suppose also that for this price-quality combination, the student is just as unlikely to have purchased the original work as in the first case. Therefore, the effect on the market value of the original work is the same.⁵⁸ However, in this case the law considers the copy “complete” and “non-transformative,” despite the fact that its reduced quality derives from the decrease in the amount of digital information that it contains. Such inferior, but complete, copying is much more likely to be found infringing than an exact, but fractional, copy. In other words, the law trades off the quality and quantity of copying at a relative price that is not necessarily determined by the effect of the copying on the copyright owner.^{59,60}

Although the larger policy problem raised by digital copying is the potential to make an infinite number of exact reproductions costlessly, a more interesting economic problem is the expanded dimensions of *quality* (and the increasing scope for price discrimination) that are available in the digital economy. In addition to compression technology (that creates inferior digital copies), digital technology makes possible many personalized formats, such as *streaming* (one-time display of information over a network, without creating a permanent copy at the user’s site), *sizing* (the physical size of the display), *editing* (recording and delayed display of copyrighted works with certain segments (like adult material) included and others (like advertising) excluded). These personalized formats obviously increase the scope for price discrimination; just as obviously, they raise questions about whether — and to what extent — certain low-quality uses will be accused of, or excused from, infringement. Under the present law, it is likely that copyright holders will be able to successfully prevent a large fraction of low-quality uses, while failing to provide comparable services. Whatever its legal rationale (and, being based on property rights, the rationale is strong), this regime leaves open the possibility of significant dead-weight losses from unserved market segments.

One contentious area of copyright enforcement, where the failure of copyright holders to serve certain low-quality markets allegedly leads to widespread infringement, is computer software. A puzzle noted by several recent authors is the seemingly contradictory position taken by software manufacturers: while decrying the widespread piracy of their goods, they do not avail themselves of basic software tools with which to prevent illegal duplication, particularly by new and/or non-commercial users. Although it is true that the ex post cost of enforcing copyright against users who have low valuations and/or low costs of switching is not likely to yield significant returns, this does not explain sellers’ failure to incur the fixed cost of installing copy-protection mechanisms ex ante.

Two explanations have been offered for the phenomenon of explicitly denouncing piracy while tacitly tolerating it. First, economists have pointed out that in the presence of network externalities, the value to fee-paying customers

increases with the size of the network, whether the additional network members are themselves fee-paying.⁶¹ Thus, depending on the relative valuations of paying customers (*business* users) and pirating customers (*home* users), and on the relative costs of enforcement, a software author's optimal strategy may be to permit piracy by home users while extracting some of the additional network value they bring in the form of higher annual licensing fees to business users. Because copyright is not a *use-it-or-lose-it* right (as is trade-mark protection in common law), copyright holders may nominally discourage infringement by anyone, while only taking steps to enjoin infringement by a business.

The second explanation for widespread piracy is a variation of dynamic pricing. Dynamic pricing means charging different prices for the same good at different periods in order to maximize profits. The simplest example of dynamic pricing is a free trial period: the seller subsidizes the buyer's initial learning about the product, hoping that the latter will make sufficient complementary investments in using the product (such as training) that the loss of revenue during the trial period will be more than offset by the higher price in effect when the trial period ends. In this framework, piracy is simply seen as an extended free trial period, which varies from customer to customer. If a customer makes sufficient complementary investments in the software, he will become locked in and the seller will find it profitable to begin to enforce copyright against the erstwhile pirate. Dynamic pricing and the detection of complementary investments can be facilitated by practicing quality discrimination with respect to the complete bundle, of which the digital good is only part: for example, registered users receive live technical help, while unregistered users must refer to lists of frequently asked questions.

These two explanations for the toleration of widespread piracy are mutually consistent, so it is difficult to disentangle them empirically. For present purposes, the main conclusion to be drawn is that one can reinterpret at least some complaints about piracy as part of a larger strategy of price and quality discrimination, one that actually functions in the seller's interest, even if the discrimination practiced is, in the event, not as perfect as the seller would like.

In markets where (1) the ex-post cost of enforcing copyright is high (relative to its gains), (2) network externalities are weak or non-existent, (3) consumer learning about the digital good does not generally translate into repeat business or complementary investments, and (4) quality discrimination is expensive or impractical, digital copyright owners have less reason to subsidize or ignore widespread infringement. Markets that have these properties include digital music and video. In these cases, digital copyright owners have resorted to non-copyright means of preventing infringement *ex ante*. These means may be divided into two types: technological and legal. The most pervasive example of technological means is the encryption algorithm used to prevent the decoding of digital versatile disks (DVDs), except by complementary DVD players.⁶²

The most prominent legal means are so-called “anti-circumvention provisions” like that enacted in the U.S. *Digital Millennium Copyright Act* (DMCA).⁶³ The DMCA makes it illegal to attempt to circumvent technological devices that operate to prevent the copying of digital goods. The sanctions apply whether the protected work is itself copyrighted, and whether the contemplated use is “fair”. Thus, the DMCA tips the balance of bargaining power sharply in favour of producers of digital goods by creating a form of quasi-property whose lifetime is, in principle, infinite.

As noted previously, piracy as a form of price discrimination raises difficult measurement issues in the damages phase of an infringement action to the extent that a copyright holder must prove the number of units he would have sold but for infringement, and the revenues these sales would have generated. This essentially micro-economic difficulty has an important macro-economic analogue, to which we now turn.

THE APPARENT RISE IN PRODUCTIVITY

ONE OF THE IMPORTANT CONCEPTUAL WEAKNESSES of the national income accounts is the measurement of gross domestic product rather than gross consumer surplus. Gross domestic product represents the market value of goods sold, i.e. the valuation of the marginal consumer. Gross consumer surplus represents the aggregate willingness of consumers to pay for the goods exchanged, including the valuation of infra-marginal consumers. Of course, gross consumer surplus is potentially much larger than gross domestic product.

As price discrimination for digital goods becomes more pervasive and precise, equilibrium prices and quantities change predictably. The simplest way to see that change is to imagine a market moving from a single, perfectly competitive price to a perfect price discrimination regime. In this case, previously unmeasured consumer surplus is recorded as revenue by the perfectly price-discriminating monopolist who extracts all the gains from trade. Although the total number of units sold and total costs of production remain unchanged, the level of gross domestic product converges to gross consumer surplus. Measured productivity thus increases, although there is no *efficiency gain* as economists normally use that term. The apparent increase in efficiency is due entirely to the ability of the monopolist to capture the consumer’s previously unmeasured gains from trade. Thus, an increase in the degree of price discrimination in an economy biases measured productivity upward, unless by chance that same price discrimination affects all input markets in the same way.

This phenomenon has important empirical and policy implications. Economists generally believe that intellectual property laws exist to promote progress.⁶⁴ Progress, in economic terms, generally implies productivity improvement. Such improvement has been difficult to associate definitively with the

presence of intellectual property rights, and even more so with copyright than with patents. Therefore, a finding of productivity improvement associated with the strengthening of copyright protection must be carefully distinguished from the inherent measurement bias, due to improved price discrimination, that a particular form of strengthening may induce. While the knowledge-based economy holds the potential for real and large productivity increases (through decreased supply-side costs), it also holds the potential for illusory gains caused merely by improved pricing management.

THE RISING TRADE DEFICIT

THE INTERNATIONAL ANALOGUE OF THE INCREASE in price discrimination has ambiguous interpretations for net importers of digital goods, like Canada. Increased price discrimination results in a transfer of surplus from high-value consumers in the importing country to producers in the exporting country. On the other hand, increased price discrimination results in welfare gains for low-value consumers in the importing country who previously were denied access to the copyrighted digital good at the single monopoly export price. Both types of transactions contribute to an increase in imports relative to exports, that is to an increasing trade deficit in the importing country. However, only the first type of transactions represents a welfare loss for the importing country; the second type provides a welfare gain.

In the case of Canada, which imports its digital goods mainly from the United States, the trade effects of increased price discrimination are likely to be negative, on balance, because Canada's consumers have relatively high valuations. Improved price discrimination should not lead to a large expansion of previously unserved low-value markets, but rather to higher prices on existing high-value markets. On the other hand, increased price discrimination in poor countries may well yield welfare improvements, since a larger fraction of total transactions represents previously unserved market segments.

THE DECLINE IN AVERAGE PRODUCT QUALITY

A FINAL POTENTIAL CONSEQUENCE of increased price discrimination lies in its effects on the average quality of digital goods that are brought to market. Suppose that, within a given period, the quality q_i of a certain type of digital goods (say, action films) is drawn from a distribution $F(\cdot)$ having support on the interval $(0, \infty)$. Suppose also that the revenue earned by a film is a monotonic transformation of quality: $R_i = aq_i$, for some revenue parameter a . Moreover, suppose that each film costs k to produce. Total film profits equal $R_i - k$, so a film must earn at least $a\bar{q} = k$ to break even; in other words, the minimum quality film produced is $\bar{q} = k/a$. Then, the fraction of all potential films produced

per period is $1 - F(q)$. Thus, the average quality of films produced is given by $Q^* = \int_{\underline{q}}^{\infty} s \, dF(s) \, ds$.

Now suppose that improved price discrimination makes action filmmaking systematically more profitable, such that the new revenue parameter is $a' > a$. It follows that the new minimum quality film has fallen: $\underline{q} = k/a' < \underline{q}$. Therefore, the new average quality, $Q^{**} = \int_{\underline{q}}^{\infty} s \, dF(s) \, ds < Q^*$, has fallen as well.⁶⁵

The same results hold if the cost of producing a film increases with the quality of the film: films of quality q_i cost $k + bq_i$, for some cost parameter b . Then, the film profits equal $(a - b)q_i - k$, and the average quality decreases as long as the cost of film quality b is independent of the degree of price discrimination in the economy, or at least increases more slowly with a rise in price discrimination than does the revenue parameter a .

It is important to observe, once again, that increased price discrimination creates an efficiency gain that makes the production of digital goods more profitable, but has mixed effects on consumer welfare. While increased price discrimination may result in welfare gains, this is not a productivity improvement as economists traditionally define that term. The reduction in average film quality represents a variation on the theme that price discrimination has mixed effects on average price, total output and consumer surplus.

Before jumping too quickly to the notion that price discrimination merely makes bad movies more profitable, it is important to say a word about what *quality* actually means to an economist. There are several ways to motivate the notion of quality here without invoking judgments about taste. The simplest is vertical quality differentiation, which imagines a heterogeneous population of consumers among whom the heterogeneity is given by the willingness to consume films of a given quality. Low-quality films are those consumed by a small fraction of the population who will watch *anything*. Higher-quality films capture a larger fraction of the potential audience, who demand higher film quality. Under this interpretation, a reduction in minimum quality is interpreted as an increase in the number of films produced that appeal to a small audience of indiscriminate filmgoers.

However, in a horizontally differentiated products model of the film market, a reduction in average quality may in fact correspond to an increased *variety* of films, including an increase in critically acclaimed *art* films that traditionally appeal only to a small audience. This is true because the efficiency gain associated with price discrimination makes it more profitable to produce films that appeal to *any* previously unprofitable market segment, not just *low-quality* segments. As in other markets, an increase in price discrimination for art films will result in higher prices for customers who currently view such films, but lower prices for those who do not currently view such films, both effects resulting from the seller's broader menu of prices.

CONCLUSIONS

THIS STUDY HAS GIVEN AN OVERVIEW of several economic impacts of digital copyright on the *knowledge-based* economy. The main structural change wrought by digital copyright is the necessary increase in the complexity of the legal relationship between the seller of a digital good and the buyer of that good, who often cannot consume it without making a copy. The need to make a copy requires a licence; licences, in turn, facilitate monitoring and inhibit arbitrage through resale. An increase in monitoring coupled with a reduction in arbitrage across consumers makes price discrimination more likely and more profitable. Most of the study's arguments flow from this simple logic.

It is important to stress the study's omissions as well as its conclusions. The most important category of omissions concerns those issues that digital copyright shares with traditional copyright. For example, apart from a brief discussion of international trade issues, the study has omitted any description of the transjurisdictional problems that increasingly arise in a networked world.⁶⁶ A more general treatment of these issues would consider domestic copyright policy as endogenously determined given a country's endowment of *creativity capital*, and then examine the nature of the optimal regime among net importing countries. It is easy to see international conflict brewing as the leading exporter of copyrighted goods — the United States — lengthens and strengthens the protection it offers to authors, both through copyright and through non-copyright legislation like the *Digital Millennium Copyright Act*. As in so many other areas, the appropriate Canadian response to U.S. self-interest is likely to be determined as much by larger political calculations, not to mention co-pending but unrelated trade disputes, as by a strong sense of Canada's optimal copyright regime.

The present study has largely ignored another fundamental issue in the economic justification for copyright: the increasingly common presence of a negative correlation between the degree of creativity required to produce a digital good and the corresponding level of economic investment at stake. The type of economic activity that copyright seeks to protect varies from investments that require creativity and originality (such as authoring a non-derivative work, or adapting or performing a work in a different medium) to those that require accuracy and comprehensiveness in reproduction (such as recording and telecommunications). Because these are fundamentally inconsistent economic activities ("the creative is the enemy of the true"), it is often difficult to base the legal justification for copyright on a consistent economic framework. While (as previously noted) this conflict arises most blatantly in the absence of copyright protection for databases, it is present more subtly in a

variety of other arenas — like software — that play important roles in the new economy.

Perhaps the thorniest area of the law implicated by digital copyright is consumer privacy. Constitutional lawyers will have to articulate and test the arguments for and against privacy, particularly in an age of increased demand for collective security. This study has merely raised the possibility that consumers may not desire economic privacy as much as purely political arguments would suggest. If that were the case, the legal (and technological) definition of privacy would have to be expanded in ways that further distinguish between commercial and political privacy, much as the law of free expression distinguishes between commercial and political speech. Whether the potential economic welfare gains to be derived from increased price discrimination are consistent with, or are outweighed by, the demand for political privacy, depends on an array of yet-to-be-created institutions and norms.

ENDNOTES

- 1 “The approach elaborated in this document is based on the premise that the *Competition Act* generally applies to conduct involving IP as it applies to conduct involving other forms of property.” (Canada Competition Bureau, 2000). “[F]or the purpose of antitrust analysis, the Agencies regard intellectual property as being essentially comparable to any other form of property.” (U.S. Department of Justice and Federal Trade Commission, 1995).
- 2 For example, the copyright notice on the software used to create this study reads, “Copyright © 1983-99.”
- 3 Canada’s copyright term is defined as 50 years from the end of the calendar year in which the author dies. *Copyright Act*, R.S.C. 1985, c. C-42, s. 6.
- 4 See Llobet and Hopenhayn, 2000; see Scotchmer, 1996.
- 5 In the patent context, the breadth of protection usually refers to the extent to which products similar to the claimed invention may be excluded. For example, in Canada the inquiry focuses on whether the accused product has taken the “pith and marrow” of the patent. The United States has developed the somewhat more formal, but no more predictable, “doctrine of equivalents.” For a formal treatment of length vs. breadth, see Gilbert and Shapiro, 1990.
- 6 While the extension to software may seem uncontroversial, it should be remembered that, historically, copyright has not subsisted in purely utilitarian works, nor in works that are not literary, visual or musical. Thus, for example, one cannot copyright a computer chip. The recognition of software as a creative work like other works — despite its utilitarian dimensions — confers on the software author copyright protection for his creation. At the same time, the author’s decision to implement an algorithm in software or hardware is largely arbitrary. Therefore, a

computer chip can embody a copyrightable software algorithm, which effectively extends copyright subject matter to physical devices.

- 7 Depending on the nature of the work and transaction costs, the market for second-hand copies of the work may provide zero or vigorous competition for the producer of the original.
- 8 In the United States, the court in *MAI Systems Corp. v. Peak Computer Inc.* [991 F. 2d 511 (9th Cir. 1993)] held that the creation of a copy of a copyrighted work in a computer's read-only memory (RAM) constitutes copying, even if the entire work is never contained at one time in the computer's RAM — instead, a copy is created even though only certain portions of the work are copied piecemeal in the RAM. Other jurisdictions have reached similar conclusions (e.g. Australia); see *Microsoft Corp v. Business Boost Pty Ltd.*, FCA 1651 (November 17, 2000). However, the U.S. *Copyright Act* exempts certain types of copying: “[I]t is not an infringement for the owner of a copy of a computer program to make or authorize the making of another copy or adaptation of that computer program provided: ... that such a new copy or adaptation is created as an essential step in the utilization of the computer program in conjunction with a machine and that it is used in no other manner ...” See *Copyright Act*, 17 U.S.C. § 117. No such exemption is provided in Canada.
- 9 *Copyright Act*, 17 U.S.C. § 104. The statute determines whether a use is fair by balancing four factors.
- 10 For example, one of the permissible uses is consuming the work by viewing it or listening to it. This permission extends to consumption by a small number of other persons at the same time. It is also generally permissible to lend one's copy, as a library does, thereby permitting consumption by a large number of other persons at different points in time. But it is impermissible to *broadcast* or *publicly perform* the work by facilitating the consumption of many others at a single point in time, or many others at multiple points in time (e.g. by placing a copy on the Internet for viewing), particularly for a fee. The line between permissible and impermissible uses is not always easily drawn.
- 11 By “one-off” I do not mean to suggest that contracts are not long-term or that they do not contemplate repeated transactions. In this context, “one-off” means that the exchange itself implicitly or explicitly transfers title to a good or specifies the scope of a service rendered, and performance of that exchange merely requires that the good be as described or the service be performed according to specifications. Except in the context of intellectual property, most such contracts do not *reach through* the buyer to govern the usage of the good or service as an input into the buyer's subsequent contracts with a downstream seller.
Of course, the exception to this general rule is when the buyer acts as an intermediary (i.e. distributor or agent) for the seller. As discussed below, the move to the digital licensing world can be viewed as one in which the *final* consumer is transformed into an agent of the seller.
- 12 The manufacturer often uses this opportunity to request demographic and other data that may be used to market to the buyer in the future, but this information is usually of a very general nature (“name your hobbies”), its disclosure is voluntary,

and the manufacturer does not restrict or even monitor the user's post-purchase usage.

- 13 Many such claims relate to intellectual property-related aspects of the purchased good. For example, trade-mark laws restrict the buyer's freedom to pass off (to other secondary buyers) a purchased good as anything other than a used good made by the seller.
In the analog world, the use to which the copyrighted good is put differentiates a buyer from a prospective reseller; readers and viewers generally do not make copies, at least not in those capacities. In the digital world, the technology that facilitates consumption is the same as, or closely related to, the technology that facilitates reselling.
- 14 Foreseeing this hold-up risk, the buyer will reduce his demand for the good in question. But when a shift in technological and legal regimes causes *all* producers to offer similar post-purchase terms, this shift operates as an implicit increase in cost: the consumer's choice is not whether to be locked in, but with whom.
- 15 Consumer lock-in can be viewed as a form of intertemporal tying.
- 16 When the tangible embodiments of copyrighted goods wear out (such as paperback books and vinyl records), the presence of a secondary market performs the function of price discrimination between buyers who prefer high-quality versions and those who prefer low-quality versions. The seller not only does not capture the gains from selling to low-value customers, but must generally choose a price path that takes into account the ever-expanding supply of used versions. Because digital goods do not wear out, consumers who choose to resell offer essentially perfect substitutes to the original and thus compete directly with the seller. By prohibiting resale, the seller not only eliminates this competition, but also enables additional price-discriminating selling strategies that exploit the lower willingness to pay of those who would have purchased in the secondary market.
- 17 See, for example, Tirole, 1990.
- 18 In the marketing literature, price discrimination is known as market segmentation.
- 19 See Ulph and Vulkan, 2000.
- 20 An interesting legal question is the delineation of the circumstances in which price discrimination is permitted and when it is not. For example, price discrimination based on race or gender is not permitted, but some price discrimination based on age or employment status may be. It appears that, where it is permitted, price discrimination must be characterized as a benefit to the target segments. The same relative price structure, characterized as a tax, would likely fail to pass constitutional scrutiny. Following standard economic reasoning, preventing price discrimination increases welfare for some groups but reduces it for those who would otherwise qualify for the lower of the prices offered by the monopolist.
- 21 The magnitude of the access fee depends on the slope of the demand curve and the variance of the distribution of types. It may be that the optimal access fee is zero or negative ("give away the razor; sell the blade").
- 22 Two-part tariffs also provide a means of sharing post-contract risk between buyers and sellers. When the risk involves factors other than the buyer's preferences (such as uncertain post-purchase demand for the buyer's services), this pricing

structure implements bargaining elements that extend beyond classical price discrimination.

- 23 The economic literature recognizes that advertising by sellers (and consumption by buyers) may have informative as well as persuasive dimensions. That is, buyers and sellers may not just jointly *discover* the buyer's type; they may also *create* it. However, the theoretical modeling of endogenously determined types is still in its infancy. See Akerberg, 2001.
- 24 For example, a movie ticket entitles the holder to an experience that, measured ex post, some consumers would prefer not to have purchased.
- 25 However, universities do not capture all the gains from selling education because part of the buyer's demand for education is based on his uncertain future earnings stream. Nevertheless, universities may offer loans at rates that effectively discriminate based on future income by, for example, forgiving the loans of graduates who enter certain (low-paying) public-interest jobs.
- 26 In this context, it should be noted that the true significance of the *open software* movement lies not in its price — sometimes zero — but in the terms under which use is granted. In the case of Linux, for example, the only post-sale duty imposed on the buyer is to share his modifications to the software with all other users. But this duty does not prevent the buyer from creating complementary products that the buyer may offer for licence under the usual model. See Lerner and Tirole, 2000.
- 27 For example, Microsoft has created the “how to tell” campaign, in which both hardware and software suppliers who create Microsoft-compatible hardware and software educate the final consumer to make sure he will use only licensed Microsoft software. See www.microsoft.com/piracy/howtotell/ (accessed April 22, 2005).
- 28 Consider the telephone service tariff described above. A company may offer 1000 minutes per month for \$50 (5 cents/minute), or 500 minutes per month for \$30 (6 cents/minute). After the allotted minutes are used, however, the company charges 10 cents/minute under the first plan and 15 cents/minute under the second. Two points are clear: (1) the customer's pre-commitment implies that, in effect, she must monitor herself to obtain the lowest per-minute charge, and (2) the metering charge incurred (if the customer exceeds the allotted maximum) bears no relationship to the seller's incremental cost.
- 29 Note that the average per-station charge may decline with the number of users, as a form of *bulk discount*. Metering need not require that total charges be constant or even linear in the metered variable. In particular, it should be noted again that the number of stations bears no relationship to the seller's cost of installing an incremental copy of the software on the network.
- 30 As is well known, network scale economies occur when each user benefits from the presence of additional users, in addition to his own use. For example, the value of intra-company e-mail increases with (the square of) the number of employees that have access to e-mail.
- 31 Recording artist Courtney Love has extended the real property metaphor to the notion of “intellectual sharecropping” (albeit in the context of true production rather than joint production/consumption). See Love, 2000.

- 32 These problems arise in other contexts as well. For example, the user of a spreadsheet program is generally free from the obligation to remunerate the copyright holder, regardless of the value added by the user's calculations. If, however, the user wishes to distribute a customized version to his own customers for their use (thereby creating a derivative work), he will need a separate *run-time* licence for the spreadsheet program, which in effect gives him certain redistribution rights. The cost of purchasing the right to redistribute may vary directly with the sale price and/or number of units sold of the customized software, thereby permitting the original spreadsheet creator to price-discriminate based on the value to his customer of the right to redistribute.
- Of course, in this situation, the spreadsheet author is not supplying a final good, but an intermediate input, to his customer. Price discrimination by suppliers of intermediate goods based on the value of the finished product is common in some industries and technologies but uncommon in others.

- 33 A synopsis of the exhaustion doctrine and its relationship to other restrictions and remedies available to the patentee (as well as to the licensee) was offered by the court in *Braun Medical Inc. v. Abbott Laboratories*, 124 F.3d 1419 (Fed. Cir. 1997):

[A]n unconditional sale of a patented device exhausts the patentee's right to control the purchaser's use of the device thereafter. The theory behind this rule is that in such a transaction, the patentee has bargained for, and received, an amount equal to the full value of the goods. This exhaustion doctrine, however, does not apply to an expressly conditional sale or license. In such a transaction, it is more reasonable to infer that the parties negotiated a price that reflects only the value of the "use" rights conferred by the patentee. As a result, express conditions accompanying the sale or license of a patented product are generally upheld. Such express conditions, however, are contractual in nature and are subject to antitrust, patent, contract, and any other applicable law, as well as equitable considerations such as patent misuse. Accordingly, conditions that violate some law or equitable consideration are unenforceable. On the other hand, violation of valid conditions entitles the patentee to a remedy for either patent infringement or breach of contract.

The patent misuse doctrine, born from the equitable doctrine of unclean hands, is a method of limiting abuse of patent rights separate from the antitrust laws. The key inquiry under this fact-intensive doctrine is whether, by imposing the condition, the patentee has impermissibly broadened the "physical or temporal scope" of the patent grant with anticompetitive effect. Two common examples of such impermissible broadening are using a patent that enjoys market power in the relevant market to restrain competition in an unpatented product or employing the patent beyond its 17-year term. In contrast, field of use restrictions (such as those at issue in the present case) are generally upheld, and any anticompetitive effects they may cause are reviewed in accordance with the rule of reason.

- 34 For example, in Canada Sony prohibits the resale of its OpenMG software; see www.sonymstyle.ca/webapp/commerce/servlet/sony/OpenMGDownload_1.jsp.
- 35 See Scotchmer, 1991.
- 36 See Green and Scotchmer, 1995.

- 37 More precisely, the consumer must supply the transformed good to a market that
is not perfectly competitive.
- 38 It should be noted that the offer of a digital good/licence/agency contract bundle
is a special, take-it-or-leave-it case of the general contract that the monopolist
might offer to a prospective consumer, in which the agency contract was negoti-
ated separately from the purchase of the digital good. The mandatory tie of the
licence/contract to the good increases the bargaining power of the monopolist vis-
à-vis the consumer.
- 39 *Copyright Act*, § 3(1)(f).
- 40 Since a single monopolist over the entire chain makes more profits and saves
transaction costs relative to a chain of monopolists, there is a clear economic in-
centive to integrate. In general, economists favour such integration because the
increased output it provides is welfare improving. But in a copyright context, it
may be difficult to distinguish efficient vertical integration from inefficient or anti-
competitive tying. For example, in its U.S. antitrust trial, Microsoft argued that
the integration of its Internet browser, Internet Explorer, with the Windows oper-
ating system represented an increase in efficiency. Hypothetically, the efficiency
arose not only from better technical integration but also from the lower price that
Microsoft charged for the combined product. Yet, Microsoft's opponents argued
that this represented a form of bundling or tying that facilitated its exercise of
market power. See, for example, *Court's Findings of Fact*, in *United States v. Microsoft
Corporation*, Civil Action No. 98-1232 (TPJ), (par. 160 and subsequent), available
at: www.usdoj.gov/atr/cases/f3800/msjudgex.htm (accessed April 22, 2005).
- 41 For simplicity, we abstract from the intermediate links between the author and
consumer, and speak of the transaction between them as the *sale of the creation*;
the second link in the chain is the *sale of the transformation* by the consumer.
- 42 See Kitch, 1977.
- 43 Perhaps the most prominent example of an information organizer is the Internet
portal Yahoo. Yahoo generally organizes the addresses of Internet sites; addresses
generally cannot be copyrighted. However, addresses represent a contentious set
of issues surrounding the ability of a downstream user to *frame* the context in
which the intellectual property of an upstream creator appears. For example,
Ticketmaster sued Microsoft for so-called "deep linking" into Ticketmaster's web-
site from Microsoft's site; these links bypassed Ticketmaster's initial pages (which
promoted certain products to users and gathered information about their re-
sponses). *Ticketmaster Corp. v. Microsoft Corp.*, 97 Civ. 3055 (C.D.Ca. April 28,
1997).
- 44 *A&M Records v. Napster*, 114 F. Supp. 2d 896, 900 (N.D. Cal. 2000).
- 45 *Idem*.
- 46 Gnutella, a peer-to-peer program briefly distributed by America Online, does not
require a centralized user exchange, as does Napster. By querying directly other
computers in a network, Gnutella places the search cost on the individual user (to
the extent that users internalize the cost of network usage), not on a central
server. Gnutella could be used, for example, to allow every network user to search
and retrieve digital goods from every other user, in a combination defined by the
user's query.

- 47 This definition of “substitute” can, however, be stretched very far, even to include goods that seem much more likely to be complements. Playwright Tom Stoppard, an exemplary creator of clear economic complements, wrote *Rosencrantz and Guildenstern are Dead*, an absurdist play that draws on two peripheral characters in Hamlet. The two plays are complements because there is little point in reading the Stoppard play unless one has also read Shakespeare’s work. In a more recent example, Alice Randall wrote *The Wind Done Gone*, which comments on Margaret Mitchell’s *Gone With The Wind* by adopting the perspective of one of Mitchell’s slave characters. Arguably, Randall’s work is a complement to Mitchell’s for the same reasons that Stoppard’s is a complement to Shakespeare’s. However, Mitchell’s estate obtained an injunction against the publication of *The Wind Done Gone*. The injunction was subsequently vacated. *SunTrust Bank v. Houghton Mifflin Co.*, 136 F. Supp. 2d 1357, 1364 (N.D.Ga. 2001), *vacated*, 252 F.3d 1165 (11th Cir. 2001).
- 48 This failure occurs for reasons similar to the “lemons” market failure identified in Akerlof (1970): the conditional distribution of licensees who offer to license may be sufficiently different from the distribution of all prospective licensees that the pioneer/licensor (who cannot verify the actual value of the licence to the licensee) turns down profitable offers.
- 49 *Tasini et al. v. The New York Times*, 206 F.3d 161 (2nd Cir. 2000).
- 50 If voting were defined as “one person, one vote,” and consumers could purchase multiple units, the model would have to specify the joint distribution of income and preferences in order to determine how individual consumers would vote.
- 51 In a complete model, the increase in the number of goods reduces the monopoly power of any single seller as the product space becomes more densely packed with potential substitutes. Here, we fix the number of goods (and the degree of monopoly power of each seller) to focus on a consumer’s aggregate preference for price discrimination.
- 52 *Tele-Direct (Publications) Inc. c. American Business Information Inc.* (1997), 76 C.P.R. (3d) 296 (C.A.F.).
- 53 *Feist Publications, Inc. v. Rural Telephone Service Company, Inc.*, 449 U.S. 340, 113 L. Ed. 2d 358 (1991).
- 54 See Maurer, 2005, in this volume.
- 55 *Matthew Bender & Co. v. West Publishing Co.*, 158 F.3d 674, 683 (2d Cir. 1998).
- 56 U.S. copyright law explicitly requires consideration of these factors when an accused infringer defends a charge of infringement on the grounds that his use is “fair”; see *Copyright Act*, 17 U.S.C. § 104. Canadian analysis of “fair dealing” proceeds similarly, although the list of factors that the court may or must consider is not explicitly enumerated in the *Copyright Act*.
- 57 It should be noted that there is no explicit economic justification for apportioning all the gains from the creation of an infringing, but fair, complement to the accused infringer, as fair use/fair dealing analysis does. On the other hand, as will become clear shortly, the law creates liability for certain other economic complements, and thereby apportions all the gains from these uses to the original author. Presumably, the law is engaged in some type of cost/benefit analysis which, in

the aggregate, attempts to divide gains efficiently between original authors and imitators.

- 58 It should be noted that, in a complete analysis, the ability of the infringer to produce further copies of the original work depends on the quality of the copy that she has acquired.
- 59 While liability may be different in these circumstances, the final economic result may reflect more accurately the absence of a causal relationship between the infringer's use and any loss to the plaintiff. The fact that the copy is inferior (and the infringing price is lower or zero) complicates the plaintiff's proof of damages: under the assumption that consumers are heterogeneous, it is difficult to establish the fraction of those who purchased the infringing copy who would have purchased the high quality original had the inferior copy not been available. In this respect, copyright law lags behind patent law, which increasingly requires that a prevailing plaintiff who proves that the infringer's sales occurred at a lower price than the plaintiff's must, as a part of his claim, establish the (reduced) number of sales he would have made at his higher price. See Froeb, Beavers and Werden, 1999. See also *Crystal Semiconductor Corp. v. TriTech Microelectronics International Inc.*, 246 F.3d 1336 (2001).
- 60 The relatively restricted scope of "complementary (exempt) uses" probably derives from the law's anxiety to avoid Type II errors (erroneously excusing the infringement of a property right when unobserved efficiency (or equity) considerations demand that it be enforced).
- 61 See Slive and Bernhardt, 1998.
- 62 Note that the encryption technology is itself a means of practicing price discrimination: by creating different decoding algorithms for different geographic regions, copyright holders can sell the same digital good at different prices to these regions without fear of resale arbitrage across regions.
- 63 *Digital Millennium Copyright Act*, Pub. L. No. 105-304, 112 Stat. 2860 (1998). See also Samuelson, 1998; and Chisick and Perry, 2000.
- 64 *United States Constitution*, art. I, § 8, cl. 8, the copyright authorization clause empowers Congress "to promote progress ... by securing ... to authors ... exclusive rights to their ... writings ...".
- 65 If the supply of new films is perfectly elastic, then the increased profitability of a film having a given quality will be offset by increased entry. Thus, the reduction in average quality depends on some barrier to entry or a rising long-run supply curve. Given the present degree of concentration of the filmmaking industry, barriers to entry are likely to be relatively high.
- 66 See, for example, *National Football League et al. v. TVRadio Now Corp. et al.*, No. 00-120, and *Twentieth Century Fox Film Corporation et al. v. iCraveTV et al.*, No. 00-121 (W. Dist. Penn.), which concerned the redistribution ("streaming") of television signals over the Internet.

ACKNOWLEDGMENTS

I WOULD LIKE TO THANK the Centre for Innovation Law and Policy, especially Richard Owens and Carol Oblak, for financial and administrative support; the Intellectual Property Directorate, especially Marie-Josée Thivierge, Michelle Gervais and Gilles McDougall, for their encouragement and patience; and participants to the joint Industry Canada–Centre for Innovation Law and Policy Conference on Intellectual Property and Innovation in the Knowledge-Based Economy for their helpful comments.

BIBLIOGRAPHY

- Akerberg, Daniel. 2001. "Empirically Distinguishing Informative and Prestige Effects of Advertising." *RAND Journal of Economics* 32, 2: 100-118.
- Akerlof, George. 1970. "The Market for Lemons: Qualitative Uncertainty and the Market Mechanism." *Quarterly Journal of Economics* 89: 488-500.
- Canada Competition Bureau. 2000. *Intellectual Property Enforcement Guidelines*.
- Chisick, Casey, and Mark Perry. 2000. "Copyright and Anti-Circumvention: Growing Pains in a Digital Millennium." *New Zealand Intellectual Property Journal*.
- Froeb, Luke, Lucian Wayne Beavers and Gregory J. Werden. 1999. "Quantity Accretion – The Mirror Image of Price Erosion from Patent Infringement." *Journal of the Patent and Trademark Office Society* 81.
- Gilbert, Richard, and Carl Shapiro. 1990. "Optimal Patent Length and Breadth." *Rand Journal of Economics* 20: 106-112.
- Green, Jerry, and Suzanne Scotchmer. 1995. "On the Division of Profit Between Sequential Innovators." *Rand Journal of Economics* 26: 20-33.
- Kitch, Edmund. 1977. "The Nature and Function of the Patent System." *Journal of Law and Economics* 20: 265-290.
- Lerner, Josh, and Jean Tirole. 2000. *The Simple Economics of Open Source*. NBER Working Paper No. 7600 (March).
- Llobet, Gerard, and Hugo Hoppenhayn. 2000. *Rewarding Sequential Innovators: Prizes, Patents and Buyouts*. Federal Reserve Bank of Minneapolis. Research Department Staff Report No. 273 (July).
- Love, Courtney. 2000. "Courtney Love Does the Math;" transcript of a speech given by Courtney Love to the Digital Hollywood Online Entertainment Conference, published on *Salon.com*. Available at: <http://dir.salon.com/tech/feature/2000/06/14/love/index.html?sid=836331> (accessed April 22, 2005).
- Maurer, Stephen M. 2005. "Across Two Worlds: Database Protection in the United States and Europe". Chapter 13 in this volume.
- Samuelson, Pamela. 1998. "Intellectual Property and the Digital Economy: Why the Anti-Circumvention Regulations Need to Be Revised." *Berkeley Technology Law Journal* 14, 2.

- Scotchmer, Suzanne. 1991. "Standing on the Shoulders of Giants: Cumulative Research and the Patent Law." *Journal of Economic Perspectives* 5, 1: 29-41.
- . 1996. "Protecting Early Innovators: Should Second-Generation Products be Patentable?" *RAND Journal of Economics* 27: 322-331.
- Slive, Joshua, and Dan Bernhardt. 1998. "Pirated for Profit." *Canadian Journal of Economics* 31, 4: 886-899.
- Tirole, Jean. 1990. *The Theory of Industrial Organization*. Cambridge (Mass.): MIT Press. Chapter 3.
- Ulph, David, and Nir Vulkan. 2000. "Electronic Commerce and Competitive First-Degree Price Discrimination." London: University College (December). Mimeo.
- U.S. Department of Justice and Federal Trade Commission. 1995. *Antitrust Guidelines for the Licensing of Intellectual Property*.



Stephen M. Maurer
Attorney-at-Law

13

Across Two Worlds: Database Protection in the United States and Europe

SUMMARY

IN 1998, EUROPEAN UNION (EU) Member States gave database owners a so-called “*sui generis*” right against copying. This study summarizes the limited literature on Europe’s database experiment and compares it to the legal/business environment found in Canada and the United States. It also presents extensive original research based on (i) a detailed quantitative comparison of 1,164 database providers that operated in Canada, the United States, the United Kingdom, Germany and France between 1993 and 2001, (ii) extended interviews with academic scholars, officials, practising lawyers and business executives who have first-hand knowledge of European database issues, and (iii) the first published attempt to find out whether the *sui generis* right has had a quantitative impact on European database production.

European and North American database industries have many similarities. For example, every country surveyed for this study offered consumers a broad variety of basic data including telephone directories, marketing materials and court decisions. However, there are also important differences. First, the U.S. and U.K. database industries have consistently offered consumers the most new and/or innovative products. Second, the U.S. and U.K. database industries include a larger fraction of commercial, for-profit firms than their counterparts in other countries. Third, growth rates differ significantly from country to country. For example, Germany and the United States enjoyed strong, steady growth (especially among commercial providers) throughout the 1990s. By contrast, the French database industry experienced strongly negative growth. The French database industry also included fewer commercial firms and offered consumers a narrower range of products than any other country studied.

Canada's database industry has a mixed record. During the 1990s, Canada's commercial sector enjoyed steady growth. By 2001, commercial firms accounted for approximately 65 percent of all Canadian database providers — the same percentage as the United Kingdom and Germany. On the other hand, Canada's government and academic providers declined sharply during this same period. As a result, Canada produces fewer scientific databases than other countries examined in this study. Furthermore, Canadian database providers often specialize in domestic data. This automatically limits the Canadian database industry's export potential.

Despite these problems, Canada's database industry has significant growth potential. Possible growth areas include (i) Francophone databases, (ii) commercial databases that specialize in specific industries and/or North American coverage, and (iii) mid-sized scientific databases, particularly in biotechnology.

All commercial database providers rely on a sophisticated blend of legal protections and business methods to protect their products from copying. Europe's new database right supplements, but does not replace, these earlier forms of protection. During its first year, the new right seems to have produced a one-time boost in (i) database production, and (ii) the number of new firms entering the industry. Since 1999, however, growth rates have returned to previous levels. European database protection has also had unfortunate side effects. Two of these are evident from court decisions: (i) excessive protection for certain databases (for example, telephone directories and sporting event schedules), and (ii) new barriers to data aggregation. Other probable side effects include (iii) new opportunities for dominant firms to harass competitors with threats of litigation, (iv) increased transactional gridlock due to so-called "anti-commons" effects, and (v) inadvertent impediments and disincentives for non-commercial database providers.

If Canada had to decide its database policy now, most of the available evidence would be against adopting EU-style legislation. Fortunately, no immediate decision is required. Although frequently discussed, threat of discrimination by European courts will have a minimal impact on Canadian firms. For this reason, Canada should adopt European-style protection laws for reasons of domestic policy or not at all. The most prudent course is for Canada to wait until the results of Europe's database protection experiment become clearer.

OVERVIEW

FIVE YEARS AGO, THE EUROPEAN COMMISSION (EC) passed a directive requiring Member States to enact a new form of intellectual property protection — the so-called "*sui generis*" right — for data. Because of implementation delays, the effects of that decision have not been visible until recently.

This study profiles existing database industries in Canada, the United States, Britain, France and Germany; it summarizes the current legal environment in North America and Europe; and it tests claims that the EC Directive has increased database protection in Europe.

The next section (*Modern Databases*) sets the stage by describing generic features that all database industries studied for this study share in common. Useful categories for describing database providers are defined and briefly discussed.

The third section (*Databases in the United States and Europe*) surveys database industries in the United States, Britain, France and Germany.

The fourth section (*The Canadian Database Industry*) describes Canada's database industry and compares it with the countries examined in the previous section. That section concludes by identifying potential growth opportunities.

The fifth section (*Database Protection in North America*) summarizes the legal, technical and economic strategies that providers currently use to protect their databases in North America. It then compares these protections against typical commercial databases to determine whether *gaps* exist. Pending proposals to extend U.S. law are briefly discussed.

The sixth section (*European Law*) focuses on the so-called *sui generis* right which the EC mandated in 1996. The EC Directive, national implementation legislation, and recent European case law are examined in turn.

The seventh section (*Is the European Commission Directive Working?*) looks for evidence that the EC Directive has fulfilled its intended purpose by encouraging database production in Europe. In total, seven lines of evidence are examined.

The eighth section (*Unintended Side Effects*) examines the opposite side of the ledger by looking for unwanted side effects that the Directive has either created or made worse.

The ninth section (*Canadian Choices*) examines Canada's policy options in light of the foregoing discussions.

ORIGINAL RESEARCH

THIS STUDY COULD NOT HAVE BEEN WRITTEN without extensive original research. The principal items include (i) a detailed analysis of 1,164 database providers that operated in Canada, the United States, the United Kingdom, France and Germany between 1993 and 2001, (ii) extended interviews with four EC officials and scholars familiar with recent European court decisions, and (iii) extended interviews with five additional scientists and executives familiar with database issues in biotechnology. Interested readers can find further details in the Appendix.

MODERN DATABASES

BEFORE ESTABLISHING A NEW POLICY toward databases, lawmakers need a clear sense of databases that already exist, who produces them (and why), and what functions they serve within the broader economy.

The task is complicated by the fact that the seemingly simple concept of a *database* hides a bewildering variety of activities by very different organizations. Today's world is awash in government, academic and commercial databases. Furthermore, the term 'database' can include everything from written articles to graphics to indexes and tabular information. Finally, databases come in many formats. These can vary from traditional bound volumes to digital products (for example, searchable full-text files and graphics) that barely existed 20 years ago.

PORTRAIT OF AN INDUSTRY

What is a Database?

THE FACT THAT SOMEONE, SOMEWHERE knows about a particular fact does not make that information useful to society. In the broadest sense, databases act as *conveyor belts* between those who discover information and those who use it.* This study follows the EU's definition of a "database" as "a collection of independent works, data, or other materials arranged in a systematic or methodical way and individually accessible by electronic or other means."¹

One natural way to think about databases is in terms of *value added*.[†] Table 1 divides databases into four broad categories. The schema is used throughout this study.

* It is easy to denigrate this activity. For example, some scientists argue that databases are unnecessary because researchers should be willing to find and review the published literature for themselves. This overlooks the fact that good databases save users time and effort. While databases cannot replace literature searches, they do make the process more targeted and productive. See Maurer, Firestone and Sriver, 2000.

† Note that the term "low added value" refers to the provider's *investment*. From the user's perspective, even minimal improvements (for example, full text search) can add enormous value.

TABLE 1		
TYPICAL DATABASES		
TYPE OF DATABASE	DESCRIPTION	EXAMPLES
Publisher	Converts pre-existing documents to a convenient, usually searchable electronic format.	Electronic versions of newspapers, magazines and books; wire services; scientific, engineering, and other scholarly journals; public domain literature; public domain clip art; telephone books; and professional sports scores.
Gatherer	Collects information from multiple sources and reports it as a single, unified database.	Product catalogues; industry directories; firm credit ratings; financial market data; consumer surveys; consumer credit ratings; court opinions and statutes; census data; economic statistics; gene sequences; space images; weather; library catalogue data; membership directories; bibliographies and abstracts.
Refiner	Takes raw data and improves it by searching for errors, adding commentary, and/or recommending best values.	Biotechnology data; chemical data; nuclear science data; mapping and spatial information products; market analyses; industry profiles.
Portal	Provides access to multiple databases through a common gateway.	Sites that collect multiple databases from a single vendor; sites that collect multiple databases from multiple vendors; sites that bundle journal access with indexes, abstracts and other research tools; sites that use links and/or sophisticated software to help users find related information over the Internet.

Table 1 defines *publishers* as providers who take existing data and make it available with minimal alteration. Firms that convert existing print documents (for example, newspapers) into searchable electronic formats are the most common example. *Gatherers* find information in the external world and then report it in essentially unaltered form. *Refiners* use human and computerized editors to improve raw data by finding errors, giving opinions and recommending best values. Refiners are particularly important in the sciences. Finally, there are limits to the amount of information that any one database can provide. *Portals* and *links* alleviate this problem by increasing the public's ability to find and combine data from multiple databases.

Who Are Providers?

Database legislation usually starts from the proposition that existing intellectual property rights are inadequate. This implicitly assumes that database production depends on commercial incentives. However, many databases are produced

outside the commercial sector by governments and non-profit organizations. In order to be successful, a policy innovation must benefit — or, at least, not injure — all three of these sectors.

Table 2 describes some typical examples of government, non-profit and commercial providers.

From a public policy standpoint, deciding what type of provider should produce a particular database is non-trivial. Within North America, there remains a broad consensus that government should (i) concentrate on producing data that practically everyone agrees the society needs, and (ii) provide this data at or near the cost of reproduction. Conversely, commercial providers should specialize in producing databases where the underlying need is inherently controversial or uncertain. The justification for having government produce basic data at cost is that intellectual property rights create a legal monopoly which (like all monopolies) artificially raises the price of information, forcing some consumers to go without data that society has already paid for and could provide at near-zero cost.

Despite this orthodoxy, some proponents of intellectual property rights argue that government should leave *all commercially viable* databases to the private sector. The reason for maximizing the commercial sector is rarely articulated, but is usually based on perceptions that government database budgets are politically unsupportable in the long run. This viewpoint is particularly common in discussions of space imaging data, where the U.S. National Aeronautics and Space Administration (NASA) has adopted *commercializing space* as an end in itself.

TABLE 2			
TYPICAL PROVIDERS			
TYPE OF PROVIDER	EXAMPLES	TRADITIONAL PRICING MODEL	TRADITIONAL ROLE
Government	Federal and provincial governments; government-supported foundations and institutes; universities; libraries; museums.	Free of charge or cost of reproduction	Provide data needed by society as a whole.
Non-profit	Trade associations; scientific and professional bodies; self-supporting institutes.	Non-profit	Provide data needed by distinct user groups.
Commercial	Corporations and partnerships.	For profit	Provide data needed by individuals.

Overlapping Categories

Despite its utility, the distinction between government, non-profit and commercial providers is often blurred. There are three basic reasons for this:

Saving Tax Dollars. During the 1990s, many governments tried to recover the cost of producing data through user fees. This was particularly true in Europe.

Need to Cover Costs. Even if an organization does not try to earn a profit, it still needs to cover its costs. Some associations provide *free* databases to members in exchange for dues. Other non-profit vendors charge substantial user fees. Annual subscriptions of \$US 5,000 or more are common.²

Organizational Creep. Non-profit organizations typically believe that their mission includes keeping databases affordable.³ Nevertheless, the opportunity to raise prices is often hard to resist. This is particularly true when — from the institution's perspective — enhanced revenues can be used to support good works.

Despite these qualifications, the distinction between commercial and non-commercial providers remains important and will be used throughout the study.

DATABASES IN THE UNITED STATES AND EUROPE

THIS SECTION DESCRIBES THE RESULTS of a detailed survey of the U.S., U.K., French and German database industries between 1993 and 2001. The survey was performed especially for the current study using data on 936 database providers. All data was taken from *The Gale Directory of Databases*, a leading industry catalogue. Interested readers can find additional details in the Appendix. A similar survey of Canada's database industry is presented separately in the section entitled *The Canadian Database Industry*. As used in this study, the term "database industry" does not distinguish between domestic firms and local subsidiaries of foreign multinationals. This approach is justified by the fact that new database legislation would almost certainly affect both groups equally.

Throughout the 1990s, the largest database industries were those of the United States and the United Kingdom. These industries were also the most commercialized, with for-profit firms consistently accounting for two-thirds of all providers. Germany's database industry was much less commercial in the early 1990s but had closed the gap by the end of the decade. France began and ended the period with the least commercialized database industry of any country examined in this study.

All countries examined for this study offered consumers a complete assortment of *basic* data. Examples include consumer marketing information, TV ratings, books-in-print, library catalogue listings, credit information, industry directories, statutes, court opinions, telephone directories, financial market prices, and price and employment statistics. Since most of these products have existed for decades, future growth is likely to be modest no matter what type of database legislation is adopted.

New legislation will probably have the biggest impact on specialized or innovative goods that differ from country to country. These are stressed in what follows. Readers interested in an overview of the five database industries profiled in this study may wish to consult Tables 3a to 3g before reading further.

TABLE 3a**OVERVIEW: ON-LINE PROVIDERS**

[PERCENTAGE OF DATABASE PROVIDERS IDENTIFIED AS PUBLIC, NON-PROFIT OR COMMERCIAL ENTITIES, BY COUNTRY, 2001 vs. (1993)]

PROVIDERS	FRANCE	GERMANY	UNITED KINGDOM	CANADA	UNITED STATES
Governments, Libraries,	40	10	15	25	12
Museums and Universities	(35)	(15)	(15)	(40)	(15)
Associations, Institutes and	25	25	20	10	12
Churches	(30)	(35)	(20)	(15)	(15)
Commercial Entities	35	65	65	65	75
	(35)	(50)	(65)	(40)	(70)

TABLE 3b**OVERVIEW: CD-ROM PRODUCTS**

(PERCENTAGE OF PROVIDERS WHO PRODUCE PARTICULAR TYPES OF CD-ROMs, BY COUNTRY, 2001)

PROVIDERS	FRANCE	GERMANY	UNITED KINGDOM	CANADA	UNITED STATES
Clip Art and Shareware	10	–	5	10	10
Multimedia and Interactive Software	10	–	10	20	25
Electronic Versions of Existing Publications	25	20	35	30	25
Conventional Databases	55	80	50	40	40

TABLE 3c

CLOSE-UP: ON-LINE COMMERCIAL PROVIDERS
(PERCENTAGE OF PROVIDERS WHO OPERATE PARTICULAR TYPES OF DATABASES,
BY COUNTRY, 2001)

PROVIDERS	FRANCE	GERMANY	UNITED KINGDOM	CANADA	UNITED STATES
Portals	15	5	10	5	5
Publishers	35	40	30	45	50
Newspapers, Wire Services and Magazines	20	15	10	40	25
Scholarly Journals and Books	—	—	>5		5
Court Opinions and Statutes	—	5	>5	>5	
Newsletters and Business Magazines	15	15	15	5	
On-line News Sites and Magazines	—				10
Miscellaneous	—	5	>5	—	5
Gatherers	40	45	50	45	40
Company Products, People and Financial Data	20	30	20	20	20
Market, Consumer and General Economic Data	10	10	15	12	10
Science	—	>5	10	—	>5
Legal	10	>5	5	12	>5
Refiners	10	10	10	5	10
Scientific	5	>5	>5	>5	>5
Legal	5	>5	>5	>5	>5
Market Intelligence	—	5	5	>5	5

TABLE 3d

EXPORT POTENTIAL: SUBJECT MATTER FOCUS
(PERCENTAGE OF DATABASE PROVIDERS WHO PRODUCE DATA OF POTENTIAL
INTEREST TO DOMESTIC, MIXED OR INTERNATIONAL AUDIENCES,
BY COUNTRY, 2001)

PROVIDERS	SUBJECT MATTER	FRANCE	GERMANY	UNITED KINGDOM	CANADA	UNITED STATES
On-line Databases						
	Domestic	55	45	45	80	40
	Mixed	15	15	10	10	10
	International	35	40	35	10	40
CD-ROMs						
	Domestic	50	50	40	70	30
	Mixed	50	5	5	10	10
	International	0	45	55	20	60

TABLE 3e

EXPORT POTENTIAL: LANGUAGE
(PERCENTAGE OF DATABASE PROVIDERS WHO PRODUCE ENGLISH, BILINGUAL AND NON-ENGLISH DATA, BY COUNTRY, 2001)

LANGUAGE(S)	FRANCE	GERMANY	UNITED KINGDOM	CANADA	UNITED STATES
English Only	10	5	95	70	95
Bilingual/Multiple	15	25	>5	25	>5
Non-English	75	70	>5	5	>5

TABLE 3f

EXPORT POTENTIAL: SCIENCE CONTENT
(PERCENTAGE OF PROVIDERS WHO PRODUCE SCIENCE AND ENGINEERING DATABASES, BY COUNTRY, 2001)

	FRANCE	GERMANY	UNITED KINGDOM	CANADA	UNITED STATES
Science and Engineering Databases	30	30	30	10	25

TABLE 3g

DATABASE GROWTH
(ABSOLUTE AND PERCENTAGE GROWTH IN NUMBER OF PROVIDERS, BY SECTOR AND COUNTRY, 1993 AND 2001)

YEAR	PROVIDER TYPE	FRANCE	GERMANY	UNITED KINGDOM	CANADA	UNITED STATES**
1993	Governments, Libraries, Museums and Universities	43	39	33	84	[No Data]
	Associations, Institutes and Churches	33	15	39	17	[No Data]
	Commercial	50	58	135	60	[No Data]
	Total*	171	121	207	163	1,250
2001	Governments, Libraries, Museums and Universities	27	16	33	37	120
	Associations, Institutes and Churches	18	32	39	9	150
	Commercial	37	100	131	82	740
	Total*	100	173	202	135	1,010
	Percentage Change	-41	+43	-2	-13	-19

Notes: * Includes unidentified entities and miscellaneous categories (for example, international bodies).

** Estimates based on 10-percent sample.

UNITED STATES

AS OF 1993, U.S. PROVIDERS OFFERED roughly 5,000 databases. For comparison, this was 12 times larger than its nearest rival (the United Kingdom). Throughout the 1990s, the number of databases offered by U.S. providers grew steadily at approximately six percent a year. Despite this, the United States' relative share of the world's database production declined. Today, that country provides roughly 7,000 databases. This is only seven times the U.K. figure.

The United States has the most heavily commercialized database industry of any country examined for this study. Today, 75 percent of all U.S. providers are commercial entities — 10 percent more than in Britain or Germany. The U.S. database industry is also becoming more concentrated. While the number of U.S. databases grew 40 percent between 1993 and 2001, the total number of providers fell by 19 percent.

Commercial Sector

U.S. *portals* like LEXIS and Westlaw currently offer thousands of titles, suggesting that the ability to offer convenient *one-stop* shopping strongly favours large providers. During the mid-1990s, many providers — particularly in science and technology — significantly enhanced traditional *dumb* portals by adding new search capabilities in the form of sophisticated bibliographies, indexes, software and other research tools.⁴ Thomson's ISI (*Web of Science* portal) and Kluwer's Ovid Technologies subsidiary (large biomedical portal) are the best-known examples of this trend.⁵

Most electronic journals are *spin-offs* of pre-existing print media. During the 1990s, however, some U.S. *publishers* began to launch all-electronic journals. Still other firms published their data as *content* for Internet sites. Probably the most noteworthy innovation involved scientific journals. By the end of the 1990s, several scientific publishers were providing all of their journals on-line. Examples included the American Society of Civil Engineers (a non-profit professional society) and Johns Hopkins Press. Unified text search capabilities welded many of these collections into powerful research tools.

U.S. *gatherers* include a large number of familiar names such as LEXIS, Dialog and Dun & Bradstreet. Although headquartered in the United States, most large gatherers maintain substantial overseas operations through subsidiaries and local partners.⁶ This reflects the fact that almost all commercially useful data (for example, credit ratings, court opinions or financial market data) is geographically dispersed. Presumably, there are strong competitive pressures for gatherers to be close to their sources.⁷ Despite this trend, many smaller gatherers maintained a much more limited presence overseas.⁸

U.S. *refiners* include a large number of industry newsletters. Within the sciences, refiners include the American Chemical Society, a non-profit institute

that provides *recommended best values* and literature abstracts for users in academia, industry and law. Other well-known examples included Jane's (military data), Celera and Incyte (genomic data) and Space Imaging (processed satellite data).

Government, Academic and Non-profit Providers

As in the commercial sector, non-profit *portals* grew steadily larger and offered users growing numbers of research tools throughout the 1990s. Examples include SPARC (portal offering access to approximately 100 journals) and OCLC (portal enhanced with extensive research tools). Within government and academia, a few portals have started to experiment with *federations*, in which member databases agree to adopt minimally uniform computing standards and nomenclatures. Portal users can then search the federation as if it were a single, seamlessly searchable resource.⁹

Government and academic producers are particularly important to science. Compared to other countries, the U.S. federal government continues to fund an enormous number of science and social science databases. Non-profit providers also produce many science databases. By comparison, commercial firms accounted for only 40 percent of U.S. scientific databases.

UNITED KINGDOM

DURING THE 1990S, THE TOTAL NUMBER of U.K. databases grew steadily at just under 10 percent per year. During this time, the total number of government, non-profit and commercial providers remained essentially constant. This overall picture suggests a mature industry enjoying steady growth.

The United Kingdom has one of the world's most commercialized database industries. In 1993, commercial firms accounted for roughly 65 percent of the country's database providers. This fraction remained constant throughout the 1990s.

Commercial Sector

As in the United States, many U.K. portals grew very large during the 1990s in order to offer consumers *one-stop shopping* for data. This trend was not limited to portals aimed at the general public. Portals aimed at narrower scientific and business audiences also grew dramatically.*

* Dialog Corporation is probably the best-known example of a large, general-purpose portal. Examples of specialized portals include Chem-Web (60 chemical, pharmaceutical and related databases) and FT Profile (100 newspapers, wire services and trade journals).

U.K. *publishers* tend to cover overseas information much more than their counterparts in other countries. To some extent, this may be a legacy of the Empire.¹⁰ Examples include a wide variety of newsletters covering regional politics and business. British firms also engage in extensive re-publication of overseas newspapers and broadcasts.*

Britain's commercial *gatherers* and *refiners* have a similarly international outlook. Far more than in any other country surveyed for this study, British providers specialize in producing industry profiles and *business intelligence*†. Large news organizations, which already possess substantial information-gathering assets and reputations, seem to be particularly adept at producing business intelligence.¹¹

The United Kingdom's internationalism also spills over into science. British firms produce abstracts and bibliographies that cover the worldwide literature in a broad assortment of disciplines.‡

Government, Academic and Non-profit Providers

As in the United States, government and non-profit organizations continue to play a large role in the production of British scientific and engineering databases. During the 1990s, the British government tried to make at least some of these resources self-supporting. Success was, at best, uneven. For example, British Ordnance survey fees rose so steeply that many U.K. colleges stopped teaching students about British cities and began to use U.S. maps instead. Despite high prices, revenues were disappointing.¹²

GERMANY

THE TOTAL NUMBER OF GERMAN DATABASES was roughly constant during the early 1990s, but nearly doubled in the two years after database legislation was passed in 1998. Since then, the number of databases has declined slightly.

The total number of German database providers grew by more than 5 percent a year between 1993 and 2001. Eighty percent of these new providers

* Examples include Peat Marwick McLintock (English language Czech newspaper), FT Profile (100 world newspapers), FT Discovery (Asian newswires) and Moneyclips Ltd. (selected Mid-East press articles).

† Examples include Art Sales Index Ltd. (worldwide art sales), BioCommerce Data Ltd. (worldwide biotechnology industry), Crain Communications (worldwide tire production), The Economist Intelligence Unit (information on 66 developing countries), ESPICOM (medical markets in 70 countries), PJB Publications (international pharmaceutical industry newsletters) and Lettres (United Kingdom) (Latin American business newsletters).

‡ Examples include Bowker-Saur Ltd. (Anglo-American social science literature), BRF International (brewing technology), Derwent Publications (scientific, industrial and patent data), Elsevier/Geo Abstracts (worldwide earth sciences and textile technology) and Geosciences (earth sciences data).

were commercial. As a result, private sector firms went from 50 percent of all providers in 1993 to 65 percent in 2001. Whether the number of commercial providers will now level off, as it has in the United States and the United Kingdom, remains an open question.

Commercial Sector

Compared to the United States and the United Kingdom, most German commercial portals remain relatively small. Germany's largest and most advanced portal — the European Service Center for STN — is operated by a non-profit institute and will be discussed in the next section.

Like other European countries examined for this study, German publishers include a large number of on-line business newsletters. While most are domestic, many have a regional or worldwide focus. Most of these international newsletters are devoted to traditional German specialties like chemistry and pharmaceuticals.*

German *gatherers* produce a variety of scientific bibliographies covering worldwide research. Most of these involve disciplines of interest to German industry.† Other gatherers collect economic data on various international industries. Once again, these databases tend to center on traditional German specialties like chemicals and pharmaceuticals.‡

Germany's *refiners* also produce a substantial number of scientific databases. Most of the databases are related to chemistry,§ which has the longest tradition of commercial data anywhere in the sciences. As in the United Kingdom, several German news organizations have developed business intelligence reports in order to find new markets for their existing research assets.**

* Examples include Aertze Zeitung Verlagsgesellschaft (pharmaceuticals newsletter), Global Press Nachrichten-Agentur und Informationsdienst GmbH (international computer, aviation and automobile newsletters), Handelsblatt GmbH (magazines covering German and European chemical industry), and Datacom-Zeitschriften Verlag GmbH (worldwide telecommunications industry newsletter).

† Examples include Comargus Information Center GmbH (printed circuits), Bayer, AG (chemical engineering literature), International Food Information Service GmbH (worldwide food, wine and packaging literature), and Xtract-Informatinsverarbeitung GmbH (worldwide agriculture, data processing, energy, economics and technology literature). As in most other countries, trade groups, non-profit institutes, universities and governments also produce important literature surveys.

‡ Examples include Aertze Zeitung Verlagsgesellschaft (international pharmaceuticals industry data), Broenner Umschauverlag Breidentstein GmbH (worldwide auto industry data) and CWD (economics of chemical industry).

§ Examples include Bayer (chemical engineering), BASF (NMR spectra), Chemical Concepts (optical spectra) and Volkswagen (automotive literature).

** Examples include the Frankfurter Allgemeine Zeitung (country reports and German company profiles) and the Suddeutsche Zeitung Dokumentations — und Informations Zentrum Munchen (unspecialized information products).

Government, Academic and Non-profit Providers

FIZ Karlsruhe, a non-profit institute founded by the German government, operates the European *portal* for a spectacular assortment of approximately 150 chemistry, biotech, materials science, patents, engineering, physics and industrial technology databases. The portal is used worldwide and is part of a larger collaboration between non-profit organizations in the United States, Germany and Japan.¹³ Like its counterparts in the United States, FIZ Karlsruhe is largely self-supporting.

German trade association and institute *gatherers* produce a variety of commercially important science and technology research databases.^{*} The country's most important *refiners* focus on chemistry and the physical sciences. Most of these databases are produced by an interlocking system of non-profit institutes originally founded by Germany and the EU.[†]

Language Barriers

German providers face substantial language barriers compared to their Anglo-American counterparts. Slightly more than half — 55 percent of the *Gale Directory* sample — include English in their databases.

Paradoxically, language barriers seem to have stimulated database production in some cases. For example, several science and technical databases specialize in German-language resources that the big Anglo-American databases seem to have missed.[‡] Other providers extend coverage beyond Germany's borders to include smaller German-speaking nations.[§]

^{*} Examples include DECHEMA (chemical engineering literature), Deutsche Bundesanstalt für Materialforschung und — prüfung (international material strength and testing literature), Deutsches Bundesanstalt für Geowissenschaften und Rohstoffe (worldwide geoscience, mining and oceanography data), Deutsches Kunststoff Institut (worldwide plastics literature), Dokumentation Kraftfahrzeugwesen (worldwide automotive literature), Forschungsgesellschaft Druck e.V. (international printing industry), Gesellschaft für Biotechnologische Forschung mbH (international genomic literature), Gesellschaft für Mathematik und Datenverarbeitung (worldwide information technology literature) and HECLINET (worldwide hospital services literature).

[†] Examples include DECHEMA (chemical engineering databases), FIZ CHEMIE (database produced in cooperation with the United Kingdom), FIZ Technik (engineering), FIZ W (ceramics and metallurgy), FIZ Karlsruhe (computing, chemistry and physics), and FIZ Ka (energy).

[‡] Examples include The Umwelt Bundesamt (database of German-speaking environmental literature), Forschungsinstitut Senckenberg (database of German-speaking biology literature), Institut für Geschichte der Medizin (German supplement to U.S. bioethics database), Forschungskuratorium Maschinenbau (German mechanical engineering literature), and Deutsches Zentrum für Altersfragen (German gerontology literature).

[§] Examples include databases produced by Agrar Buch Center im Landwirtschaftsverlag GmbH (German language agricultural literature), Informationsvermittlungsagentur Waldemar Kubanski (Polish firms), Die Deutsche Bibliothek (German language books), Agentur für Weiterbildung Hunert & Neuman GbR (German, Austrian, and Swiss educational seminars), Informationsring Krediturschaff Datenbank (German banking literature), Mueller Address und Neue Mediengesellschaft Ulm GmbH & Co.

FRANCE

THE TOTAL NUMBER OF FRENCH DATABASES remained roughly constant between 1993 and 2001. However, during the same period, the number of providers fell by approximately 40 percent — far more than any other country examined for this study. France's commercial sector accounted for a very low fraction (just 35 percent) of the country's database providers. This fraction held steady throughout the period.

Commercial Sector

Compared to other countries, French database providers include a disproportionately large number of *portals* — roughly three times more than those found in Germany, Canada or the United States. The reason seems to be that the average French portal offers fewer databases than its counterparts in other countries. The absence of large, well-organized portals probably costs French consumers a modest amount of power and efficiency.

French *publishers* consist almost entirely of on-line newspapers, magazines and newsletters. At least qualitatively, France seems to have achieved good on-line coverage of its national newspapers and magazines.

With respect to *gatherers* and *refiners*, France offers numerous commercial databases for basic commercial applications such as law, business and marketing. However, French commercial providers produce relatively few databases outside these traditional categories. This may explain why commercial providers remain much less common in France than in any other country examined for this study. In the sciences, French refiners include Questel (chemical structure data) and Genset (genomic data).*

Government, Academic and Non-profit Providers

French providers include a large number of *international organizations* such as the EU, the Organisation for Economic Co-operation and Development (OECD), the European Space Agency (ESA) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). Together, these bodies accounted for 10 percent of all French providers. No other country surveyed for this study comes close to this figure.

(TV and video firms operating in Germany, Austria, Luxembourg and Switzerland) and JURIS GmbH (gateway specializing in German-speaking countries).

* Genset is a bioinformatics firm that specializes in a comparatively small subset of genomic data known as polymorphisms. Genset's narrow focus has allowed it to compete effectively with much bigger firms like Celera and Incyte. Similar specialization strategies are likely to become increasingly important for start-up firms in the post-genomic era. Interview with Lee Bendegkey dated January 30, 2001.

Compared to other countries, France produces relatively few science and technical databases commercially. Instead, 70 percent of all science and technical database providers are affiliated with government, universities and national laboratories. Examples include important physics and chemistry databases such as GAYPHOR and THERMODATA.

Language Barriers

Domestically, language barriers seem to have created a market for databases that (i) cover French-language publications, and/or (ii) describe English-language publications in French. Internationally, the language barrier makes it harder for French products to compete. This may explain why some French providers have taken to distributing their data through overseas partners.*

COMPETITION AND MARKET POWER

BECAUSE THIS STUDY IS PRIMARILY CONCERNED with the overall health of database industries at the national level, the foregoing discussion focused on aggregate descriptions with only passing references to individual markets. How competitive are these markets?

For very large commercial databases, it is not hard to find instances in which two or more providers compete in offering near-substitutes to the public.† At least anecdotally, head-to-head competition appears to be much less prevalent among small providers.¹⁴ Instead, each individual database often occupies its own niche, without obvious close competitors.

Scientists and legal scholars have frequently argued that this pattern of *niche databases* gives providers significant monopoly power‡ and that additional database rights will only make matters worse.¹⁵ For now, this argument remains inconclusive. At least in theory, the threat of potential entry could still be a powerful brake on prices even without direct competition. Furthermore, the existence of niche databases might even be beneficial to the extent that society is able to avoid a wasteful duplication of effort.

* Examples include LAMY, SA, which supplies French legal materials to LEXIS, and Thomson-Marconi, which produces a defence database for Jane's.

† Examples of head-to-head competition include Westlaw and LEXIS (legal opinions); NEXIS and Dialog (full-text newspapers and commercial databases); and Dun & Bradstreet and Kompass (company profiles and credit ratings). A slightly different form of competition occurs between basic data sets produced by government agencies (usually available at zero or nominal cost) and enhanced versions produced by the private sector. Examples include topographic maps, weather information and biology data. As explained below, many subscribers are willing to pay more than \$100,000/year for enhanced versions of public domain genome data.

‡ Skyrocketing subscription prices for scientific journals show that vendors serving niche markets can, in fact, wield significant market power. See Maurer and Scotchmer, 1999.

Further understanding of this issue requires detailed empirical study. Even a handful of detailed case studies would do much to resolve the debate.

THE CANADIAN DATABASE INDUSTRY

THE FIRST PART OF THIS SECTION describes the Canadian database industry between 1993 and 2001. The description is based on a study of 226 Canadian database providers performed especially for this study. The study is based on information extracted from the *Gale Directory of Databases*, a leading industry catalogue. Interested readers can find additional details in the Appendix. The rest of the section describes opportunities for growth over the next decade.

CANADIAN DATABASES

IN CONTRAST TO THE UNITED STATES, the United Kingdom and Germany, the total number of Canadian databases *decreased* by 20 percent between 1993 and 2001. During the same period, the total number of Canadian database providers fell by roughly 10 percent.¹⁶ Fifty percent of the providers who left the market were associated with governments, universities and libraries. Tight budgets during the early 1990s explain much of this trend.

Despite the decline in the public sector, the commercial sector grew. In 1993, only 40 percent of Canada's providers were commercial firms. Over the next eight years, commercial entities accounted for roughly three-quarters of all new providers. Not surprisingly, the commercial sector eventually took over database functions that had previously been performed by government. Examples include law, mineral exploration and data on company filings.*

Today, the commercial sector accounts for 65 percent of all providers — the same figure found in older, more established database industries in the United Kingdom and Germany. Because many of Canada's commercial providers operate relatively simple on-line newspapers, this comparison may overstate the database industry's maturity (see below). Nevertheless, Canada's private sector appears to be healthy.

* Examples include databases formerly maintained by the Alberta Department of the Attorney General (statutes), Alberta Oil Sands Technology and Research Authority (geology and industrial data), Alberta Research Council (Alberta geology data), Canada Department of Energy, Mines and Resources (mineral processing information), Commission de la santé et de la sécurité du travail du Québec (Quebec law), Industry, Science and Technology Canada (information on Canadian corporations), Manitoba Legislative Council (statutes), New Brunswick Department of Justice (statutes) and Revenue Canada (tax regulations).

Commercial Sector

Presumably, Canadian consumers do much of their research on U.S. *portals*. Despite this, Canadian portals have done a good job of organizing local subject matter. Since 1993, providers such as Southam, Infomart, and Dialog have offered consumers a growing assortment of Canadian newspapers, wire services, trade journals, newsletters and firm databases. Dialog's Canadian portal currently contains roughly 60 separate databases. This has allowed Canada to (a) share in the global trend toward convenient *one-stop* access to data and (b) increase the rate at which the country's existing databases are used.

The existence of large Canadian portals may also have encouraged entrepreneurs to create new databases that would not otherwise exist. For example, Dialog added at least 35 regional Canadian newspapers and magazines to its portal between 1999 and 2001. None of these on-line resources appear to have existed previously.

Most of Canada's *publishers* are on-line newspapers. As shown in Table 3c, this proportion is more than twice as high as comparable figures for the United Kingdom or Germany. To some extent, the phenomenon may reflect Canada's larger geographic size and diversity. The fact that the United States has the second highest proportion of on-line newspapers (25 percent) in Table 3c tends to support this thesis. At the same time, on-line newspapers are among the simplest databases to produce. This suggests that the Canadian database industry may be less developed than gross figures suggest. The fact that on-line newspapers account for a fairly large fraction (20 percent) of France's otherwise underdeveloped commercial sector supports this thesis.

Canada's *gatherers* provide a full range of legal opinions, statutes, firm credit ratings and marketing information. Beyond this basic information, the commercial sector has also developed several purely Canadian sub-specialties. These include business and geophysical databases serving the mineral and oil industries, and a variety of financial databases aimed at Canadian investors.*

Canadian *refiners* have a mixed record. Despite a strong government and academic base (see below), no commercial biotechnology or chemistry databases seem to exist. On the other hand, Canadian firms are extremely innovative in combining multiple geospatial data sets such as satellite images, maps and tax records. This comparative advantage probably arose in response to peculiarly Canadian challenges connected with mineral exploration and/or the need to map and administer vast, thinly settled territories. Applications include

* Examples include databases provided by Petroleum Information Canada (Alberta production time series), Woodside Research Ltd. (Canadian petroleum industry data), and Financial Post Datagroup (Canadian businesses and financial markets).

such diverse fields as mineral exploration, retail marketing and cell phone tower construction.¹⁷

Government, Academic and Non-profit Providers

Between 1993 and 2001, the number of Canadian providers engaged in scientific and technical databases fell from 20 percent to just 10 percent. The decline reflects the contraction of Canada's government and academic database sectors during the early 1990s.

Today, government-supported *refiners* continue to produce a variety of world-class databases. Examples include sites operated by the National Research Council (crystallography data), Toronto's Bioinformatic Computing Centre (genome data) and McGill University (thermodynamics and mutations data). At least some of these institutions have experimented with user fees and other strategies that make them partially self-supporting. The Canada Institute for Scientific and Technical Information (CISTI) and the National Research Council have adopted an explicit business orientation since 1993.¹⁸

As in most other countries, non-profit *portals* supply most of Canada's biology, chemistry and other types of scientific databases. Historically, the Canadian National Research Council, CISTI and various universities have played a leading role. Although several of these databases — including CISTI's large CAN/OLE industrial and business portal — closed during the early 1990s, others have opened since then. For example, the National Research Council operates a portal that provides access to foreign biotechnology data.

Language

Approximately 25 percent of all Canadian databases include at least some French content. However, the corresponding figure for Canadian *commercial* databases is only 12 percent. This suggests — but does not prove — that the commercial sector is less vigorous in Quebec and/or has not done enough to serve French consumers.

Interactions with the United States

Particularly in the wake of the North American Free Trade Agreement (NAFTA), proximity to the U.S. economy has probably had a profound influence on Canada's database providers. On the positive side, competition with the innovative U.S. market may have encouraged Canadian firms to embrace new products. Table 3b provides limited evidence for this proposition by showing that Canadian and U.S. firms are twice as likely to offer multimedia/interactive software products as their nearest European rivals.

On the debit side, Canadian providers face strong competition from cheap and sophisticated U.S. databases. Based on relative populations, one would expect Canadian firms to account for roughly one-sixth of all database products serving the combined U.S./Canadian market. In fact, such products seem to be disproportionately American. This may explain why Canadian providers focus on domestic data nearly twice as much as their counterparts in other countries.* (See Table 3d.) The availability of U.S. and foreign products may also explain why Canada's commercial sector has not produced more scientific and technical databases. (See Table 3f.)†

As always, international trade is a two-sided business. Access to U.S. data helps consumers. Furthermore, some Canadian firms may earn substantial revenues from U.S. clients. On the other hand, U.S. competition may discourage development of Canada's commercial sector.

GROWTH OPPORTUNITIES: EMULATING FOREIGN SUCCESS STORIES

THE THIRD SECTION DESCRIBED A VARIETY of new and/or specialized products that helped the U.S. and European database industries grow during the 1990s. This section asks whether Canadian firms should try to emulate any of these models. For convenience, each provider type is discussed separately.

Portals

During the 1990s, U.K. and U.S. portals competed by offering consumers (i) one-stop shopping for large numbers of databases, and (ii) *smart portal* research tools for coping with the resulting flood of databases. Both of these trends favour large existing portals over newcomers. For this reason, Canadian firms are not likely to penetrate the market for large, general research portals in the foreseeable future.

Publishers

In order to grow, Canada's electronic publishers need to find new stocks of books, magazines, newsletters, scholarly journals and other print media that have not yet appeared on-line or as CD-ROMs. The recent explosion of regional

* The situation may be getting worse. Examples of providers which have dropped combined U.S./Canadian coverage since 1993 include the Royal Bank of Canada (newsletter covering U.S. and Canadian economies), PComm Information Systems (computer magazine covering the United States and Canada), and Teleglobe Insurance Systems (building cost data for the United States and Canada).

† There are at least two possible explanations for the historic success of U.S. firms within the combined U.S./Canadian market. First, new start-up firms may find it easier to mature in a large domestic market like the United States before attempting to operate abroad. Second, the large number of U.S. database firms may make it easier to find skilled workers with appropriate know-how. The increasing integration of the U.S./Canadian economy under NAFTA should reduce both of these advantages over time.

newspaper databases shows that significant growth may still be possible. In general, however, publishers have probably exhausted the backlog of print media materials that fuelled growth in the early 1990s. This suggests that future growth will be comparable to that of Canada's underlying print media industry.

Gatherers

Large gatherers usually maintain a physical presence at or near the regions they cover. In part, this is because materials like credit ratings, court opinions and marketing data usually need to be collected where they originate. Furthermore, firms like to have offices close to their customers — and most users tend to be interested in their own geographic regions. This gives firms headquartered in the United States and the United Kingdom a substantial advantage over Canadian competitors for large databases like legal opinions, credit information and marketing data.* On the other hand, small U.S., U.K. and German firms have shown that it is possible to offer more modest databases (covering, for example, a specific geographic region or industry) using one or two offices. By analogy, Canadian firms may be able to find similar niches by focusing on (i) North American regional data and/or (ii) worldwide industries (for example, petroleum and mineral exploration) that have strong Canadian associations.

Refiners

Unlike gatherers, refiner databases are rarely tied to a particular geographic region. This makes them ideal for firms in a small, open economy like Canada. Although Canadian refiners probably cannot hope to match the United Kingdom's existing lead in worldwide business intelligence newsletters, they may be able to create narrower but still useful reports for North America. Large Canadian news organizations might find this an appealing way to squeeze additional revenue from their existing reputation and information-gathering assets.

Science refiners are discussed separately in the subsection entitled *Growth Opportunities: Science and Engineering Databases* below.

GROWTH OPPORTUNITIES: NICHE DATABASES

SEVERAL GERMAN AND FRENCH PROVIDERS specialize in (i) supplementing worldwide U.S. and U.K. literature surveys with focused regional coverage, or (ii) providing local language guides to worldwide research in other languages.†

* This is obviously less of a problem for Canadian multinationals that are already operating abroad.

† Examples include Informania (third-world medical literature supplement to MEDLINE); BNI (British supplement to U.S. nursing literature database); Umwelt Bundesamt (German language environmental literature); Forschungsinstitut Senckenberg (German language biology literature); Institut for

Tables 3d and 3e show that Canadian providers have also done a good job at covering local issues.

Despite this success, additional niche databases may be possible. One particularly promising idea is to produce French-language databases for export. This would allow Quebec firms to specialize in translating, adapting and/or marketing North American databases for use in France. In effect, Canadian firms would reap arbitrage profits by introducing databases that have already succeeded in North America to French and Francophone consumers. Canadian firms could also sell their services to North American database vendors who need help to enter French markets.

GROWTH OPPORTUNITIES: SCIENCE AND ENGINEERING DATABASES

MOST OF THIS SECTION FOCUSES on biotechnology, which had the largest and best-funded science databases throughout the 1990s. Prospects for other types of scientific databases are briefly discussed.

Biotechnology

The world's best-funded science databases are concentrated in the biotechnology sub-field known as "bioinformatics." Canada's academic and government sector institutions provide a strong — if so far largely unrealized — base for future development.¹⁹

Bioinformatics came of age during the 1990s, when big pharmaceutical and biotechnology research firms found that they could no longer manage high volume genome data on their own. As of 1997, the total worldwide value of bioinformatic goods and services was US\$ 917 million.²⁰ According to one study, 62 percent of the world's bioinformatic firms were based in the United States, 33 percent were based in Europe and just 3 percent in Canada.²¹ Most bioinformatic firms mix traditional database production with other activities (for example, writing software and performing laboratory research) in a ratio that varies from firm to firm.* Typical database activities include (i) preparing bibliographies and abstracts listing all papers that mention a particular location in the genome, (ii) improving public domain genome data by using computers

Geschichte der Medizin (German language supplement to U.S. bioethics database); and Deutsches Zentrum for Altersfragen (German gerontology literature).

* One extreme example is Proteome, whose products consist almost entirely of computerized — but otherwise traditional — bibliographies and abstracts. Interview with Mark Mooney dated February 15, 2001. By contrast, the industry's largest players — Incyte and Celera — earn most of their revenues by discovering and selling proprietary information. That said, they earn substantial revenues from traditional database activities like collecting, cleaning and annotating data that are already available in the public domain. In 1999, a subscription to Incyte's public domain data cost approximately \$100,000 per year. See Maurer, 2000b.

and human editors to search for and correct errors, and (iii) devising advanced software architectures that let users search enormous datasets using flexible and powerful search tools.²²

Two firms — Celera and Incyte — currently dominate the world market for extremely large, general-purpose genome maps. Canadian firms cannot hope to compete with these databases directly because of the enormous up-front investments involved. Over the next decade, however, research will almost certainly shift from mapping (What is the genome?) to function (What does the genome do?). Most observers believe that this new focus will favour smaller, more specialized databases that pull together clues from many different branches of biology. This should re-open the market to smaller, more specialized firms.²³ To some extent, this is already happening. Since 1998, approximately 70 percent of all new entrants in the bioinformatics industry have been specialized firms. Today, 85 percent of all bioinformatic firms employ fewer than 500 employees.²⁴

Building a Canadian bioinformatics industry will require (i) connecting the country's bioinformatics specialists to sources of funding and business expertise, (ii) identifying commercial needs that modest databases can satisfy, and (iii) counselling and encouraging would-be entrepreneurs. Government's ability to facilitate these processes is limited, but could be useful at the margin.

Other Big Science Databases

Apart from bioinformatics, the best known large-scale science and engineering databases involve space imaging and chemistry. Canada's public sector provides a strong base for these activities. Prominent Canadian programs include Radarsat (space images) and CISTI (crystallography data).

Two large U.S. firms (Carterra and Space Imaging) currently dominate the market for one-meter resolution, on-demand *space imaging*. Because of the enormous required up-front investment, new Canadian firms have little hope of challenging these firms directly. As in biotechnology, success will depend on firms' ability to find new ideas for commercially useful, but moderately sized database products.

For now, the outlook appears bright. Canadian firms have a long history of combining space images with other data sets (for example, tax records and census data) to create value-added products. This means that new start-up firms should be able to find plenty of human capital. Perhaps more importantly, space imaging is ideally suited to a vast, thinly-settled country like Canada. This suggests that new firms can grow to maturity in Canada's domestic markets before they incur the cost and complexity of foreign operations.

Small Science Databases

Many physical science databases are difficult to use or narrowly targeted to the needs of particular disciplines.²⁵ In principle, Canadian business could profitably re-package or extend these databases to serve new user groups in academia or industry. However, scientific database production is almost always a small-scale activity involving budgets of less than \$1 million/year. Even if successful, commercialization would not have a major impact on Canada's economy.

A more promising approach is to create a coordinating hub to collect, rationalize and preserve data that are currently fragmented or go unpublished. There are at least three possible strategies:

Data Warehousing. This approach uses a central facility to combine data from existing databases without help from their providers. Although extensive research has gone into building data warehouses, the technology is currently very expensive and has limited capabilities.

Central Infrastructure Model. This approach provides a central body to coordinate and provide computer support for a single worldwide database. Providing this *overhead* encourages volunteers to combine their fragmented databases into a powerful, unified research tool.

Federation Model. This approach involves persuading existing database providers to adopt minimum standard nomenclatures and computing protocols. This allows users to search the entire collection of databases from a central portal. One site provided by the U.S. Geological Service has already demonstrated the technology for large networks (200 members). However, participating members still need fairly strong computing skills.

Leading bioinformatics firms have already expressed strong interest in funding hubs for microarray²⁶ and human mutations data.* Other commercially viable projects can probably be identified with modest effort.

DATABASE PROTECTION IN NORTH AMERICA

ADVOCATES OF DATABASE LEGISLATION usually ignore the fact that most North American databases are already protected by law and/or clever business methods. The present section reviews these strategies and asks whether additional legislation is needed to fill gaps.

* Over the past two years, the author served as Associate Director for a worldwide organization of academic mutations scientists trying to negotiate database collaboration with industry. Although no contract was ever signed, Incyte and Celera both showed that they would have been willing to commit substantial funds (\$100K-\$1M/year) to such a project.

EXISTING LEGAL ENVIRONMENT

Copyright

FOR MOST OF THE 20TH CENTURY, the extent to which databases were protected in Canada and the United States was uncertain. In the United States, federal appellate courts were still divided as late as the 1980s. Courts sitting in the country's leading intellectual property centres (New York and California) believed that most types of data could not be copyrighted because they lacked sufficient *creativity*. Elsewhere, however, many courts adopted a *sweat of the brow* doctrine that extended copyright protection to any data that cost time, energy and money to collect. Creativity was not required.²⁷

The situation was similar in Canada.²⁸ Prior to NAFTA, most Canadian courts refused to extend copyright protection to documents that did not display some creativity. For example, the Supreme Court of British Columbia held that documents could not be copyrighted unless they reflected the author's "taste and discretion"²⁹ or "knowledge, skill and experience."³⁰ Similarly, Quebec's Supreme Court held that a chart could not be copyrighted unless it involved at least some "creativity."³¹ The view also received support — albeit indirectly — from the Supreme Court of Canada, which held in 1994 that a Quebec judge had correctly stated the law when he declared that copyright only protects information that embodies "the fruit" of a particular author's "personal judgment and . . . mind."³²

Despite these decisions, other Canadian cases embraced theories that were similar to the U.S. courts' *sweat of the brow* doctrine.³³ As of the mid-1990s, the issue remained unsettled.

Feist and NAFTA

The modern era of North American database law begins with the U.S. Supreme Court's 1991 decision in *Feist Publications, Inc. v. Rural Telephone Service Co.*³⁴ Defendant in *Feist* tried to copy a local telephone company's printed directories so that it could publish a competing edition.³⁵ The telephone company brought suit to stop the practice and prevailed in the lower court. The Supreme Court agreed to hear the case in order to settle what was then a 50-year old debate over whether U.S. copyright law extended to documents created through *sweat of the brow*. Reasoning that "facts are not copyrightable,"³⁶ the Court held that conventional telephone books lacked the "minimal degree of creativity" required for copyright protection under the U.S. Constitution.³⁷ It then went on to say that earlier cases extending copyright to works created by "sweat of the brow" had been wrongly decided.³⁸

Canada revised its copyright statutes in 1993 as part of its NAFTA implementation legislation. Although the new statute extended protection to

“work resulting from the selection or arrangement of data,”³⁹ it was not initially clear whether such work could be satisfied by *sweat of the brow*. This lingering question was finally addressed by the Canadian Federal Court of Appeal in *Tele-Direct (Publications) Inc. v. American Business Information Inc.*,⁴⁰ which held that Canadian law contained a “creativity” requirement comparable to *Feist*’s.

Copyright Protection after *Feist*

Since 1991, roughly one dozen U.S. courts have analyzed and elaborated on the principles announced in *Feist*. In doing so, they have frequently found the compiler’s choice and arrangement of data sufficiently creative to trigger copyright protection.⁴¹ The fact that many courts have been willing to find creativity in the way databases are arranged does not mean that the data itself is protected. If *free-riders* are willing to take the time and trouble to select from and rearrange copyrighted databases they remain free to do so.⁴²

Some U.S. cases have also extended the concept of creativity to situations in which authors apply human judgment to raw data in order to recommend *best values*.⁴³ Many refiners, including scientific databases, probably fit this description.

Similar developments are taking place in Canada. For example, the *Tele-Direct* case held that a set of white pages limited to Canadians of Italian extraction was creative enough to be copyrighted.⁴⁴ On the other hand, a law publisher’s headnotes, case summaries and indices could not be protected because they lacked “creative spark”.⁴⁵

Unfair Competition

In addition to copyright, U.S. federal law has occasionally flirted with a second theory based on unfair competition. The theory was first announced by the U.S. Supreme Court in a 1918 decision called *International News Service v. Associated Press*,⁴⁶ in which a wire service re-sold news copied from its rival. The Supreme Court held that the policy in favour of putting facts into the public domain did not create an absolute right to engage in such practices. Instead, it drew a distinction between the general public (which has a right to use information) and business competitors (which may not).⁴⁷ Attempting to draw a bright line between *fair* and *unfair* competition, the Court suggested a standard based on economic reasoning:

Indeed, it is one of the most obvious results of defendant’s theory that, by permitting indiscriminate publication by anybody and everybody for purposes of profit in competition with the news-gatherer, it would render publication profitless, or so little profitable as in effect to cut off the service by rendering the cost prohibitive in comparison with the return.⁴⁸

Unlike copyright, the *INS* standard does not create a hard-and-fast property right that can always be asserted. Instead, it requires courts to analyze each case separately on its own economic merits. As such, it represents a clear intellectual alternative to the EU's *sui generis* right discussed below.

For the next 70 years, most courts argued that *INS* had been wrongly decided or, at most, should be limited to its facts.⁴⁹ This started to change after the *Feist* court refused to overrule the case.⁵⁰ In *National Basketball Assn. v. Motorola, Inc.*⁵¹, the prestigious federal appeals court for the Second Circuit declared that the core situation addressed by *INS* — the so-called “hot news” cases — is still good law. Although currently confined to time-sensitive *hot news*, the Second Circuit's endorsement suggests that the doctrine could be extended to cover databases at some future date.

The status — or, more accurately, existence — of the *INS* tort is even more obscure in Canada. In 1977, the Supreme Court of Canada suggested in *McDonald*⁵² that section 7(e) of the federal *Trade-Marks Act*⁵³ might support *INS*-type claims. However, this turned out to be a Pyrrhic victory because *McDonald* also cast doubt on the federal Parliament's constitutional power to pass such laws in the first place.⁵⁴ The issue remains in doubt.

At the provincial level, there have been almost no judicial decisions. One British Columbia trial court has expressed doubt that *INS* is good law.⁵⁵

Licensing and Trade Secrets

Although most databases serve mass markets, a few *high-value products* are sold to relatively small numbers (dozens to hundreds) of purchasers.* Because face-to-face bargaining is feasible under these circumstances, buyers and sellers can agree to maintain the data confidential. Such promises are enforceable as trade secrets under U.S. and Canadian⁵⁶ law.

Shrinkwrap/Clickwrap Licences

A more difficult question arises when the number of customers is so large that genuine face-to-face negotiations between buyer and seller are no longer possible. Despite their ubiquity, the effectiveness of so-called “shrinkwrap” or “clickwrap” licences remains unclear. In the past, courts have often ignored the fiction that the act of buying a product creates an *agreement*, particularly where the terms are one-sided. Nevertheless, at least one recent case has held that shrinkwrap licences can sometimes create enforceable rights. *Pro-CD, Inc. v. Zeidenberg* (enforcing shrinkwrap licence restrictions protecting telephone listings database against copying).⁵⁷ The limits of this doctrine are unclear, as witnessed

* One of the most important examples is in biotechnology. Celera and Incyte have historically sold their data to fewer than 300 customers at a time.

by another case, *Vault Corp. v. Quaid Software Ltd.* (contract restrictions against decompiling computer programs are invalid.)⁵⁸

Despite these uncertainties, clickwrap/shrinkwrap clauses offer substantial protection. Bioinformatics executives interviewed for this study report that they and their customers never use data if their legal rights are uncertain. The reason is that the cost of obtaining data is almost always tiny compared to total research and development (R&D) expenditures. This makes the legal risk of creating a product based on *stolen* data unacceptable.⁵⁹

TECHNICAL MEASURES AND OTHER SELF-HELP STRATEGIES

LEGAL RIGHTS ARE NOT THE ONLY — or even the main — method that database providers use to protect their products. Instead, most rely on *self-help* strategies which limit users' access to data in ways that do not rely on contracts, statutes or courts. Probably the best-known examples of such strategies involve technical protections. Examples include:

Submitted Queries. Many on-line research tools (for example, LEXIS) require customers to submit search requests and then report back results. These systems are intrinsically secure because customers never gain access to the underlying database. Although customers could theoretically attack the system by submitting millions of search requests, it is almost never economical to do so.⁶⁰

Registration and Monitoring. Many on-line providers require users to identify themselves and routinely monitor search requests.⁶¹ For example, LEXIS routinely refuses to perform searches that are likely to produce more than 1,000 hits.

Encryption. Firms that supply data through CD-ROMs cannot retain physical control over their data. However, they can still deter unauthorized use through encryption. U.S. law makes it a crime to obtain data by reverse-engineering an encrypted system.⁶²

Trusted Systems. Some firms have experimented with hardware and software that limit access to data depending on the terms of *digital contracts* between buyer and seller.⁶³ In one popular implementation, special software in the user's computer deletes data after a pre-set period unless the provider receives additional payment.⁶⁴

Security and 'Speed Bumps'. Large vendors invariably worry about hackers. Although no protection is perfect, security experts work hard to detect intruders and limit the amount of information that a successful attacker can obtain at any one time.⁶⁵

In addition to technical protections, database vendors also rely on economic strategies to protect their products. These methods are usually based on the fact that most decision-makers are willing to pay a large premium for timely, accurate data. This is because the amount of money at stake in most business decisions (for example, plant acquisition, product development or marketing campaigns) is typically much larger than the cost of data. The effect is particularly dramatic for high-end products like biology and space imaging, where users routinely pay hundreds of thousands of dollars for comparatively modest improvements over publicly available information.⁶⁶ This leads to the following strategies:

Reputation. According to one leading database vendor, “our ultimate protection is in the brand.” Unless consumers know who gathered and compiled the data, they have no reason to trust it.⁶⁷

Updating. Most providers sell updated data to the same consumers year after year. In economic terms, the original data is nearly irrelevant: In the words of one well-known intellectual property lawyer, “They’re selling the updates.”⁶⁸

Because the database debate focuses on legislation, participants sometimes assume that formal contracts and statutes are more important than other types of protection. Business executives (including several lawyers) interviewed for the present study reject this view. Instead, their business strategies are uniformly based on a balanced mix of legal, technical and economics-based strategies.⁶⁹

DO GAPS EXIST?

TABLES 4a AND 4b COMPARE the protection strategies summarized in the preceding section against typical Canadian databases. Obvious gaps are rare. In fact, the only high-risk category seems to be CD-ROMs containing public domain materials like clip-art or shareware. Given intrinsically limited demand,⁷⁰ increased database protection is not likely to expand the supply of such products significantly.

Of course, it is dangerous to judge intellectual property laws by existing databases because additional protection could lead to new products. As a practical matter, the best that can be done is to ask providers whether they would produce new products if additional protections existed. Their response is uniformly negative.⁷¹

TABLE 4a						
PROTECTION STRATEGIES: ON-LINE PROVIDERS						
PROVIDERS		PREFERRED LEGAL STRATEGY	EFFECTIVENESS	PREFERRED NON-LEGAL STRATEGY	EFFECTIVENESS	CANADIAN MARKET SHARE (%)
On-line		See Below	See Below	See Below	High	5
Portals	Newspapers, Wire Services and Magazines	Copyright	High	Download Restrictions	High	40
	Scholarly Journals and Books	Copyright	High	Download Restrictions	High	–
	Court Opinions and Statutes	None	Low	Download Restrictions, Updating	High	>5
	Newsletters and Business Magazines	Copyright	High	Updating	High	5
	Miscellaneous References	Copyright	High	Download Restrictions	High	–
Gatherers	Company Products, People and Financial Data	Copyright	Low	Updating	High	20
	Market, Consumer and General Economic Data	Unfair Competition	Low	Updating	High	12
	Science	Copyright	Moderate	Updating	High	>5
	Legal	Unfair Competition	Moderate	Download Restrictions, Updating	High	12
	Refiners	Copyright	Moderate	Updating	High	>5
Refiners	Scientific	Copyright	Moderate	Updating	High	>5
	Legal	Copyright	Moderate	Download Restrictions, Updating	High	>5
	Business Intelligence	Contract	High	Updating	High	>5

TABLE 4b					
PROTECTION STRATEGIES: CD-ROM PROVIDERS					
PROVIDERS	PREFERRED LEGAL STRATEGY	EFFECTIVENESS	PREFERRED NON-LEGAL STRATEGY	EFFECTIVENESS	CANADIAN MARKET SHARE (%)
Original Clip Art and Shareware	Copyright	High	None	Low	5-10
Public Domain Clip Art and Shareware	Unfair Competition	Low	None	Low	> 5
	Shrinkwrap Licensing	Uncertain			
Multimedia and Interactive Software	Copyright	High	Encryption	Moderate	20
Electronic Versions of New Publications	Copyright	High	Encryption	Moderate	20
Electronic Versions of Public Domain Materials	Unfair Competition	Low	Bundling with Copyrighted Enhancements	Moderate	10
Conventional Databases	Shrinkwrap Licensing	Uncertain			
	Copyright	Low	Bundling with Copyrighted Enhancements, Updating	Moderate	30
	Shrinkwrap Licensing				

PROPOSED LEGISLATION

WIPO Treaty

SHORTLY AFTER ISSUING ITS DIRECTIVE (see the section entitled *European Law*), the EC asked the World Intellectual Property Organization (WIPO) to consider a worldwide database treaty based on the European model. After preliminary discussions involving the United States, WIPO published a draft version of the proposed treaty on August 10, 1996.⁷² Although the Clinton Administration originally backed the idea, protests by U.S. scientists and developing nations derailed the treaty in late 1996.⁷³ WIPO has continued to study database protection at a reduced pace since then.

Pending U.S. Legislation

WIPO's database protection provisions would have required domestic legislation. Despite doubts over its constitutionality,⁷⁴ Congress started considering the required legislation in May 1996. Revised bills have been introduced every year since. There is also an extensive academic literature recommending different statutory solutions.⁷⁵

The most recent bills are HR 354 and HR 1858. HR 354 is designed to follow the basic *sui generis* framework laid down by the EC Directive and would prohibit "extraction or use" of data for a period of 15 years. Over time, the bill has amassed an increasingly lengthy list of exemptions for science, education, research and other uses. However, none of these exemptions applies when data is used in a way that "directly harms" the underlying database's "existing or potential market." In this respect, HR 354 is even more stringent than the Directive itself.⁷⁶

HR 1858 presents a less burdensome alternative because it does not limit "use" of data, but only "selling" and "distribution" in commerce. Users could thus make copies for their own use. More importantly, HR 1858 would exempt any activity that did not "significantly threaten" the underlying database's ability to make a return on its investment. Unlike HR 354, this would usually enable would-be copiers to re-tailor data for a new audience, although direct competition would still be barred in most cases.⁷⁷

Some version of these bills will almost certainly be debated in the current session of Congress. Most observers believe (i) that some type of U.S. legislation is inevitable, but (ii) that whatever bill is adopted is unlikely to satisfy the EU. This will presumably lead to further WIPO negotiations aimed at finding a middle ground.

State Legislation

Academic and practicing lawyers have drafted a model statute called the *Uniform Computer Information Transactions Act* (UCITA) to clarify the status of shrinkwrap/clickwrap contracts.⁷⁸ In principle, a statute strengthening such contracts could allow firms to create their own private versions of Europe's database right. In practice, however, UCITA's effects are likely to be minimal. This is because the statute gives courts virtually unlimited discretion to decide whether a particular clickwrap/shrinkwrap term (i) offends public policy, (ii) conflicts with federal law, or (iii) is unconscionable.⁷⁹ Thus, even if the statute passes, it will provide very little assurance that any particular shrinkwrap/clickwrap clause is enforceable.

UCITA has been adopted in Maryland and Virginia. However, it has encountered strong resistance elsewhere.⁸⁰ It is still unclear whether enough States will adopt the statute to implement a unified approach to shrinkwrap/clickwrap contracts.

EUROPEAN LAW⁸¹

ALTHOUGH THE EUROPEAN COMMISSION passed the Directive in 1996, Member States were slow to implement it. As a result, courts have only recently begun to interpret its key concepts.⁸² This section reviews the original Directive, subsequent implementation legislation and emerging case law.

THE DIRECTIVE

DATABASES TRADITIONALLY RECEIVED strong copyright protection in the United Kingdom, Ireland, the Netherlands, and (to a lesser extent) the Nordic countries. Additionally, German courts had developed a strong tort based on unfair competition. By comparison, most other European countries provided fairly minimal protection for databases.

In the late 1980s, the European Community began studying database protection as part of a larger project to harmonize Member States' copyright laws. Initial proposals were moderate and would have been based on German unfair competition. However, it ultimately rejected this approach on three grounds:

- (i) Unfair competition provides remedies after unfair use has occurred without creating transferable economic rights at the outset;
- (ii) Unfair competition only applies to cases where the owner of the database and the unfair user are competitors; and
- (iii) Existing unfair competition laws were not uniform within the Community.⁸³

Calls for protection grew stronger over time. In March 1996, the EC issued its Directive on the Legal Protection of Databases.⁸⁴ The Directive applies to any “collection of independent works, data, or other materials arranged in a systematic or methodical way and individually accessible by electronic or other means.”⁸⁵ It protects such works against “temporary or permanent reproduction,”⁸⁶ “adaptation” or “alteration,”⁸⁷ or “distribution to the public.”⁸⁸ However, these protections do not apply unless a “substantial part” of the database, “evaluated qualitatively and/or quantitatively,” has been copied.⁸⁹

The EC Directive provides protection for a period of 15 years.⁹⁰ Furthermore, this period can be indefinitely extended if the “accumulation of successive additions, deletions, or alterations” amounts to a “substantial new investment.” This extension applies to the database as a whole and is not limited to “new” components.⁹¹ Finally, protection is “grandfathered in” for databases created on or after January 1, 1983.⁹²

To North American eyes, the most striking aspect of the Directive is that it refuses to extend protection to citizens of countries that fail to pass their own database protection statutes. Formally, Art. 11, ¶13 gives the Council discretion to withhold database protection from “databases made in third countries . . .” The Directive’s preamble underlines this threat:

[T]he right to prevent unauthorized extraction and/or re-utilization in respect of a database should apply to databases whose makers are nationals or habitual residents of third countries or to those produced by legal persons not established in a Member State, within the meaning of the Treaty, only if such third countries offer comparable protection to databases produced by nationals of a Member State or persons who have their habitual residence in the territory of the Community.⁹³

The resulting discrimination against U.S. and Canadian firms is less complete than it sounds. Firms willing to move substantial database work to European subsidiaries and/or European collaborators can claim full protection.⁹⁴ As one English lawyer has remarked:

It has been objected that the net effect of the [Directive] seems to amount to a rather cynical attempt to boost the European information technology market at the expense of the rest of the world. We would not quarrel with such an apparently harsh judgment. We are dealing with the realms of Big Money and High Politics. The Commission, having cottoned on to the economic importance of databases, was not about to let the opportunity pass of digging another section of the trench around Fortress Europe and labelling it database right.⁹⁵

IMPLEMENTATION LEGISLATION

THE 1996 DIRECTIVE REQUIRED MEMBER STATES to pass legislation implementing *sui generis* database rights on or before January 1, 1998. In the event, Germany, Sweden and the United Kingdom were the only members to meet this deadline.⁹⁶ After the EC filed infringement proceedings,⁹⁷ all but two countries passed some form of implementation legislation. In 2000, the European Court of Justice issued judgments requiring Ireland and Luxembourg to adopt conforming legislation.⁹⁸ Ireland has complied.⁹⁹ In light of existing Association Agreements with the EU, over 40 countries are eventually expected to enact some form of *sui generis* protection.¹⁰⁰

EC officials contacted for this study said that they were satisfied with the way most Member States have implemented the Directive.¹⁰¹ The only material exceptions seem to be the Nordic countries:

Sweden. Although the Directive asked Member States to create an entirely new (*sui generis*) right, Sweden's implementation legislation is limited to fairly minor changes its copyright statute's pre-existing *catalogue rule*. Furthermore, the legislation has extremely broad exceptions.¹⁰²

Finland. Finland also implemented the legislation by modifying its catalogue rule. Nevertheless, the result is slightly closer to the Directive's requirements. Like Sweden, Finland enacted a broad range of exceptions.¹⁰³

Denmark. Denmark's legislation also modifies a pre-existing catalogue rule. However, the result is closer to the Directive's requirements than for Sweden or Finland. One EC official contacted for this study suggested that the statute is partially acceptable.¹⁰⁴ That said, the concept of database is not defined. Denmark has also enacted very broad exceptions.

EC officials contacted for this study expressed strong dissatisfaction with the Nordic countries' failure to follow the Directive more closely.¹⁰⁵ More tentatively, they also expressed doubt that the Nordic countries' broad defences fell within the Directive's recitals authorizing traditional exceptions.¹⁰⁶ Private litigants and/or the EC will probably challenge these implementation statutes before the European Court of Justice within a few years.¹⁰⁷

Except for the Nordic countries, most legislatures seem to have followed the Directive's wording closely, with little elaboration.¹⁰⁸ The biggest differences involve the Directive's optional exceptions for scientific, private and educational uses.¹⁰⁹ Most EU members adopted all available exemptions.¹¹⁰ However, France did not enact any educational or scientific exceptions. Italy included these exceptions in its statute, but implemented them in a restrictive way.¹¹¹

Table 5 provides an overview of how the Directive's most important provisions have been implemented in the United Kingdom, Germany and Belgium.

TABLE 5

SELECTED IMPLEMENTATION LEGISLATION

STATUTE	DATABASE	PROTECTED RIGHT	FOREIGN CORPORATIONS	TERM	EXCEPTIONS	REPEATED USE
EC Directive ¹¹²	"For purposes of this Directive, 'database' shall mean a collection of independent works, data or other materials arranged in a systematic or methodical way and individually accessible by electronic or other means." [Art. 1(1)]	"Member States shall provide for a right for the maker of a database which shows that there has been qualitatively and/or quantitatively a substantial investment in either the obtaining, verification, or presentation of the contents to prevent extraction and/or re-utilization of the whole or of a substantial part evaluated qualitatively and/or quantitatively, of the contents of that database." [Art. 7(1)]	"The [database right] shall also apply to companies and firms formed in accordance with the law of a Member State and having their registered office, central administration or principal place of business within the Community, however, where such a company or firm has only its registered office in the territory of the Community, its operations must be genuinely linked on an ongoing basis with the economy of a Member State." [Art. 11(2)] "Agreements extending the [database right] to databases made in third countries . . . shall be concluded by the Council acting on a proposal from the Commission." [Art. 11(3)].	"The [database right] shall run from the date of completion of the making of the database. It shall expire fifteen years from the first of January of the year following the date of completion." [Art. 10 (1)] "Any substantial change, evaluated qualitatively or quantitatively, to the contents of a database, including any substantial change resulting from the accumulation of successive additions, deletions, or alterations, which would result in the database being considered to be a substantial new investment, evaluated qualitatively or quantitatively, shall qualify the database resulting from that investment for its own term of protection." [Art. 10(3)]	"Member States shall have the option of providing limitations on the [database right] . . . where there is use for the sole purpose of illustrating for teaching or scientific research, as long as the source is indicated and to the extent justified by the non-commercial purpose to be achieved." Art. 6(2b)]	"The repeated and systematic extraction and/or re-utilization of insubstantial parts of the contents of a database that conflict with a normal exploitation of that database or which unreasonably prejudice the legitimate interests of the maker of the database shall not be permitted." [Art 7(5)]

TABLE 5 (CONT'D)						
SELECTED IMPLEMENTATION LEGISLATION						
STATUTE	DATABASE	PROTECTED RIGHT	FOREIGN CORPORATIONS	TERM	EXCEPTIONS	REPEATED USE
German Multimedia Law ¹¹³	"A database within the meaning of this law is a collection of independent works, data, or other material arranged in a systematic or methodical way and individually accessible by electronic or other means and the obtaining, verification, or presentation of which requires a substantial investment." [§ 87a]	"The author of a database has the exclusive right to display the database as a whole or a substantial part therefore, evaluated qualitatively or quantitatively." [§ 87b]	Protection extends to authors located within one of the EU states and additional countries "in accordance with international treaties and agreements concluded with third countries by the European Union." [§ 127a]	"The rights of the database author expire fifteen years following publication of the database . . ." [§ 87d]	Reproduction of a substantial part of a database, evaluated qualitatively or quantitatively, is permissible . . . for private scientific use, if and to the extent that reproduction is appropriate and such use is for non-commercial purposes." [§ 87c]	"The reproduction distribution or public display of a substantial part of the database, evaluated qualitatively or quantitatively, is equivalent to repeated and systematic reproduction, distribution, and public display of insubstantial parts of the database which conflict with normal exploitation of the database or which unreasonably prejudice the legitimate interests of the database author." [§ 87b]

TABLE 5 (CONT'D)

SELECTED IMPLEMENTATION LEGISLATION

STATUTE	DATABASE	PROTECTED RIGHT	FOREIGN CORPORATIONS	TERM	EXCEPTIONS	REPEATED USE
United Kingdom Copyright and Rights in Databases Regulations 1997 ¹¹⁴	"In this Part, 'database' means a collection of independent works, data, or other materials which – (a) are arranged in a systematic or methodical way, and (b) are individually accessible by electronic or other means."	"[A] person infringes database right in a database if . . . he extracts or re-utilizes all or a substantial part of the contents of the database." [§ 16(1)]	"Database right does not subsist in a database unless, at the material time, its maker, or if it was made jointly, one or more of its makers, was . . . a body which was incorporated under the law of an EEA state . . ." [§ 18(1)] Corporate makers must be incorporated under the laws of an EEA state and either (i) have their principal place of business within the EU, or (ii) conduct operations "linked on an ongoing basis with the economy of an EEA state." [§ 18(2)]	"Database right in a database expires at the end of the period of fifteen years from the end of the calendar year in which the making of the database was completed." [§ 17(1)] "Any substantial change in the contents of a database, including a substantial change resulting from the accumulation of successive additions, deletions or alternations . . . shall qualify the database resulting from that investment for its own term of protection." [§ 17(3)]	"Database right in a database which has been made available to the public in any manner is not infringed by fair dealing with a substantial part of its contents if . . . it is extracted for the purpose of illustration for teaching or research and not for any commercial purpose." [§ 20(1)(b)]	"For purposes of this Part, the repeated and systematic extraction or re-utilization of insubstantial parts of the contents of a database may amount to the extraction or re-utilization of a substantial part of those contents." [§ 16(2)]

TABLE 5 (CONT'D)

SELECTED IMPLEMENTATION LEGISLATION

STATUTE	DATABASE	PROTECTED RIGHT	FOREIGN CORPORATIONS	TERM	EXCEPTIONS	REPEATED USE
Belgian Legal Protection of Databases Act 1998 ¹¹⁵	"For purposes of this Chapter, the following terms shall have the following meanings . . . database: a collection of independent works, data, or other materials arranged in a systematic or methodical way and individually accessible by electronic or other means." [§ 2.1]	"The database author has the right to prevent the extraction and/or re-utilization of the whole or of a substantial part, evaluated qualitatively or quantitatively, of the contents of that database." [§ 4]	The right of database authors shall apply to . . . companies and firms formed in accordance with the law of Member State . . . However, where such a company or firm has only its registered office in the territory of the EU, its operations must be genuinely linked on an ongoing basis with the economy of a Member State." [§ 12] "Databases produced in third countries . . . which are covered by agreements concluded by the Council acting on a proposal from the Commission of the EU, shall be protected by the right of database authors." [§ 12]	"The right of database authors shall run from the date of completion of the production of the database and shall expire 15 years from . . . the date of completion." [§ 6] "Any substantial change, evaluated qualitatively or quantitatively, to the contents of a database, including any substantial change resulting from the accumulation of successive additions, deletions, or alternations which would result in the database being considered to be a substantial new investment, evaluated qualitatively or quantitatively, shall qualify the resultant database for its own term of protection." [§ 6]	"The lawful user of a database which is legally made available to the public in whatever manner may, without the authorization of the author . . . extract a substantial part of the contents of the database where such extraction is effected for purposes of illustration for teaching or scientific research, provided that such extraction is justified by the non-commercial purpose to be achieved." [§ 7]	"The repeated and systematic extraction and/or reutilization of insubstantial parts of the contents of the database shall not be permitted where this conflicts with a normal exploitation of that database or unreasonably prejudices the legitimate interests of the maker thereof." [§ 4]

In general, most legislatures have simply repeated the Directive's language without elaborating on it. National courts have been left with the task of working out ambiguities.

Not surprisingly, European courts have tended to ignore specific national legislation. Instead, their rulings usually try to interpret database law directly from the Directive itself.¹¹⁶

CASE LAW

UNDER THE EU SYSTEM, community-wide initiatives like the Database Directive are initially interpreted by national courts. If different court systems disagree, appellants can take the matter to the European Court of Justice. So far, no one seems to have done this.¹¹⁷ This section looks at how the Directive's concepts are evolving, and at lingering areas where uncertainties remain.

The Database Concept

In order to assert *sui generis* rights, database owners must meet two threshold tests: (i) their information must qualify as a *database*, and (ii) their investment must be *substantial*. How hard is it to meet these requirements?

Existing case law suggests that the first half of the test (*database*) is extremely elastic. According to one British judge, the concept of a "database . . . has a very wide meaning covering virtually all collections of data in searchable form."¹¹⁸ In practice, courts have been liberal. According to one German case, even a collection of hyperlinks qualifies as a database.¹¹⁹

It is possible that courts will eventually use the Directive's requirement that facts be "independent" and arranged "in a systematic or methodical way" to limit protection.

For example, one scholar has argued that a collection of Web pages that are only connected by a search engine is not "systematically arranged."¹²⁰ For now, the most that can be said is that the required amount of organization is probably quite limited. For example, one German court has held that the classified ads section of a newspaper meets the standard.¹²¹

The second half of the test (*substantial investment*) is slightly more stringent. Nevertheless, there is widespread recognition "that the qualifying level of investment is fairly low."¹²²

Courts have evaluated *substantiality* in at least three ways. The first method is to infer investment by examining the face of the database. In general, this test has been applied leniently. For example, one German court held that a collection of 251 hyperlinks was a database.¹²³ Similarly, a Belgian court extended protection to an association directory that contained just 151 names.¹²⁴ On the other hand, at least two German databases have failed

the test. In one case, a single promoter's concert schedule was judged "insubstantial," although the combined schedule of 400 such promoters would not be.¹²⁵ Similarly, a German court has held that single-number averages of stock prices (for example, the Dow Jones index) are too insubstantial to warrant protection. Courts have also used *substantiality* to make what appear to be moral judgments about whether particular databases should be protected.* For example, a German court held that a Web site's effort to put frames around another provider's Web pages was not "substantial."¹²⁶ Similarly, a French case held that simply copying a pre-existing government document did not create a database.¹²⁷

The second method for determining substantiality is to look at investment directly. Again, the standard is fairly low. German, French and Belgian courts have confirmed that the act of maintaining and updating a database is itself a substantial investment.¹²⁸ Similarly, a German court has held that a newspaper's acceptance, preparation and editorial processing of advertisements is enough to make its classifieds section a protectible database.¹²⁹ A *safe harbour* seems to be emerging for databases created by outside employees or contractors.¹³⁰ For example, a Belgian court found that an umbrella organization of self-help groups made a substantial investment when it hired an outside contractor to prepare a directory. Two German courts have held that trade fairs that hire professional catalogue compilers make substantial investments.¹³¹

The third method for determining substantiality is the most troubling. In at least two cases, European courts have inferred substantiality from the fact that data were important to the infringer.¹³² Such reasoning could quickly lead to a *Catch 22* situation in which any taking of data would qualify as substantial.

Previous forms of intellectual property protection had fairly limited coverage. For example, information could only be patented if it was *novel* or copyrighted if it was *creative*. The Directive, on the other hand, clearly covers most forms of commercially useful information. So far, European courts have done very little to limit this broad sweep of protection.

Spin-offs

Both the Directive and the cases discussed above tend to treat substantiality as an absolute concept that does not depend on the economic circumstances in which a particular database is created and sold.¹³³ This has led many European courts to protect databases (for example, telephone directories) that would continue to be produced even if copying were permitted. Although EC officials

* Europe's civil law tradition embraces purely moral arguments involving "rights of authorship" to a much greater extent than common law countries like Canada. Even if copying were shown to be economically efficient, many European jurists might still invoke the Directive to ban it on grounds that it was "unfair" to the "owner." Interview with Jens Gaster dated March 1, 2001.

contacted for this study endorse such a rule,¹³⁴ it goes well beyond the position taken by most database protection advocates in North America.¹³⁵

Some Dutch courts have tried to correct the problem by holding that database investments are not substantial if they are created as a free *spin-off* of other activities. So far, Dutch courts have used this argument to withhold protection from on-line newspapers¹³⁶ and on-line real estate listings.¹³⁷ On the other hand, at least one court has rejected the spin-off theory in a case involving on-line telephone directories.¹³⁸ The spin-off theory has also received limited support in the United Kingdom, where one court has held that “the costs and effort in . . . fixing the date [for a horserace] does not count toward the relevant investment” in data.¹³⁹

The spin-off theory is probably dead in other jurisdictions.¹⁴⁰ For example, French courts have rejected spin-off arguments in cases involving trade fair catalogs¹⁴¹ and parts numbers.¹⁴² A definitive ruling on the spin-off theory will probably require an appeal to the European Court of Justice.¹⁴³

Copying Databases vs. Use of Facts

Intellectual property law has a long tradition of keeping *mere facts* in the public domain so that everyone can use them. The Directive claims to preserve this tradition by protecting users’ right to extract individual facts from databases. In a Dutch case, the tribunal has used this provision to uphold a competitor’s right to extract headlines from an on-line newspaper. According to the court, headlines are not a substantial part of the articles that contain them.¹⁴⁴

For the most part, European courts extend protection to even miniscule collections of facts. For example, a U.K. court has held that the list of horse races for a single week can be protected.¹⁴⁵ Perhaps more importantly, German and U.K. judges frequently stress the fact that individual takings can *become substantial* if they are repeated over time.¹⁴⁶

Competition Policy

Even before the Directive, European courts had wrestled with the conflict between intellectual property rights and competition policy.¹⁴⁷ Many people thought that the Directive — which increased database rights — would aggravate the conflict. One member of the German Supreme Court even published an article warning that *sui generis* rights could be used to stifle competition in data.

European courts have invoked competition policy to undercut database rights on at least three occasions. The first case involved broadcasters in the Netherlands who used their database rights to prevent a newspaper from publishing its own weekly listings. The Dutch court refused to enforce the rights, finding that the broadcasters had previously abused their monopoly position by refusing to license their data to would-be competitors.¹⁴⁸ A second Dutch case

involved a national telephone company's attempt to protect its directories from copying. Although the court ruled in the company's favour, it invoked competition policy to set royalties at a tiny fraction of what had been requested.¹⁴⁹ Finally, the German Supreme Court invoked competition policy in another telephone directories case brought by Deutsche Telekom. The court found that the directories were protected, but went on to warn Deutsche Telekom that it would have to license competitors on reasonable terms.¹⁵⁰

Other European courts have been more hesitant. For example, in a Dutch case, the tribunal rejected the defence because the plaintiff (a large national telephone company) had supposedly licensed its directories to others on "fair and reasonable" terms. Similarly, a French court held that a defendant who had never actually requested a licence could not raise the defence.¹⁵¹

On balance, these cases probably limit — but do not eliminate — database owners' ability to abuse their *sui generis* rights. Since the concept of a *fair and reasonable* price is notoriously ill defined, courts will be hard-pressed to tell the difference between sham offers and genuinely reasonable behaviour.

Other Public Policy Defences

To a greater or lesser degree, all legal systems limit individuals' ability to assert property rights in antisocial ways. However, this is more explicit in European legal systems than in common law. Potential defences include human rights¹⁵² and the public policies behind the Directive.¹⁵³

To date, none of these defences was upheld. At least one Dutch court has declared that human rights do not include *free riding* on another database.¹⁵⁴

Extraterritoriality

The Internet has raised new issues about whether the Directive applies to providers who get no closer to Europe than putting data on a North American server. Although no case has yet addressed the issue, most observers believe that European courts will not assert jurisdiction based on the mere availability of a database over the Internet. However, European courts *would* apply EU laws to firms that "targeted users in Europe and/or the whole world."¹⁵⁵ For this reason, Canadian firms that limit their operations to North America are unlikely to be sued in Europe. The prospects for Canadian firms that do operate in Europe are analyzed in the section entitled *Canadian Choices*.

IS THE EUROPEAN COMMISSION DIRECTIVE WORKING?

DESPITE PROPONENTS' ASSERTIONS that databases have grown "at enormous rates" since the protection went into effect,¹⁵⁶ no formal empirical study of database protection has been performed anywhere in Europe.¹⁵⁷

Proponents admit that their evidence is third-hand. "We see court proceedings," said one official, "not companies."¹⁵⁸

The Directive originally required the EC to complete a study of database protection's effect on the European economy by January 1, 2001.¹⁵⁹ However, the EC allowed this deadline to slip after most Member States failed to pass implementation legislation on time.¹⁶⁰ EC officials hope to begin the study later in 2001, but still have not finalized key details. For example, they do not know who will conduct the study or when it will be completed.¹⁶¹

This section uses three broad classes of evidence to evaluate the Directive's impact on the European database industry. The first part collects anecdotes and interviews describing how individual U.S. and European firms have reacted to the Directive. The second part compares aggregate statistics to see whether the Directive has had a noticeable effect on database production. Finally, the last part tests claimed success stories for post-Directive CD-ROMs and telephone directories against the available evidence.

HAVE INCENTIVES CHANGED?

European Firms

ONE OF THE MOST STRIKING ASPECTS of the U.S. debate over database legislation has been proponents' inability to document instances of substantial copying,¹⁶² let alone identify potential projects that have been deterred by piracy.¹⁶³ Interviews conducted for our study suggest that such stories are similarly scarce in Europe.¹⁶⁴

Biotechnology databases provide an important test case for these assertions because (i) they constitute a tempting, high-value target for would-be copiers, (ii) the EC sees biotech as an important industry, and (iii) commentators and lawyers have publicized the Directive's importance for biotech databases.¹⁶⁵

Interviews conducted for this study show that many European lawyers routinely address *sui generis* rights when counselling clients. This is easy to do, since the required legal judgments tend to be simple and can be implemented by inserting modest changes into existing contract forms.¹⁶⁶ On the other hand, the interviews found no evidence the Directive had persuaded providers to create new databases that would not otherwise exist. Instead, firms seem to be using database legislation as an extra layer of protection for existing products.

North American Firms Operating in Europe

U.S. and Canadian firms operating in Europe face a more difficult choice: (i) move selected operations to Europe and/or accept local partners,¹⁶⁷ or (ii) forego *sui generis* protection entirely. Anecdotal reports claim that a number of U.S. firms have moved database work to Europe in order to take advantage

of EU protections.¹⁶⁸ Interviews conducted for this study (principally in biotechnology) could not confirm this.

In general, it is very hard to know whether a firm that moves operations to Europe would have done so without the Directive. Theory suggests that the Directive will only be effective in cases where the perceived value of *sui generis* rights is large compared to the economic costs and benefits of moving operations to Europe. As pointed out in the section entitled *Databases in the United States and Europe*, these economic costs appear to be substantial. For most providers, the Directive's incentives will usually be small in comparison.

Interviews conducted in the biotechnology sector for this study show that Celera,¹⁶⁹ Incyte¹⁷⁰ and Amgen¹⁷¹ have all considered (albeit briefly) moving operations to Europe in order to obtain EU protection. All three firms decided against it. Instead, they concluded (i) that their existing licences and technical protection methods were already adequate; (ii) that additional protections offered by the *sui generis* right are fairly minimal; and (iii) that their existing *critical mass* in U.S. people and equipment makes re-location impractical.¹⁷² Celera in particular reported that, to a first approximation, the firm was doing exactly what it would have done if the EC Directive did not exist.¹⁷³

HAS PRODUCTION INCREASED?

IF THE EC DIRECTIVE HAS STIMULATED database production, the effects should be visible in the *Gale Directory* listings. This section looks at data for the United Kingdom, Germany and France to examine how the Directive has affected (i) the entry of new providers into the market, (ii) the departure of existing providers, and (iii) the total number of databases available to consumers. Canadian and U.S. data are also summarized for the sake of comparison.

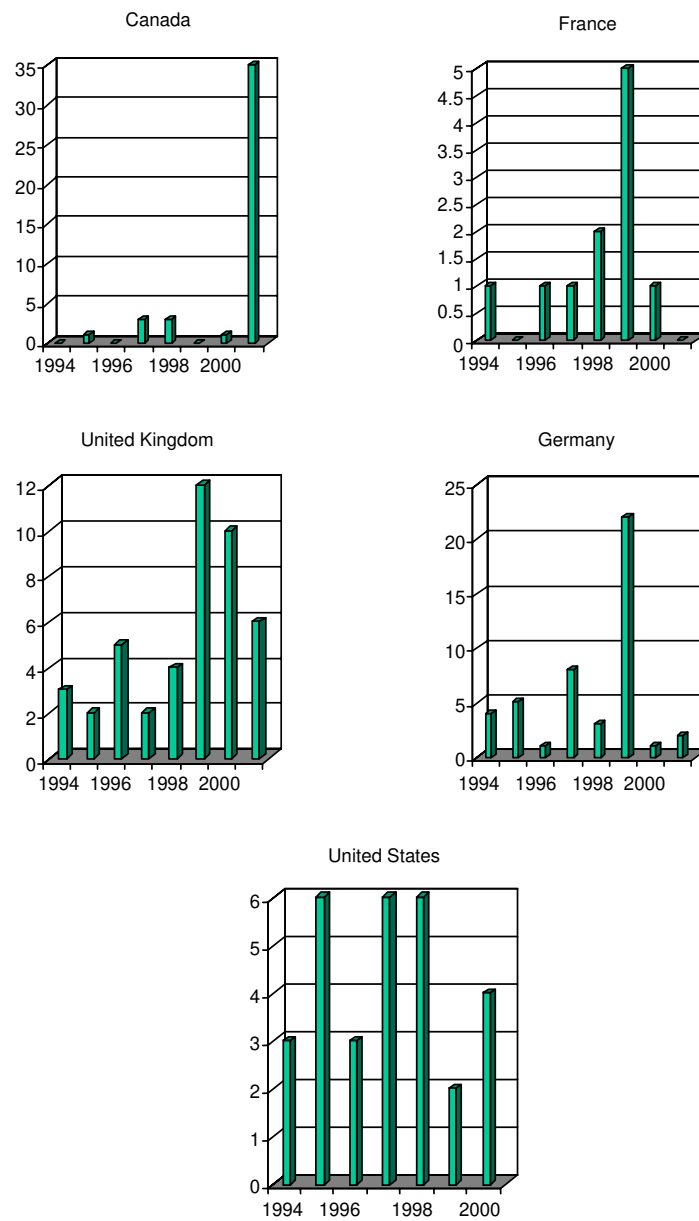
New Entrants

As shown in Figure 1, the number of new providers entering the French, U.K. and German database industries rose sharply in 1999. Because the graphs reflect data published in January of each year, most providers actually entered the market during 1998.* This result is significant because it supports EC claims that the number of database products rose sharply between December 1997 and January 1998. It also suggests that German and U.K. enabling legislation — which became effective on January 1, 1998 — persuaded some new providers to enter the market.

* An informal look at the *Gale Directory*'s June, 1998 edition confirms this interpretation.

FIGURE 1

COMMERCIAL DATABASE PROVIDERS: NEW ENTRANTS



What Figure 1 *does not* show, at least so far, is that the Directive has had a lasting impact on the rate at which commercial providers enter the market. As of 2001, the number of new entrants in Germany, France, and the United Kingdom had returned to pre-1998 levels. This suggests that the 1998 spike was probably a one-time event. Since firms that entered the European market during 1998 are still doing business, the spike has produced a continuing benefit for consumers. Nevertheless, long-term growth has not changed.

Finally, there is the question of timing. Because the Directive *grandfathers* protection to pre-existing databases, it would have been reasonable for new providers to enter the market *before* the United Kingdom and Germany enacted formal implementation legislation in January 1998. Instead, the data shows that most entrants took a wait-and-see attitude. This leaves open the possibility that part — though not all — of the 1998 spike reflects *delayed* entries that would have occurred in 1996-97 had it not been for legal uncertainties created by the Directive.

Attrition

Figure 2, which shows how many commercial firms left the market each year (*Attrition*), is more puzzling. French, U.K. and German database industries all suffered bursts of attrition at some point in 1997. This suggests that the prospect of implementation legislation may have forced a significant number of commercial providers out of the market. The reason for this is obscure. Since many database providers also purchase data, the phenomenon may reflect rising production costs. Alternatively, new database protection may have encouraged the industry to restructure itself through mergers and acquisitions that could not be detected from the *Gale Directory* listings. This would have decreased the apparent number of providers while leaving the industry's physical resources unchanged. As explained in the Appendix, the quoted statistics have been systematically adjusted for known mergers and acquisitions.

Finally, data for more recent attrition rates show no obvious pattern. Post-1997 data suggest that the Directive may have permanently reduced attrition rates in the United Kingdom. However, German data is basically indistinguishable from pre-1997 levels.

Total Existing Databases

Because incentives act on individuals, most of the statistics compiled for this study have focused on producers instead of databases *per se*. However, the health of a particular country's database industry is ultimately measured by the number, quality, variety and affordability of the products that it offers to consumers. Figure 3 summarizes *Gale Directory's* annual report¹⁷⁴ on the number of databases available in England,¹⁷⁵ Germany, France, the United States and Canada. Unlike Figures 1 and 2, *Directory* editors include non-commercial databases in their sample.

FIGURE 2

COMMERCIAL DATABASE PROVIDERS: ATTRITION

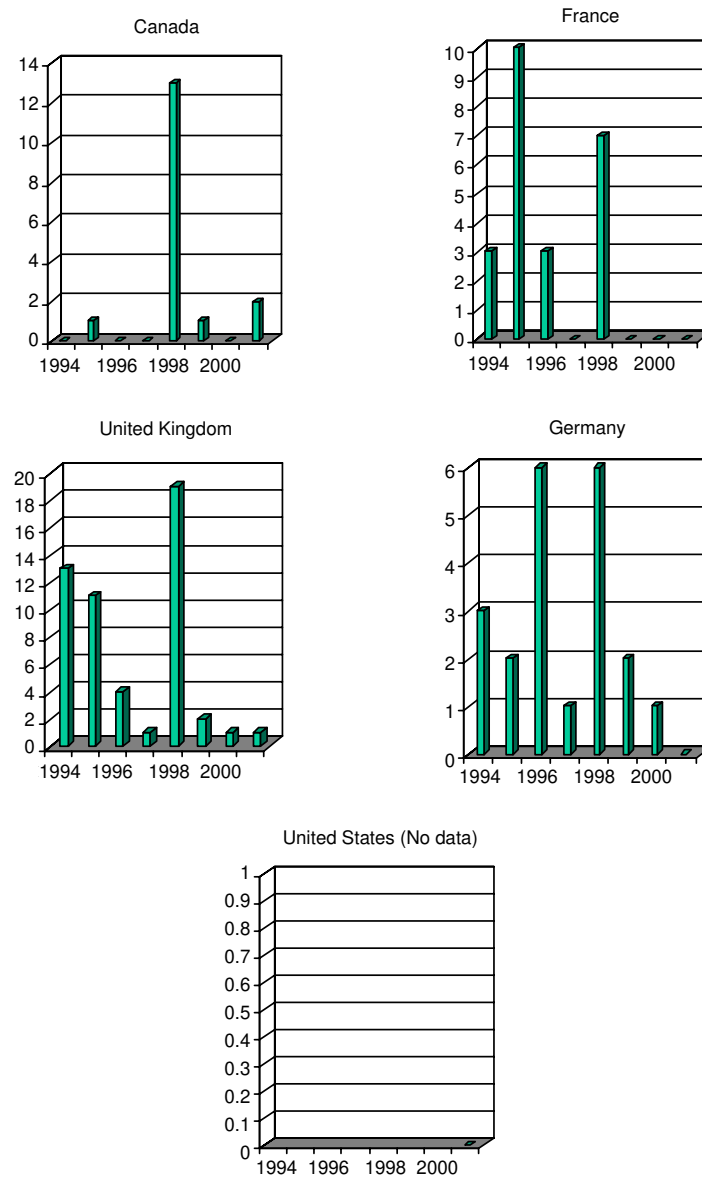
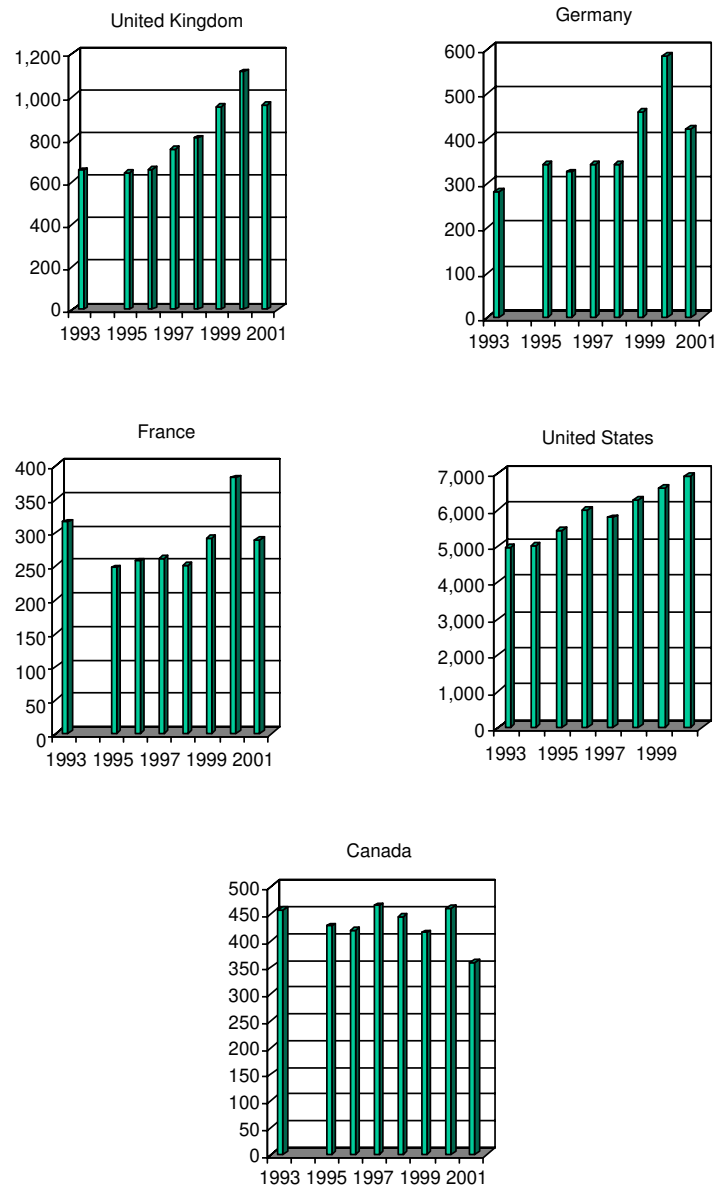


FIGURE 3

NUMBER OF EXISTING DATABASES



Data for the three EU nations show evidence of a one-time spike. In particular, the *Directory's* January 2000 edition reports significantly more databases in 2000 than the year before. This suggests that the total number of databases increased sharply in 1999, one year *after* the number of providers spiked.¹⁷⁶ The reasons for this lag, assuming that it is not an artefact, are unclear.

The fact that the *Directory's* January 2001 edition reported a decline in the total numbers of European databases is also puzzling. One possible explanation is that commercial growth continued, but was masked by an offsetting drop in non-commercial products. If so, it is an open question whether the Directive drove at least some of these providers out of the market by (i) increasing their data acquisition costs, and/or (ii) persuading them to redirect their energies from academic data to more lucrative commercial products.

ANECDOTAL EVIDENCE

PEOPLE CONTACTED FOR THIS STUDY were uniformly unaware of any published studies examining the impact of database protection on Europe.¹⁷⁷ However, EC official Jens Gaster reported that the number of CD-ROMs offered by German and Dutch department stores increased sharply between December 1997 and January 1998. Gaster also indicated that the Directive had not prevented Europe from producing numerous telephone directories.¹⁷⁸

Unfortunately, the EC is keeping the details of Gaster's work confidential. This section tries to evaluate his comments in light of the *Gale Directory* listings and other publicly available data.

CD-ROMs

Figure 4 shows CD-ROM production for each of the five countries studied. Unlike the *Gale Directory* data for on-line databases, CD-ROM production shows no obvious correlation with the enactment of database legislation in January 1998.* To the extent that a trend exists, all five markets suggest that CD-ROM growth peaked in early 1990s and steadily declined thereafter. This interpretation is consistent with anecdotal observations suggesting that CD-ROM production was much more important in the mid-1990s than it is today.

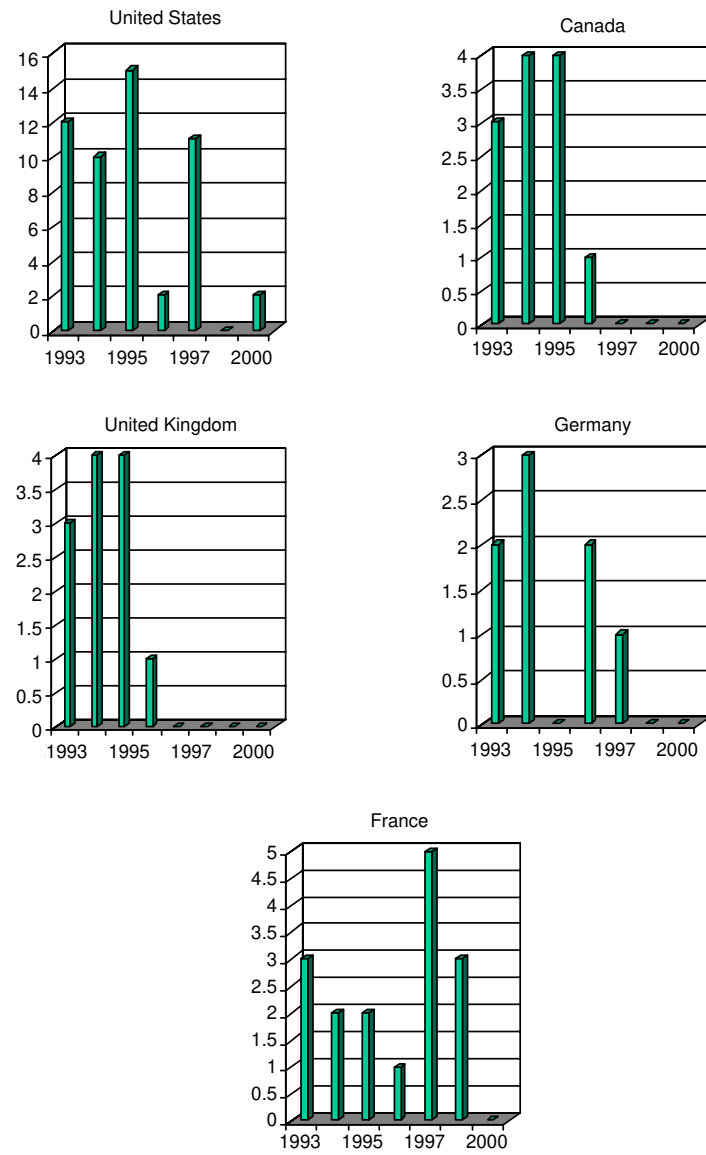
Even though Figure 4 conflicts with Dr. Gaster's observations, the difference may not be important. First, Figure 4 is based on very small data sets. Second, *Gale Directory* listings intentionally exclude many consumer-oriented CD-ROM products.[†] Accordingly, Figure 4 may not be a fair sample of the department store products that Gaster saw in 1997-98.

* The French peak in 1997 involves very small numbers and is not particularly convincing.

† The *Gale Directory's* selection criteria are discussed in the Appendix.

FIGURE 4

CD-ROM PROVIDERS



Telephone Directories

Gaster reported that the Directive had not discouraged the creation of abundant on-line telephone directories.¹⁷⁹ Table 6 tests this claim by listing the telephone directories found under each country in Teldir.com's Web Site.¹⁸⁰

Because Table 6 is limited to current information, it is hard to say whether the Directive has helped Europe to close the gap in on-line directories vis-à-vis North America. It does, however, show that such a gap exists.* It also shows that gaps within the EU are at least as important as those between Europe and North America. The fact that French consumers have just four directories to choose from — two of them official — stands in sharp contrast to the comparatively vibrant output of Germany and the United Kingdom.

Finally, the Teldir listings contain qualitative evidence that telephone companies' ability to charge high prices for *official* listings may have harmed consumers. For example, European directories based on official data often limit the number and/or type of free searches that consumers can perform.¹⁸¹ Conversely, sites based on unofficial data are said to contain many misspelled names, and duplicates, and other errors.¹⁸²

UNINTENDED SIDE EFFECTS

EC REPRESENTATIVES TYPICALLY CITE existing case law for the proposition that "the *sui generis* regime works without difficulties or undesirable side effects"¹⁸³ and "is working well."¹⁸⁴ They also claim that it has avoided producing the types of outcomes that the scientific community warned against.¹⁸⁵ How accurate are such statements?

EXCESSIVE MONOPOLIZATION

ALL INTELLECTUAL PROPERTY RIGHTS create monopolies that foster high prices and create artificial scarcities in knowledge. The question is one of degree. Traditionally, rights that create powerful monopolies (for example, patents) have been granted much more sparingly than rights that do not (for example, trade secrets). How powerful is *sui generis* protection on this continuum?

* North American on-line directories are also more innovative. For example, several products allow consumers to search by subscriber address and/or phone number.

TABLE 6				
ON-LINE TELEPHONE DIRECTORIES				
UNITED STATES	CANADA	UNITED KINGDOM	GERMANY	FRANCE
Switchboard.com	Canada411	Phone Net UK*	TeleAuskunft	Les Pages Jaunes*
AnyWho*	YellowCa	AskAlix	InfoSpace	Les Pages Blanches*
WhitePages.com	Infospace	UK PhoneBook	Yellow.www	Annu
Yahoo	Yellowpage.ca*	Thom.Web	Jokerland Business-Treff	Kapitol
Bigfoot	Alberta.com	Scoot	11880.com	
InfoSpace	NBTel Smart Directory*	Electronic Yellow Pages*	Business Deutschland	
SuperPages*	MyBC.com	The FreePhone Directory		
SmartPages*	QuebecTEL*	GT Online*		
Zip2	MTSInternet YellowPages	UK White Pages		
USWestDex*	MySask.com*	Colour Pages Ltd.		
BellSouth*	Canada.Toll.Free*	192.com		
Sbn.com				
WorldPages				
PhoneGuide				
Internet800 Directory				
Yellowpages.com				
Business Yellow Pages				
Feist Online				
McLeod				
PhoneGuide				
InfoSpace				
Information Xchange**				
Notes : * 'Official' telephone company listings. ** Directory maintained by the U.S. government.				

Individuals' willingness to invest in litigation provides a good proxy for measuring the power of the *sui generis* right. Database law has become a very litigious subject, particularly in the Netherlands and Germany.¹⁸⁶ More importantly, lawsuits are not randomly distributed among database types. Because today's databases cover hundreds of topics, it would have been natural to think that *sui generis* lawsuits would reflect a similar diversity. Instead, litigated cases concentrate on a small handful of database types. These include:

Telephone Directories. Telephone companies have repeatedly brought *sui generis* actions to prevent would-be competitors from creating their own directories.¹⁸⁷ Cases have included white pages, yellow pages, and every conceivable type of telephone book.¹⁸⁸

Stock Market Data. At least one European stock exchange has asserted its database rights to prevent others from copying historical share prices.¹⁸⁹

Sporting Events and Concerts. U.K. football clubs currently have four cases pending to enforce database rights over their own schedules.¹⁹⁰ A horse racing association has also sued to protect its events schedule.¹⁹¹ German courts have extended similar protection to a group of concert organizers which sets dates for classical music concerts.¹⁹²

Parts Numbers. Several European cases involve attempts to sell parts to consumers using competitors' catalogue numbers. One pre-Directive Swedish case held that the numbers — many of which were more than 10-years old — were insufficiently creative to be protected under copyright.¹⁹³ More recently, however, a French court ruled that a do-it-yourself store could use its database rights to prevent competitors from using its catalogue numbers.¹⁹⁴

Trade Fairs. German¹⁹⁵ and French¹⁹⁶ courts have invoked the Directive to protect catalogue data from at least three trade fairs.

Collectively, these categories account for *at least* 50 percent of the 40 or so cases decided so far. At the same time, these databases represent less than 5 percent of all *Gale* entries for the United Kingdom, France and Germany.

What do these cases have in common? Most databases are created by gathering and organizing information that already exists *out in the world*. If a would-be competitor wants to create a database of judicial opinions, for example, it can always visit courthouses and collect copies for itself. By contrast, *synthetic* data like telephone listings, catalogue numbers and concert schedules are arbitrary. The *only* way to acquire them is through copying.

This observation explains why the Directive has made telephone numbers and other forms of synthetic data so valuable. For most forms of intellectual property, independent invention is both legal and practical. This tends to keep

barriers to entry low and prevents intellectual property owners from charging full monopoly prices.¹⁹⁷ The economic importance of this phenomenon is illustrated by patents, which are more valuable than other forms of intellectual property precisely because independent invention is illegal.¹⁹⁸ The situation for synthetic data under the Directive is similar, except that the barriers to independent invention are practical rather than legal. Nevertheless, the end-result — unusually valuable intellectual property rights — is the same.

As explained in the section entitled *European Law*, some European courts have tried to remedy the problem by arguing that the Directive does not apply to databases that were created as *spin-offs* from some other activity. This rule runs counter to the economist's usual instinct that database owners should see a price signal that reflects *all* potential applications and positive externalities. At least in principle, the use of spin-off rules could lead to systematic underproduction of databases.

Despite this criticism, spin-off rules are probably sensible in practice. This is because synthetic data (for example, telephone numbers) are usually worthless unless the owner *already* has significant market power in its core business. Under these circumstances, a rule against spin-offs is usually beneficial because it keeps firms that are already dominant in one field (for example, telephone service or horse racing) from extending their power to another market (telephone directory or pari-mutuel betting). So far, most of the plaintiffs who have sued to protect synthetic data under the Directive fit this description.

Finally, it is worth noting that existing *spin-off* cases all involve databases that were already produced before the Directive. It is reasonable to think that providers will continue to produce these databases whether or not courts extend their power to ancillary markets.

INTERFERING WITH DATA AGGREGATION?

FROM SOCIETY'S STANDPOINT, a well-run database industry should constantly integrate previously disparate materials.¹⁹⁹ Some European firms have used intellectual property rights to block this elementary but vital function:

Television Listings. North American consumers have been able to buy weekly *TV Guides* that list all available broadcasters since the early 1950s. However, Irish broadcasters used copyright to block similar listings until the mid-1990s. More recently, Dutch broadcasters asserted their database rights in an effort to keep non-broadcasters out of the market. The broadcasters lost on appeal.²⁰⁰

Newspaper 'Deep Linking'. The term "deep linking" refers to on-line databases that allow consumers to search for data across multiple competing web sites. Each search produces links to specific, relevant pages. This allows

consumers to visit *hits* directly without having to navigate through underlying web sites. The practice is contentious because it tends to deprive the underlying web sites of consumer traffic and ad revenue. Two recent cases from the Netherlands²⁰¹ and Germany²⁰² involve deep-linking sites that allow users to search multiple on-line newspapers. In the Dutch case, the court held that the Directive did not ban deep linking because the plaintiff's on-line newspapers were a *spin-off* of older, print media operations. The German court rejected this reasoning and found for the plaintiff.

Realtor Deep Linking. Realtors have been powerful advocates of database protection in both the United States and Europe. In a recent case from the Netherlands, a realtors' association attempted to shut down a deep linking site that allowed consumers to search its multiple listing records. The court found the practice legal. A similar case in the United Kingdom was settled out-of-court before a judgment could be handed down.²⁰³

These incidents show that database protection has enhanced database providers' ability to keep data splintered and disaggregated.²⁰⁴ Furthermore, the status of deep-linking sites under the Directive remains unclear. Commentators have suggested that fear of litigation may prevent European firms from imitating U.S.-style Web sites that let consumers compare prices and products offered over the Internet.²⁰⁵ If successful, such challenges could severely limit consumers' ability to find and use databases.*

CANADIAN CHOICES

THE BEST REASON TO ADOPT DATABASE protection in Canada would be if it made good sense domestically. The first part of this section reviews the arguments for and against this proposition. The second part describes some alternatives to European-style protection that might be better suited to Canadian conditions. The third part examines arguments that database protection is needed in order to conduct international trade with Europe. Finally, the last part concludes with some brief final thoughts.

POLICIES FOR A PERFECT WORLD

THE BEST REASON TO PASS DATABASE protection legislation would be that it made good sense for Canada *regardless* of Europe's legislation. This section uses lessons from the EC Directive to examine the likely costs and benefits of adopting European-style protection in Canada. The first part reviews arguments that

* Deep linking could enhance almost all *publisher* databases. According to Table 3c, publishers account for 30 to 50 percent of all commercial database providers.

database protection will foster the growth of the database industry in general. The second part focuses on how new legislation is likely to help or hinder the Canadian database industry's most promising growth segments.

Promoting Growth in General

Based on the limited available evidence, database legislation has probably given the European database industry a one-time *boost* equal to roughly a year's worth of normal growth. On the other hand, database protection has also had significant costs. Examples include:

Excessive Monopolization. All intellectual property rights create monopolies that raise prices and limit output. This implies that legislators should limit new rights to the bare minimum required to make database production worthwhile. By contrast, the Directive has created excessive monopolization in at least three respects. First, it has increased *entry costs* for potential competitors by making copying illegal. This may have been acceptable if producers were keeping a significant number of database projects off the market because they were afraid of piracy. At least within North America, however, there is no empirical evidence that this is true.²⁰⁶ Second, the Directive extends *grandfathered protection* to databases that existed in 1997. This means that producers have received additional incentives for databases that would have been available in any case. Third, the Directive has extended *extra-high incentives* to providers of telephone numbers and other forms of synthetic data. Most of these providers (for example, telephone companies, sports leagues and concert promoters) already have considerable market power.

Impeding Data Aggregation. From the standpoint of society, data aggregation is one of the most valuable services that a database can perform. It is therefore troubling that firms have used the Directive to block *deep linking* and other forms of data aggregation.

Litigation Costs. In principle, the EC could mitigate excessive monopolization and impediments to data aggregation by modifying the Directive.²⁰⁷ However, even weak laws can have significant economic effects. This is because many would-be competitors do not have the resources and/or determination to challenge shaky legal claims in court.*

* The point is particularly well-illustrated by the TV listings cases. The defendant in *Magill* had to take its case all the way to the European Court of Justice before it was allowed to publish unified TV listings in Ireland. Similarly, Dutch broadcasters conducted extensive litigation before would-be competitors gained access to their data. Bernt Hugenholtz (personal communication).

Anticommons Effects. The likelihood of negotiating a successful business transaction declines with the number of parties who can veto it. Even though database legislation is designed to create incentives, it also increases the number of parties who hold vetoes. Scholars call this the “anticommons” effect.*

Impact on Non-commercial Providers. This study has repeatedly pointed out that many of Canada’s most useful databases are non-commercial. At best, database legislation is irrelevant to these providers. More realistically, database protection will probably (i) increase providers’ costs by forcing them to pay for data that can currently be obtained without charge, and (ii) encourage public providers to commercialize their data to the detriment of the public.

Canadian policymakers might judge these costs acceptable if (i) European database protection had generated substantial benefits, (ii) Canada’s database industry was sluggish or under-commercialized, and/or (iii) fear of copying had deterred Canadian providers from creating new databases. So far, however, none of these conditions seems to exist.

Promoting Targeted Growth

Even if EU-style legislation did nothing to stimulate Canadian database production in general, it could still be worthwhile if it removed bottlenecks to growth in key markets. How will database legislation affect the particular growth opportunities identified earlier in the section entitled *The Canadian Database Industry*?

The answer, in most cases, is not at all. For example, *business intelligence* reports and newsletters are already well-protected by copyright. Similarly, U.S. *small gatherers* have shown that it is possible to specialize in covering North America and/or specific worldwide industries without database rights.

In other areas, new database legislation is likely to be counterproductive. This is particularly true for Canadian firms trying to build innovative *bioinformatics* and *small science* databases. Practically all of these projects will need access to large numbers of small (often academic) data sources. Experience in biotechnology suggests that anticommons problems will raise severe obstacles in this environment.²⁰⁸ Creating new rights will only make the situation worse.

* The term “anticommons” is a play on words. Introductory economics students are usually taught about the “Tragedy of the Commons,” in which society’s failure to give peasants individual property rights led to overgrazing and destruction of shared pastures. The anticommons paradox points out that property rights in certain fields — notably biotechnology — can be equally counterproductive. The term was coined by M.A. Heller and R.S. Eisenberg in *Science* 280:698 (1998).

New database legislation is also likely to have a negative impact on Canadian *space imaging* firms. In order to prosper, vendors need convenient, affordable access to (i) high resolution U.S. commercial images and (ii) complementary data sets including low resolution (wide area) images, historical comparison images, tax and land records, marketing data, and the like. Additional property rights would make both halves of this problem harder. Furthermore, high-resolution space images are already a U.S. duopoly. Creating additional property rights will only enhance U.S. firms' ability to raise prices and otherwise restrict users' access to raw images.* Finally, there are already signs — particularly in the government sector — that tax, property and other essential records are suffering from anticommons effects.²⁰⁹ New database rights would further aggravate this situation. Given the fact that Canada already has a strong track record in space imaging, changing the rules at this point seems foolhardy.

ROOM FOR COMPROMISE?

The INS Approach

THE EC DIRECTIVE'S *SUI GENERIS* RIGHT gives owners an absolute right to prevent copying regardless of the circumstances.[†] This type of *property right* approach tends to be clear-cut, predictable and relatively easy to administer. However, it only works in situations where most real world situations can be correctly resolved by a single, uniform rule. As noted in the previous section, this may not be true.

As explained in the section entitled *Database Protection in North America*, some courts have developed a radically different approach to database protection. Under the *unfair competition* or *INS* approach, courts make a case-by-case determination of whether copying should be allowed. In theory, this approach is flexible enough to accommodate different circumstances. In practice, however, transaction costs may be prohibitive. Such costs include (i) *ex ante* uncertainty as to whether a particular act of copying is or is not legal, (ii) increased opportunities for threatening and/or bringing baseless lawsuits, and (iii) increased litigation costs for parties and courts alike.

On balance, the *INS* approach would be a good compromise in a world where database piracy (i) is too rare to justify sweeping property rights, but (ii) is nevertheless a significant impediment to new database production.

* Because space images already receive significant protection from copyright and contract law, this effect may be modest. Nevertheless, it is a step in the wrong direction.

† As previously noted, European law sometimes limits the database right when it is used in ways that are anticompetitive or against public policy. Nevertheless, the concept of an absolute property right is still a good way to think about the subject.

For now, there is little or no empirical evidence that condition (ii) is satisfied.²¹⁰ Under such circumstances, *no statute* may be the best solution of all.

Other Proposals

Scholars associated with the U.S. debate over database legislation have analyzed a wide spectrum of possible statutes.²¹¹ Almost all of these proposals combine different elements of the *property rights* and *unfair competition* approaches discussed above. Clever drafting may minimize, but is unlikely to eliminate, the weaknesses inherent in each approach.

POLICIES FOR A CROWDED WORLD

A Skeptical Look at the EU's Threat

EVEN IF CANADA AND THE UNITED STATES fail to pass *sui generis* legislation, it is far from certain that the EU will carry out its threat to discriminate against foreign vendors. At a minimum, any attempted discrimination would quickly lead to diplomatic wrangling. The EU might well back down at this point. For now, there is no way to tell.

More importantly, the evidence presented in this study suggests that sanctions will not matter in any case. The reasons for this are:

Limited European Revenues. Most Canadian database providers earn their revenues in Canada. EU policies are not likely to affect them.

The 'Localness' of Large Gatherers. Most North American firms operating in Europe are large gatherers. Since large gatherers usually maintain a physical presence in places where they collect data, they automatically qualify for protection under the Directive.

Availability of Other Protection. Because small gatherers, publishers and refiners typically have strong economic incentives for conducting operations at a single *center of mass*, they may not qualify for protection under the Directive. On the other hand, interviews conducted for this study suggest that most North American firms operating in Europe are already content with their existing copyright, contract and/or business method strategies. Protection under the Directive may be desirable, but it is not essential.

The Local Content 'Safety Valve'. Despite the foregoing, it is possible — though far from certain — that a few firms will decide that the Directive's protections are important. These providers can *purchase* protection by entering into local partnerships and/or moving selected operations to EU countries. This option will remain available whether or not Canada passes database legislation.

On balance, European threats are a poor reason to pass database legislation. There may be instances where foreign pressure might lead Canada to pass laws against its best domestic interests. Database legislation is not one of them.

Local Content Strategies

As previously noted, many observers view Europe's threatened discrimination against Canadian and U.S. database providers as a thinly-disguised effort to force local content. In principle, Canada could adopt *sui generis* legislation in order to pursue its own *local content* strategy against the United States and other countries.

In practice, such a strategy would almost certainly fail. Despite Europe's enormous market, few (if any) firms have decided to re-locate operations in order to obtain *sui generis* rights. It is hard to see how Canada — with its much smaller market — can do better. Furthermore, a Canadian local-content rule would almost certainly violate NAFTA.

CONCLUSION

THREE YEARS AFTER THE EC DIRECTIVE went into effect, there is still very little evidence on the costs and benefits of Europe's database protection experiment. Although EC officials claim that the Directive is working, the empirical basis for these assertions is limited. Worse, it remains confidential. Until the EC produces backup data, Canadian policymakers should not take such assertions on faith.

The current study confirms that the Directive may have given the European database industry a one-time boost equivalent to roughly a single year's worth of normal growth. However, this benefit has been purchased at the cost of serious — and more or less permanent — side effects including excessive monopoly, disruption of data aggregation and increased transaction costs.

Canada's existing laws have produced a successful database industry with significant growth potential. Furthermore, there is little or no evidence that protection gaps exist or, if they do, that they have hampered the creation of new databases. Whether or not Europe carries out its threat to discriminate against North American firms, the consequences for Canadian business overseas are likely to be minimal. For now, Canada's best option is to wait and see. If the EU wants Canada to pass database legislation, it can and should release the hard data needed to support its case. In the meantime, Parliament should resist being stampeded into imitating legislation that has produced such ambiguous outcomes in Europe.

APPENDIX

THIS STUDY HAS PRESENTED a quantitative profile of the Canadian, U.S., U.K., French and German database industries based on an informal census of 1,164 providers that operated between 1993 and 2001. This census was, in turn, adapted from raw data found in a leading industry catalogue called the *Gale Directory of Databases*. This Appendix explains how the census was produced. Possible sources of error are also briefly discussed.

UNDERLYING DATA

THOMSON'S GALE RESEARCH UNIT has published its *Gale Directory of Databases* twice a year since January 1993. Volume 1 of the *Directory* is limited to on-line database products, while Volume 2 is devoted to physical formats like CD-ROMs and diskettes. Although the *Directory* contains extensive information about database providers, most entries are indexed and organized by product. In particular, raw entries do not account for (i) instances in which one provider offers multiple products, (ii) instances in which multiple providers distribute the same product, (iii) instances in which two nominally separate providers appear to be functionally identical, (iv) instances in which pre-existing providers merge or are spun off from one another, and (v) instances in which products are distributed in multiple formats leading to redundant listings under Volumes 1 and 2. Furthermore, the *Directory* only reports some categories of information sporadically or partially. Examples include (i) the date that a particular product was introduced in the market, (ii) the date that a particular product is withdrawn from the market, (iii) whether a particular provider is part of government, academia or the commercial sector, and (iv) whether a particular product is mainly produced for export, domestic use or a combination of the two.

Like any resource, the *Gale Directory* is incomplete. In many cases, this reflects intentional editing choices that are readily apparent to anyone using it:

Restricted to Electronic Databases. The *Gale Directory* is restricted to databases that are published on-line and/or through other electronic media such as diskettes and CD-ROMs. It does not cover databases that appear solely in print. Given the ubiquity of on-line data, this restriction is probably not important.

Restricted to 'External' Databases. Many businesses construct large sophisticated databases for in-house use. For example, Napster devotes a large fraction of its operating budget to compiling a database of music held by clients. Since Napster does not sell this data to outside firms, the *Gale Directory* ignores it. Fortunately, in-house databases — though economically

important — are practically invulnerable to copying and therefore have little bearing on protection legislation.

Limited Coverage of 'Low-end' Databases. The Web contains an enormous number of databases ranging from trivia lists to product catalogues to self-published data by academic scientists. Although most of these resources are small and informal, some reflect substantial commercial investments. Examples include movie databases that are used to build *traffic* for on-line video stores.²¹² The *Directory* makes little or no attempt to track such sites.

Limited Multimedia Coverage. The *Gale Directory* does not cover multimedia products unless they are educational.²¹³ At least for the purposes of our study, this is unfortunate. Some European observers believe that the EC Directive was largely motivated by the perceived U.S. dominance on CD-ROM products during the early 1990s.²¹⁴ Furthermore, Jens Gaster's informal survey of Belgian and German department stores was probably weighted toward such materials.

Limited Coverage of 'High-end' Databases. The *Gale Directory* coverage focuses on databases that serve mass audiences at moderate prices (< \$US 10,000). This excludes some of the most important — and, from a policy standpoint, interesting — vendors. Examples include Carterra (custom space images) and Celera (genome data).

Beyond intentional editing choices lies the question of whether the *Directory* is biased or incomplete. According to the *Directory*'s current editor, *Gale* editors routinely attend the U.S.'s National On-Line Trade Fair to identify new vendors. Based on this and other activities, coverage of U.S. (and, to a lesser extent, Canadian) providers appears to be fairly complete. The *Directory*'s completeness can also be assessed against databases previously identified in independent case studies. Based on previously published work,²¹⁵ *Gale* entries for large chemistry, nuclear physics, and genomics databases appear to be reasonably complete. Consistent with *Gale*'s editorial preferences, small Internet databases maintained by individual scientists or labs are rarely included.

The coverage of Europe is less certain. According to its editor, the *Directory* tries to ensure that major European countries are "proportionally represented."²¹⁶ Despite repeated requests, I was unable to find out what search strategies are used to identify new European databases. However, I was able to confirm that the *Directory*'s editors perform cross-checks against other, similar catalogues (for example, *Nordguide*).²¹⁷

In the end, the question of how efficient the *Directory* is at identifying new European databases is less important than how much its efficiency *changes* from year to year. Conversations with current and former editors confirm that *Gale*

employees have sometimes made special efforts to increase the *Directory's* European coverage.²¹⁸ The employee who edited the *Directory* in 1998-99 could not remember any efforts that might explain the *spike* in new European commercial providers during that period.²¹⁹

METHODS

DATA FOR THE CENSUS WERE EXTRACTED from *Gale's* January (later, March) editions for 1993-2001. The census lists all databases providers who existed in Canada, the United Kingdom (England, Wales and Scotland), France and Germany in 1993 and/or 2001. Because of size, U.S. databases were sampled by studying every 10th entry in *Gale's* 2000 catalogue.

Data Fields

The census lists three items for each provider: (i) the provider's name, (ii) a description of the provider (for example, "commercial," "trade association," "government," etc.), and (iii) the date on which the provider first appeared in — or disappeared from — the *Gale Directory*. The census also lists three additional items about each provider's database(s) including (iv) a description of the contents, (v) whether the subject matter is primarily *local*, and (vi) the language(s) in which the database is offered. Each field is discussed separately below:

Provider Name. *Gale* entries contained three distinct sources of overlap and duplication. These were addressed as follows:

Duplicate Products. The *Gale Directory* has duplicate entries for providers who offer their databases in more than one format. The census eliminates this practice by compiling a core list of on-line providers. Providers who *only* publish their products on CD-ROMs or other physical media are listed separately.

Overlapping Entities. Many *Gale* entries describe sister entities that produce identical or closely similar versions of the same product. The census combines these listings under a single heading.

Mergers and Re-organizations. Many organizations were merged, acquired, re-named, or otherwise reorganized during the eight years covered by the census. These changes could often be detected by close examination of the *Directory*. In these cases, the census continued to list original entity names as if no reorganization had occurred.

Provider Description. The *Directory* rarely identifies provider status (for example, governments, corporations, university scientists, etc.) directly.

However, this information is usually apparent from the context. Cues included but were not limited to designations such as “corp.,” “inc.,” “ltd.,” and their French/German equivalents; Internet addresses ending in “.com” or “.org”; and job titles for listed contact individuals. German and, in particular, French listings are noticeably more ambiguous than their Canadian, U.S. and British counterparts. No assignment was made in cases where a reasonable inference turned out to be impossible. All quoted statistics are based on samples that exclude such cases. In a few cases, inferred provider types were checked against Web site descriptions to obtain further information and to verify the accuracy of inferences. The methods appear to be reasonably accurate.

Appearance/Disappearance Date. A few *Directory* listings specify the year in which a particular database was first offered for sale. When this information is not available, the date is assumed to be the first year in which the database appeared in the *Directory*. In instances where the two methods can be compared, *Gale* editors usually — but do not always — seem to identify new databases within a year or two. Attrition data is based on the date when a previously-listed database first disappears from the *Directory*’s listings. The data is believed to be fairly accurate since *Gale* editors routinely check the continued availability of databases twice each year. The chief source of error involves providers who seem to disappear because of mergers, name changes and/or a change of media (for example, switching from *on-line* to *CD-ROM*). This source of error was minimized by cross-checking providers who disappeared against putative *new entrants* for the same year.

Database Contents Description. *Gale* entries are typically one to three paragraphs long. Unless otherwise noted, all database descriptions found in this study are based on these descriptions.

Local Interest Content. The amount of local content in a particular database is based on the *Gale Directory*’s descriptions and was unambiguous in most cases. Examples of local content include credit reports, legal opinions and marketing data. Examples of international content include scientific databases and worldwide business coverage. Databases that offered a mixture of local and non-local content or regional coverage (for example, United States/Canada or German-speaking countries) were listed as “Both.”

Language. The language(s) used in a particular database is expressly recorded in most *Gale Directory* entries and this information was easy to infer in the few cases where it had been omitted.

FUTURE DIRECTIONS

WHILE DESIGNED TO BE QUALITATIVELY CORRECT, the current comparison of Canadian, U.S., U.K., German and French databases providers is necessarily informal and tentative. More formal statistical studies are urgently needed.

ENDNOTES

- 1 Directive 96/6/EC of the European Parliament and of the Council of 11 March 1996 on the legal protection of databases, at Art. 1(1).
- 2 Typical examples include Swiss Prot protein data (sliding scale to \$90,000/year) and the Swetscan database of the Canada Institute for Scientific and Technical Information (CISTI) (\$4,500/year).
- 3 See McIlrath, 1999, explaining the American Physical Society's efforts to keep its journals affordable.
- 4 See Butler, 1999.
- 5 Additional information about ISI can be found at <http://www.isinet.com/isi/products/index.html> (accessed 22 April 2005). Information about Ovid Technologies can be found at <http://www.ovid.com> (accessed 22 April 2005).
- 6 Most of LEXIS's geographic libraries (as for California or the United Kingdom) are produced in-house by employees who are physically located in the covered regions. Corrin Gee-Alvarado, personal communication. According to the *Gale Directory*, LEXIS's French library is produced in cooperation with a local firm called Lamy. Dun & Bradstreet collects information in 209 countries around the world, covering 186 currencies. www.dnb.ca/pdf/D&B_GeneralBrochure.pdf.
- 7 One of the best examples of this phenomenon is Jane's, which began as a U.K. firm studying world naval developments at a time when Britain had the largest Navy in the world. Although Jane's still produces defence industry databases, almost all of its current products are compiled in the United States. Apparently, Jane's found it cost-effective to follow post-war defence spending to Washington.
- 8 For example, the Gale Group performs all of the research for the *Directory* in the United States. However, the firm maintains sales offices in Canada and the United Kingdom. (Erin Nagle, personal communication.)
- 9 Blue Angel Technologies has developed a large (approximately 200 members) network for the U.S. Geological Service. Incyte's Genomic Knowledge Platform software will perform a similar function for biology networks.
- 10 The nexus is particularly clear for businesses like Lloyds (worldwide ship registry and casualty information) and Jane's (worldwide military systems), which were already dominant firms under the Empire.
- 11 Business intelligence providers include *The Economist*, *The Financial Times*, *Mondaq, Inc.* (business legislation and regulation), and *Oxford Analytica*. The latter offers daily articles on politics and economics; users are required to keep the articles confidential for six months.

- 12 Harlan Onsrud, personal communication. According to the *Gale Directory*, the British government also privatized several nuclear science and engineering databases.
- 13 See, for example, <http://www.fiz-karlsruhe.de/> (accessed 22 April 2005).
- 14 Jonathan Putnam, personal communication.
- 15 See, for example, Reichman and Samuelson, 1997.
- 16 The quoted decline would be 15 percent if the 16 University of Alberta providers that closed down between 1994 and 1995 were counted separately.
- 17 Canadian users of geospatial data were particularly prominent in conferences hosted by the U.S. National Academy of Sciences' Committee on Geophysical Data at Santa Barbara (CA), in August, 1999, and the American Association of Geographers *Driven by Data Conference* at Los Angeles (CA), in November 1999. See also interview with Bob Stewart dated November 2, 1999 (Prince Edward Island firm that gathers and refines *hyperspectral imaging* data for mineral exploration and other clients.)
- 18 The National Research Council and CISTI have used a *business approach* to market their data since 1993. CISTI currently processes 3,500 requests per day. www.nrc.ca/cisti/bacr/about_e.shtml.
- 19 Interview with Ramin Cyrus dated January 13, 2001. Cyrus remarked that the University of Toronto hosts several world class biotechnology institutions.
- 20 See Saviotti, deLooze, Michelland and Catherine, 2000.
- 21 Idem.
- 22 Interview with Mark Mooney dated February 15, 2001.
- 23 Interview with Lee Bendegkey dated January 30, 2001.
- 24 See Saviotti, deLooze, Michelland and Catherine, 2000.
- 25 See, for example, Stephen Maurer, invited talk at the Second Annual U.S. Committee on Data for Science and Technology (CODATA) Conference (Washington, D.C., 2000), available at: http://books.nap.edu/html/codata_2nd/ (accessed 22 April 2005).
- 26 Microarrays are a new technology that allows researchers to measure the expression level of up to 100,000 genes on a single glass chip. In order to extract information on gene function, researchers will eventually need data from hundreds of thousands of arrays. So far, the required databases do not exist. Human mutation databases can be used to distinguish medically-irrelevant portions of the genome from loci that have commercial research value. Once again, a unified seamlessly searchable data set is urgently needed.
- 27 See Abrams, 1998.
- 28 My discussion of Canadian law follows Robert Howell's report prepared for Industry Canada; see Howell, 1998; see also Knopf, 1999.
- 29 *Slumber-Magic Adjustable Bed Co. Ltd. v. Sleep-King Adjustable Bed Co. Ltd.* (1984), 3 C.P.R. (3d) 81, at 84 (B.C.S.C.); but see *British Columbia Jockey Club v. Standen* (1985), 8 C.P.R. (3d) 283 (B.C. Ct. App.) (defendant infringed copyright by extracting data from horse racing form for use in a competing product).
- 30 *Pool v. Panwar* (1993), 50 C.P.R. (3d) 396, 402 (B.C.S.C.).
- 31 *Editions Hurtubise HMH Ltée v. CEGEP André-Laurendeau* (1989), 24 C.I.P.R. 248 (Quebec S. Ct.) (translation from Howell, 1998).

- 32 *Boutin v. Bilodeau* (1994), 54 C.P.R. (3d) 160 (S. Ct.).
- 33 See, for example, *U&R Tax Services Ltd. v. H&R Block Canada Inc.* (1995), 62 C.P.R. (3d) 257, 264 (F.C.T.D.) (“sweat of the brow” rule used to hold tax form copyrightable); *British Columbia Jockey Club*, *supra*.
- 34 *Feist Publications Inc. v. Rural Telephone Service Co. Inc.*, 499 US 340 (1991).
- 35 *Idem*, pp. 342-345.
- 36 *Idem*, p. 344.
- 37 *Idem*, p. 348.
- 38 *Idem*, pp. 352-353.
- 39 *North American Free Trade Agreement Implementation Act*, 1993, c. 44, s. 53(3).
- 40 *Tele-Direct (Publications) Inc. v. American Business Information Inc.* (1997), 76 C.P.R. (3d) 296, 310 (F.C.A. 1997).
- 41 See, for example, *Key Publications Inc. v. Chinatown Today Publishing Enterprises Inc.*, 945 F.2d 509, 514 (2d Cir. 1991) (selection of businesses to be included in directory “was in no sense mechanical, but involved creativity . . . in deciding which categories to include and under what name”); but see *Warren Publishing Inc. v. Microdos Data Corp.*, 52 F.3d 950 (11th Cir. 1995) (taking facts from an “external universe of existing material” and arranging them according to an idiosyncratic list of “principal communities” was insufficiently creative to qualify as a copyrighted compilation); *Bellsouth Advertising & Publishing Corp. v. Donnelly Information Publishing Inc.*, 999 F.2d 1436, 1441 (11th Cir. 1993) (fact that company’s telephone directory limited entries to subscribers living within a certain region on or before a particular closing date did not satisfy *Feist*).
- 42 See, for example, *Warren Publishing*, *supra* (“content of datafields” was “merely fact[]” and not copyrightable); *Skinder-Strauss Associates v. Massachusetts Continuing Legal Ed. Inc.*, 914 F.Supp. 665, 675 (D. Mass. 1995) (bare fact that defendant copied information from plaintiff’s directory did not establish copyright violation); *Cable News Network Inc. v. Video Monitoring Services of America Inc.*, 940 F.2d 1471 (11th Cir. 1991) at 1485 (copyright in news broadcast only extended to compilation as a whole; individual news segments remained “factual in nature” and unprotected), vacated on other grounds, 949 F.2d 378 (1991).
- 43 *Mason v. Montgomery Data Inc.*, 967 F.2d 135, 139 (5th Cir. 1992); *Nester’s Map & Guide Corp. v. Hagstrom Map Co.*, 796 F. Supp. 729, 733-34 (E.D.N.Y. 1992) (directory that approximated street addresses so that they would be easier to remember was copyrightable); *CCC Information Services Inc. v. MacLean Hunter Market Reports Inc.*, 44 F.3d 61, 67 (2d Cir. 1994) (price estimates based on “professional judgment and expertise” rather than “reports of historical prices” or “mechanical derivations of historical prices or other data” were copyrightable).
- 44 *Ital-Press Ltd. v. Sicoli* (1999), 86 C.P.R. (3d) 129, 165.
- 45 *CCH Canadian Limited v. Law Society of Upper Canada*, slip op. (November 9 1999) described in Knopf, 1999.
- 46 *International News Service v. Associated Press*, 248 US 215 (1918).
- 47 *Idem*, p. 236.
- 48 *Idem*, p. 241.
- 49 See Brown, 1997 (citations omitted). In 1942, a federal judge argued that *INS* would have been decided differently if it had been heard in that year. *Idem*, p. 78.

- 50 *Feist, supra*, p. 354 (distinguishing *INS* as having been decided “on non-copyright grounds that are not relevant here.”).
- 51 *National Basketball Assn. v. Motorola Inc.*, 105 F.3d 841 (2d Cir. 1997).
- 52 *MacDonald v. Vapor Canada Ltd.*, [1977] 2 S.C.R. 134.
- 53 The *Trade-Marks Act* provides, in relevant part, that “No person shall . . . do any other act or adopt any other business practice contrary to honest industrial or commercial usage.” *Trade-Marks Act*, R.S.C. 1985, c. T-13, *tel que modifié*.
- 54 *MacDonald, supra*, pp. 156 and 172-173.
- 55 *Westfair Food Ltd. v. Jim Pattison Industries Ltd.* (1989), 26 C.P.R. (3d) 28, 48-49 (B.C. Super.) *aff’d.* on other grounds (1989), 68 D.L.R. (4th) 481, 488 (B.C. Ct. App.). The Court of Appeal refused to decide whether *INS* was good law in British Columbia. Instead, the Court held that plaintiff had not proven enough facts to establish an *INS* claim even if it existed.
- 56 See, for example, Howell, 1998, pp. 40-43.
- 57 *ProCD Inc. v. Zeidenberg*, 86 F.3d 1447 (7th Cir. 1996). The *ProCD* court explained that its decision should not be understood as “adopting a rule that anything with the label ‘contract’ is necessarily outside the preemption clause.” *Idem*, p. 1455.
- 58 *Vault Corp. v. Quaid Software Ltd.*, 847 F.2d 255 (5th Cir. 1988).
- 59 Interview with Lee Bendegkey dated January 30, 2001.
- 60 See, for example, U.S. National Research Council, 1999.
- 61 Interview with Ramin Cyrus, Dan Mazella and Dick Bartlett dated January 13, 2001.
- 62 See, for example, U.S. National Research Council, 1999.
- 63 *Idem*.
- 64 *Idem*.
- 65 Interview with Ramin Cyrus, Dan Mazella and Dick Bartlett dated January 13, 2001.
- 66 See, for example, Maurer, 2000a, and Maurer, 2000b.
- 67 Interview with Ramin Cyrus, Dan Mazella and Dick Bartlett dated January 13, 2001.
- 68 See Maurer, 1999, available at www.nas.edu; I am indebted to the late Jack Brown for the memorable phrase that database observers “are selling the updates.”
- 69 See, for example, interview with Ramin Cyrus, Dan Mazella and Dick Bartlett dated January 13, 2001; interview with Lee Bendegkey dated January 30, 2001.
- 70 Before the rise of electronic databases, most of the world’s public domain clip art was supplied by a single firm, Dover Books. See [http://www.doverbooks.co. uk/](http://www.doverbooks.co.uk/) (“largest collection of copyright-free images and illustration references in the world”) (accessed 22 April 2005).
- 71 See, for example, Benkler, 2000; see Maurer, 1999.
- 72 “Basic Proposal for the Substantive Provisions of the Treaty on Intellectual Property in Respect of Databases to be Considered by the Diplomatic Conference” dated August 30, 1996. Unlike the Directive, the proposed WIPO treaty would have limited individual countries’ ability to create exclusions for scientific data. *Idem*, Art. 5(1). The draft also left open the possibility that the database right

- might extend 25 years instead of the 15-year period contemplated by the Directive. *Idem*, Art. 8.
- 73 See Kaiser, 1996.
- 74 For a review of these issues, see Benkler, 2001; See also U.S. Copyright Office, 1997.
- 75 The leading articles are Reichman and Uhler, 1999, and Reichman and Samuelson, 1997.
- 76 The complete text of HR 354 (*Collections of Information Antipiracy Act*) can be found at <http://thomas.loc.gov/home/search.html>.
- 77 The complete text of HR 1858 (*Consumer and Investor Access to Information Act of 1999*) can be found at <http://thomas.loc.gov/home/search.html>.
- 78 The current UCITA draft can be found at http://www.law.upenn.edu/bll/ulc/ulc_frame.htm.
- 79 See UCITA §§ 105 ("Relations to Federal Law; Fundamental Public Policy") and 111 ("Unconscionable Contract or Term") and comments thereto.
- 80 For the current debate over UCITA, see <http://www.cpsr.org/program/UCITA/ucita-fact.html>. Critics charge that UCITA, which was heavily influenced by Microsoft and other large e-commerce vendors, is anti-consumer.
- 81 Because the current debate over database protection centers on the EU and North America, the current study has focused on these regions. Readers interested in other parts of the world should consult Codoni, 2000; Lavizzari, 2000; Deans, 2000 (Hong Kong law); and Reichman, 1997, available at <http://www.house.gov/judiciary/41121.htm> (Japanese law). Brief descriptions of the law in Brazil and Mexico can be found in Mille, 1999, at <http://ecommerce.wipo.int/meetings/1999/papers/docs/mille.doc>.
- 82 Because most decisions are unpublished, I have relied heavily on interviews with European scholars Bernt Hugenholtz, Jasper Bovenberg, Christian Auinger, and Jens Gaster. Dr. Gaster and Dr. Hugenholtz are both working on updated survey articles that should appear later this year.
- 83 See Reinbothe, 1999 (available at <http://ecommerce.wipo.int/meetings/1999/papers/reinbothe.html>). Jens Gaster confirmed this account, adding that unfair competition approaches would probably work better in a large integrated market like the U.S. Interview with Jens Gaster dated March 1, 2001.
- 84 Council Directive No. 96/9/EC, O.J.L 77/20 (1996).
- 85 *Idem*, Art. 1, ¶ 2.
- 86 *Idem*, Art. 5, subpart (a).
- 87 *Idem*, Art. 5, subpart (b).
- 88 *Idem*, Art. 5, subparts (c)-(e).
- 89 *Idem*, Art. 7, ¶ 1.
- 90 *Idem*, Art. 10, ¶ 2.
- 91 *Idem*, Art. 10, ¶ 3; see also Rees, 1998, p. 63 (discussing U.K. implementation legislation).
- 92 EU Council Directive, *supra*, Art. 14(3); see also Gaster, 2000; and Hugenholtz, 2001a.
- 93 *Idem*, ¶ 56.

- 94 Interview with Jasper Bovenberg dated January 5, 2001; see also Rees, 1998, p. 63 (discussing U.K. implementation legislation). Rees adds that any collaboration should be structured as a partnership or joint venture in order to prevent the European collaborator from becoming a *sub-contractor* (i.e. non-author) under Recital 41 of the Directive.
- 95 See Rees, 1998, p. 64.
- 96 See Gaster, 2000.
- 97 Idem.
- 98 See European Court of Justice opinion in Case C-384/99 dated 18 April 2000 (judgment against Luxembourg) and Opinion of the EU Advocate General in Case C-370/99 (requesting judgment against Ireland). Both documents are available at <http://europa.eu.int>.
- 99 Interview with Christian Auinger dated February 20, 2001.
- 100 See Auinger, 2000.
- 101 Interview with Christian Auinger dated February 20, 2001; interview with Jens Gaster dated March 1, 2001.
- 102 Interview with Christian Auinger dated February 20, 2001.
- 103 Interview with Jens Gaster dated March 1, 2001.
- 104 Idem.
- 105 One official remarked that Sweden's implementation was "outrageous" and claimed to have counted at least 90 respects in which the statute was deficient. Interview with Jens Gaster dated March 1, 2001.
- 106 See Auinger, 2000. Recital 52 of the Directive states that Members should be permitted to retain . . . the exceptions traditionally specified by [copyright]."
- 107 Interview with Jens Gaster dated March 1, 2001.
- 108 Belgium, Greece, France, Italy, Portugal and the United Kingdom were particularly faithful to the Directive's wording. See Auinger, 2000.
- 109 Directive, Art. 9.
- 110 Examples include Belgium, Germany, Austria, the United Kingdom, the Netherlands, Austria and Portugal. See Auinger, 2000.
- 111 Interview with Christian Auinger dated February 20, 2001; see Auinger, 2000.
- 112 Council Directive No. 96/9/EC, O.J.L 77/20 (1996).
- 113 Federal Law to Regulate the Conditions for Information and Communications Services (IuKDG), translated by Chris Kuner and available at www.kuner.com/data/reg/multimd3.htm. A second translation can be found at <http://www.jura.uni-muenster.de/netlaw>.
- 114 Reproduced in *Database Law*, *supra*, pp. 174ff.
- 115 22 *Commercial Laws of Europe* 173 (April 1999).
- 116 See, for example, *British Horseracing*, *supra*, para. 1 ("The parties agreed that the [UK implementation] regulations have to be construed consistently with the Directive and, for the purpose of these proceedings, attention was only paid to the provisions of the latter.") For additional instances in which courts looked to the Directive instead of specific national legislation, see Gaster, 2000.
- 117 Interview with Christian Auinger dated February 20, 2001.
- 118 *British Horseracing*, *supra*, para. 30.

- 119 *Hyperlink-Datenbank*, slip op. (Cologne, May 12, 1998). The case is described in Mille, 1999, at <http://ecommerce.wipo.int/meetings/1999/papers/docs/mille.doc>.
- 120 See Gijrath and Gorissen, 2000.
- 121 See *Zeitung*, 2000.
- 122 *British Horseracing*, *supra*, para. 32.
- 123 *Hyperlink-Datenbank*, slip op. (Cologne, May 12, 1998). The case is described in Mille, 1999, at <http://ecommerce.wipo.int/meetings/1999/papers/docs/mille.doc>.
- 124 Interview with Jens Gaster dated March 1, 2001.
- 125 Jens Gaster, unpublished case notes on file with the author.
- 126 *Idem*.
- 127 Interview with Jens Gaster dated March 1, 2001.
- 128 Jens Gaster, unpublished case notes on file with the author.
- 129 *Suddeutsche Zeitung* (Cologne Dist. Ct.), described in Heyden, 2000.
- 130 Jens Gaster, unpublished case notes on file with the author.
- 131 Interview with Jens Gaster dated March 1, 2001.
- 132 Interview with P. Bernt Hugenholtz dated January 25, 2001 (describing Dutch case in which extraction of 5-7 real estate listings was deemed substantial because users were not interested in remaining 40,000 listings); *British Horseracing*, *supra*, para. 52 ("In some cases, of which this is an example, the significance of the information to the alleged infringer may throw light on whether it is an important or significant part of the database.")
- 133 There have been at least two exceptions. A Dutch case held that a newspaper's hiring of seven employees to create an on-line edition was "numerically negligible compared to the total number of people" that worked for it. *Algemeen Dagblad B.V. et al. v. Eureka Internetdiensten*, slip op. (Rotterdam District Court, August 22, 2000; informal translation by Lars Huisman), available at: <http://www.ivir.nl/rechtspraak/kranten.com-english.html> (accessed 22 April 2005). Similarly, a French court held that a newspaper's list of open public works bids was not protectible because it had been produced as a *freebie* from other profitable activities that the newspaper was already involved in (Gaster, 2000).
- 134 Interview with Jens Gaster dated March 1, 2001.
- 135 For example, the U.S. database industry's best known position paper argues that, unlike other databases, the telephone directories at issue in the Supreme Court's *Feist* decision did not need protection because they were generated "with no additional effort" in the course of operating a publicly-sanctioned monopoly. See D'Andrea Tyson and Sherry, 1997. A popular variant of this argument suggests that firms which exercise monopoly power in one market should not be permitted to obtain an *unfair* cost advantage elsewhere.
- 136 *Algemeen Dagblad B.V. et al. v. Eureka Internetdiensten*, slip op. (Rotterdam District Court, August 22, 2000; informal translation by Lars Huisman), available at: <http://www.ivir.nl/rechtspraak/kranten.com-EN.html> (accessed 22 April 2005).
- 137 Interview with P. Bernt Hugenholtz dated January 25, 2001.
- 138 See Gijrath and Gorissen, 2000 (discussing *KPN v. XSO* and *De Telegraaf v. NOS*).
- 139 *British Horseracing Bd. Ltd. v. William Hill Org. Ltd.* (Chancery Div. 2000), available at <http://wood.ccta.gov.uk/courtser/judgments.nsf>, p. 34. The court went on

to say that additional expenditures to gather and check data would qualify for protection.

140 Interview with Jens Gaster dated March 1, 2001.

141 See Gaster, 2000.

142 Interview with Jens Gaster dated March 1, 2001.

143 P. Bernt Hugenholtz, personal communication.

144 *Algemeen Dagblad B.V. et al. v. Eureka Internetdiensten*, slip op. (Rotterdam District Court, August 22, 2000; informal translation by Lars Huisman) available at: <http://www.ivir.nl/rechtspraak/kranten.com-english.html> (accessed 22 April 2005).

145 *British Horseracing Bd., Ltd. v. William Hill Org., Ltd.* (Chancery Div. 2000), available at <http://wood.ccta.gov.uk/courtser/judgments.nsf>.

146 See Gaster, 2000 (describing German case in which cumulative the taking of individual entries through a *meta search engine* was held to be a taking); *British Horseracing, supra*, para. 11 (week-by-week extraction of upcoming race schedules held cumulatively substantial).

147 The leading pre-Directive case is a European Court of Justice opinion usually known as the *Magill* case. Cases C-241/91P and C-242/91P, *Radio Telefis Eireann (RTE) and Independent Television Publications Ltd. v. Commission*, 1995 E.C.R. I-808 [1995], available at: <http://www.cni.org/Hforums/cni-copyright/1995-02/0177.html> (accessed 22 April 2005). The case involved three Irish TV networks, each of which published their own TV listings but used copyright to block competitors from publishing a unified, Canadian-style TV Guide. After lengthy litigation, the European Court of Justice held that the broadcasters had abused their “dominant position” over the “indispensable raw material” to prevent competitors from publishing unified guides and to eliminate competition with their own existing weekly listings. It then affirmed a lower court order requiring the broadcaster to make its listings available to competitors at a reasonable royalty.

148 *DeTelegraaf v. NOS and RTL*, described in Gijrath and Gorissen, 2000; see also Hugenholtz (2001b) and Oram (2000).

149 *KPN Telecom v. XSO*, described in the interview with P. Bernt Hugenholtz dated January 25, 2001; see also Hugenholtz, 2001b.

150 See Gaster, 2000; see also interview with Jens Gaster dated March 1, 2001.

151 See Gaster, 2000.

152 Except for the United Kingdom and Ireland, most EU Member States have enacted statutes placing court opinions in the public domain. Article 10 of the *European Convention on Human Rights* also addresses the issue. Interview with Jens Gaster dated March 1, 2001.

153 For example, an individual could not enforce database rights in a stamp collection because “there would be no point in excluding others” from such an activity. Interview with Jens Gaster dated March 1, 2001.

154 See Gaster, 2000.

155 Interview with P. Bernt Hugenholtz dated January 25, 2001.

156 The clearest statement of this viewpoint is found in a brief paper by EC official Jorg Reinbothe: “Since the entry into force of the database Directive, the European CD-ROM and on-line-markets have grown at enormous rates. A large number

- of new database products have been made available in Europe, many of which have been produced by small and medium-sized firms." See Reinbothe, 1999.
- 157 Interview with P. Bernt Hugenholtz dated January 25, 2001.
- 158 Interview with Christian Auinger dated February 20, 2001. Although I asked to interview Reinbothe about his statements, Auinger assured me that Reinbothe did not have any additional information. Idem.
- 159 Directive, Art. 16.
- 160 Interview with Christian Auinger dated February 20, 2001; See Auinger, 2000.
- 161 Interview with Christian Auinger dated February 20, 2001.
- 162 The case of Warren Publishing is one of the few instances where wholesale copying has been documented. During the early 1990s, a competitor extracted data from Warren's cable TV directory and used the information to create its own competing product. *Warren Publishing, Inc. v. Microdos Data Corp.*, 52 F.3d 250 (11th Cir. 1995). Whether or not the incident should be considered piracy is debatable. At the time of the incident, Warren had been publishing directories since the late 1940s — more than enough time to recoup its original investment. Furthermore, Warren still publishes its cable directory. The only difference is that it now has a competitor.
- 163 For a comprehensive review of proponents' testimony on this point, see Benkler, 2000.
- 164 As one executive interviewed for this study remarked, this is hardly surprising in a world where U.S. music companies continue to invest in Asia despite rampant copyright violations. Interview with Ramin Cyrus dated January 13, 2001.
- 165 See Bovenberg, 2000 (bioinformatic firms should "think about establishing databases in the European Union.")
- 166 Interview with Jasper Bovenberg dated January 5, 2001; see also Bovenberg, 2000 (bioinformatic firms should "think about establishing databases in the European Union.")
- 167 Idem.
- 168 Rees, 1998, p. 64.
- 169 Interview with Ramin Cyrus, Dan Mazella and Dick Bartlett dated January 13, 2001.
- 170 Interview with Lee Bendegkey dated January 30, 2001.
- 171 Interview with Jasper Bovenberg dated January 5, 2001.
- 172 Interview with Ramin Cyrus, Dan Mazella and Dick Bartlett dated January 13, 2001; interview with Lee Bendegkey dated January 30, 2001. As long as a new bioinformatics product is still being developed, team members need to interact with one another constantly. Forcing employees to operate from multiple locations under such circumstances would be nearly impossible. Once a database product has matured, re-locating operations to Europe, though difficult, can probably be done if the need is great enough. In the past, Incyte has thought about moving certain database operations to India in order to take advantage of labour costs. Interview with Mark Mooney dated February 15, 2001.
- 173 Interview with Ramin Cyrus, Dan Mazella and Dick Bartlett dated January 13, 2001.
- 174 See Williams (1993-2001), Table 6 and under *Region and Country of Origin*.

- 175 The *Gale Directory* does not produce a separate count for the United Kingdom as a whole. Since Scotland and Wales host very few providers, the difference is probably small.
- 176 The *Gale Directory* is published twice a year. The statistics used in this study come from the first of these annual editions, which is currently published in March. An informal survey shows that many of the *new* items recorded for the March 1999 survey had already been listed in *Gale's* September, 1998 edition.
- 177 Interview with Jasper Bovenberg dated January 5, 2001. Prof. Mark Davison of Monash University [Mark.Davison@law.monash.edu.au] is currently conducting a large empirical study for the Australian government. Interview with P. Bernt Hugenholtz dated January 25, 2001. A Swedish economics professor named Cranston may also be working on the problem. Interview with Jasper Bovenberg dated January 5, 2001.
- 178 Jens Gaster, unpublished case notes on file with the author.
- 179 Inefficient enforcement may have helped to mitigate the Directive's impact on consumer choice. As recently as 2000, unauthorized copying of directories was "rampant throughout Europe." Interview with Jens Gaster dated March 1, 2001.
- 180 See <http://www.infobel.com/teldir/teldir.asp?page=/eng/euro/uk>.
- 181 According to Teldir, the U.K.'s 192.com site is "limited to 20 searches per month, and to get this you have to go through a tedious sign up process . . . where you agree not to use the results for business or tell anyone else the results of a search." [<http://www.infobel.com/teldir/teldir.asp?page=/eng/euro/uk>].
- 182 According to Teldir, the U.K. White Pages consist of "U.K. residential listing from U.S. firm Infospace, not from official sources (British Telecom have the copyright on listings in the United Kingdom.) Many people have mentioned that it doesn't seem very up to date or complete. There are many misspelled names, duplicates and other errors; use with caution." [<http://www.infobel.com/teldir/teldir.asp?page=/eng/euro/uk>].
- 183 See Reinbothe, 1999. Reinbothe heads the EC Unit responsible for Copyright and Neighbouring Rights.
- 184 See, for example, interview with Christian Auinger dated February 20, 2001.
- 185 Idem.
- 186 Interview with P. Bernt Hugenholtz dated January 25, 2001.
- 187 See, for example, Gijrath and Gorissen, 2000 (discussing *KPN v. XSO*).
- 188 Interview with Jens Gaster dated March 1, 2001.
- 189 Interview with P. Bernt Hugenholtz dated January 25, 2001; interview with Jens Gaster dated March 1, 2001.
- 190 Interview with Jens Gaster dated March 1, 2001.
- 191 *British Horseracing Bd., Ltd. v. William Hill Org., Ltd.* (Chancery Div. 2000) available at <http://wood.ccta.gov.uk/courtser/judgments.nsf>. (upholding horse racing authority's right to prevent copying of database containing declared runners, jockeys, distance and name of races, race times and related information). So far, *British Horseracing* is the only case in which a U.K. court has issued an opinion which squarely addresses the *sui generis* right. See Charkiewicz, 2000; but see Gaster, *supra*, note 96 (discussing U.K. case holding that traditional *right to repair* doctrine does not apply to database rights).

- 192 Interview with Jens Gaster dated March 1, 2001.
- 193 See Gaster, 2000; Gaster's article also argues that a database of soccer matches should be protected because of the work needed to arrange matches.
- 194 Interview with Jens Gaster dated March 1, 2001.
- 195 Idem.
- 196 See Gaster, 2000.
- 197 See Maurer and Scotchmer, 1998.
- 198 Idem.
- 199 See, for example, Maurer, Firestone and Scriver, 2000.
- 200 Interview with P. Bernt Hugenholtz dated January 25, 2001; interview with Jens Gaster dated March 1, 2001.
- 201 *Algemeen Dagblad B.V. et al. v. Eureka Internetdiensten*, slip op. (Rotterdam District Court, August 22, 2000; informal translation by Lars Huisman) available at: <http://www.ivir.nl/rechtspraak/kranten.com-EN.html> (accessed 22 April 2005).
- 202 See Zeitung, 2000.
- 203 Interview with P. Bernt Hugenholtz dated January 25, 2001. A similar case involving U.K. real estate listings was settled out of court when the defendant agreed to stop creating hypertext links to the realtors' web site. See Charkiewicz, 2000.
- 204 The number of reported cases almost certainly understates the problem, since Magill's willingness to litigate was clearly unusual. In the words of one commentator, "how would a small researcher or innovative start-up firm marshal the resources to take a case all the way to the EC?" See Oram, 2000b.
- 205 Idem; see also Oram, 2000b.
- 206 See Benkler, 2000; see also Maurer, 1999.
- 207 Options range from conservative (such as adopting the *spin-off* defence) to radical (for example, rewriting the Directive to include unfair competition principles).
- 208 Disputes over legal rights have already restricted access to two leading databases. The National Center for Biotechnology Information, a U.S. government agency, decided to stop using Swiss Prot's data in its genome maps because of licence terms that purport to limit re-use. James Ostell via Harlan Onsrud (personal communication). Similarly, Wellcome Trust has announced that it will not reimburse grantees that purchase commercial data from Celera. The reason is that Celera's licence terms might interfere the it's own right to exploit whatever intellectual property is discovered. [See <http://www.wellcome.ac.uk/en/1/biopoleseq.html>.] Incyte's Chief Counsel believes that legal uncertainties over data will become more and more urgent as bioinformatic firms enter the post-genomic era. [Interview with Lee Bendegkey dated January 30, 2001.]
- The author gained extensive first-hand knowledge of the anticommons problem while serving as Associate Director of the Human Mutation Initiative of the Human Genome Organisation between 1999 and 2001. Many large database providers saw the project's goal (a worldwide, self-supporting mutations database) as a threat to their commercial or academic ambitions. On the other hand, small database providers tended to become sidetracked by inconclusive debates over intellectual property rights that clearly had little or no commercial value.
- 209 Government privatization initiatives often restrict the dissemination of geospatial data by making it unaffordable and/or burdening it with unworkable use restrictions.

The topic has been extensively discussed at meetings hosted by the National Academy of Sciences/Committee on Geophysical Data in Santa Barbara, (CA), in August, 1999, and Washington (D.C.) in March, 2000; the American Association of Geographers' *Driven by Data Conference*, held in Los Angeles (CA.) in November 1999; and the U.S. Transportation Research Board's *Workshop on Public Agency Use of Proprietary Geographic Base Files*, held in Washington (D.C.) in June 2000.

- 210 See, for example, Benkler, 2000; see also Maurer, 1999.
- 211 See, for example, Reichman and Uhler, 1999; and Reichman and Samuelson, 1997.
- 212 See Maurer, 1999.
- 213 Erin Nagel, personal communication.
- 214 Interview with P. Bernt Hugenholtz dated January 25, 2001.
- 215 See, for example, Maurer, 1999 (science and engineering data) available at www.nas.edu; see also Stephen Maurer, invited talk at the National Academy of Sciences/Committee on Data for Science and Technology (CODATA) *National Conference on Scientific and Technical Data* (chemistry, nuclear physics), available at http://books.nap.edu/html/codata_2nd/ (2000) (accessed 22 April 2005). The author also gained considerable familiarity with genome databases while serving as Associate Director of the Mutation Database Initiative of the Human Genome Organisation between 1999 and 2001.
- 216 Erin Nagel and Lisa Kumar, personal communication. The fact that Martha Williams, *Gale Directory's* creator, regularly publishes a statistics-laden cross-country comparison called "The State of Databases Today" suggests that she also believes that the *Gale Directory* is reasonably representative.
- 217 Erin Nagel, personal communication.
- 218 Idem; Lisa Kumar, personal communication.
- 219 Lisa Kumar, personal communication.

ACKNOWLEDGMENTS

THE AUTHOR WISHES TO THANK Suzanne Scotchmer, Jonathan Putnam, Jerome Reichman, Bernt Hugenholtz, Christian Auinger, Jens Gaster, Lee Bendegkey, Mark Mooney, Jasper Bovenberg, Harlan Onsrud, Ramin Cyrus, Dan Mazella, Dick Bartlett, Thomas Reynolds, Samuel Trosow, Lisa Kumar, Erin Nagel and Corrin Gee-Alvarado for their generous help with this study. Any errors or mistakes are the author's sole responsibility. Readers who would like to comment on the study and/or identify errors should contact the author at maurer@econ.berkeley.edu.

BIBLIOGRAPHY

- Abrams, H.B. 1998. *The Law of Copyright*, West.
- Auinger, C. 2000. "Implementation of the Database Legislation in the EU and Plans for Review." Unpublished paper presented at the CODATA conference in Baveno, Italy (October 14).
- Benkler, Y. 2000. "Constitutional Bounds of Database Protection: The Role of Judicial Review in the Creation and Definition of Private Rights in Information." *Berkeley Law and Technology Journal*.
- . 2001. "Constitutional Bounds of Database Protection: The Role of Judicial Review in the Creation and Definition of Private Rights in Information." *Berkeley Technology Law Review*.
- Bovenberg, J. 2000. "Should Companies Set Up Databases in Europe?" *Nature Biotechnology* 18: 907.
- Brown, J.E. 1997. "Obscenity, Anonymity, and Database Protection: Emerging Internet Issues." *The Computer Lawyer* (October).
- Butler, D. 1999. "The Writing Is on the Web for Science Journals in Print." *Nature* 397: 195-200.
- Charkiewicz, A. 2000. "Database Protection in the UK – Past, Present and Future." *Copyright World* 106 (December): 35.
- Codoni, S. 2000. "Lack of Effective Protection for Databases in Switzerland." *Copyright World* 105: 14.
- D'Andrea Tyson, L., and E. Sherry. 1997. *Statutory Protection for Databases: Economic and Public Policy Issues*. Report commissioned by the Information Industry Association.
- Deans, R. 2000. "How Deep Is Too Deep: Copyright Issues Relating to Deep Linking." *Copyright World* 104: 14.
- Gaster, J. 2000. "The EC *Sui Generis* Right Revisited After Two Years: A Review of the Practice of Database Protection in the 15 EU Member States." *Tolley's Communications Law* 5: 87.
- Gijrath S.J.H., and B.J.E. Gorissen. 2000. "Applying the Database Act to On-line Information Services: A Trial and Error Exercise." *Copyright World* 106 (December): 25.
- Heyden, T. 2000. "Meta Search Engines Violate Copyright Law." *Copyright World* 102 (August): 7.
- Howell, R. 1998. "Database Protection and Canadian Laws". Report prepared for Industry Canada. Available at <http://strategis.ic.gc.ca/pics/ip/databe.pdf>.
- Hugenholtz, P.B. 2001a. "Implementing the Database Directive." In *Intellectual Property and Information Law – Essays in Honour of Herman Cohen Jehoram*. Edited by Jan J.C. Kabel and Gerard J.H.M. Mom. The Hague/London/Boston, p. 183.
- . 2001b. "Chronicle of the Netherlands, Dutch Copyright Law: 1995-2000." *Revue internationale de droit d'auteur* (January).
- Kaiser, J. 1996. "Treaty on Database Access Stalled." *Science* (December 20).
- Knopf, H.P. 1999. "The Database Dilemma in Canada: Is 'Ultra' Copyright Required?" *University of New Brunswick Law Journal* 48: 163.

- Lavizzari, C.E.S. 2000. "Protection of Rights in a Database: A Perspective from South Africa." *Copyright World* 98: 21.
- Maurer, S.M. 1999. "Raw Knowledge: Protecting Technical Databases for Science & Industry." Report commissioned by the National Academy of Sciences.
- . 2000a. "Protecting What's Yours: The Law and Economics of Geospatial Data." *GeoInfoSystems* (February).
- . 2000b. "Coping With Change: Intellectual Property Rights, New Legislation, and the Human Mutation Database Initiative." *Human Mutation* 15: 22.
- Maurer, S.M., R. Firestone and C. Scriver. 2000. "Science's Neglected Legacy." *Nature* 405: 117.
- Maurer, S.M., and S. Scotchmer. 1998. "The Independent Invention Defense in Intellectual Property." *Olin Working Paper Series in Law and Economics*, No. 98-11.
- . 1999. "Database Protection: Is it Broken and Should We Fix It?" *Science* 284: 1129.
- McIlrath, T.J. 1999. *Physics Today* 52 (June): 11.
- Mille, A. 1999. Untitled paper presented at WIPO's International Conference on Electronic Commerce and Intellectual Property, Geneva.
- Oram, A. 2000a. "Review of the Year." *Copyright World* 97 (February): 18.
- . A. 2000b. "The Sap and Syrup of the Information Age: Coping with Database Protection Laws." *Copyright World* 97 (February):20.
- Rees, C. 1998. "Database Right." In *Database Law*. Edited by Christopher Rees and Simon Chalton. Bristol: Jordans.
- Reichman, J.H. 1997. Statement on HR 2652 before the Subcommittee on Courts and Intellectual Property. Washington (D.C.): U.S. Congress, House Judiciary Committee (October 23).
- Reichman, J.H., and P. Samuelson. 1997. "Intellectual Property Rights in Data?" *Vanderbilt Law Review* 50: 51.
- Reichman, J.H. and P.F. Uhler. 1999. "Database Protection at the Crossroads: Recent Developments and Their Impact on Science and Technology." *Berkeley Technology Law Journal* 14: 793.
- Reinbothe, J. 1999. "Protection of Databases Workshop." Untitled paper presented at WIPO (September 16). Available at <http://ecommerce.wipo.int/meetings/1999/papers/reinbothe.html>.
- Saviotti, P., M.A. deLooze, S. Michelland and D. Catherine. 2000. "The Changing Marketplace of Bioinformatics." *Nature Biotechnology* 16: 1247.
- U.S. Copyright Office. 1997. *Report on Legal Protection of Databases* (August).
- U.S. National Research Council. 1999. "A Question of Balance: Private Rights and the Public Interest in Scientific and Technical Databases." Washington (D.C.): The National Academies Press, pp. 64-68.
- Williams, M.E. 1993-2001. "The State of Databases Today." *Gale Directory of Databases*. Various editions.



Managing Intellectual Property Rights from Public Research¹

COUNTRIES of the Organisation for Economic Co-operation and Development (OECD) are keenly interested in improving the exploitation of intellectual property (IP) of their public research base. While media attention is most often focused on legislation that expands intellectual property protection to new technologies or forms of knowledge — gene sequences, software, digital music, databases or traditional knowledge, to name a few of the hottest topics — an equally important set of policies in this transition to a knowledge-based economy are transforming the administration of universities and public laboratories. Public research organizations (PROs) and their researchers are encouraged, if not implored, to take a more commercial approach to intellectual property evaluation and management. However, this combination of legal and administrative changes to the intellectual property regime and the concomitant evolution in IP practices within PROs are raising thorny problems, from conflicts of interests to conflicts with industry.

This study reviews the major changes in the intellectual property regimes and IP management practices of the public sector in OECD countries. It then identifies the difficulties faced by PROs as their commercial activities expand, and identifies some emerging best practices for reducing conflicts of interests, tensions with the private sector, and public reactions. Finally, the study discusses how governments can evaluate the success of their publicly funded IP commercialization strategies.

CHANGES IN NATIONAL IP REGIMES AND IP MANAGEMENT

OVER THE COURSE OF THE LAST TWO DECADES, intellectual property regimes have been modernized, harmonized and strengthened world-wide.

International agreements, and particularly the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs) of the World Trade Organization (WTO), have imposed minimum standards of protection for a broad range of intellectual property devices — patents, copyright, trade-marks, semiconductor layouts, geographic indications, industrial designs and trade secrets.² Moreover, the TRIPs Agreement extended IP protection to technologies that were at the time not universally covered, such as micro-organisms, plant genetic material, and techniques used in genetic manipulation.³ It extended copyright protection to computer programs and laid the groundwork for discussions of copyright or *sui generis* forms of protection for compilations of data and databases. It also stipulated that the protection offered had to be enforceable within a country, and that IP disputes among countries could be taken to the WTO's Dispute Settlement Body as a trade complaint. Consequently, since TRIPs has come into force for advanced countries in 1996, the diversity found across the OECD in national intellectual property rights (IPR) regimes has substantially decreased. European Union (EU) accession countries have further harmonized their IP regimes to conform to EU standards.

The aim of these international harmonization processes is to create a global environment more conducive to investments in, and the exploitation of, intellectual property. The major beneficiaries and strongest supporters of the process have been the *intellectual property industries*, mainly the pharmaceutical, software, music and film industries. But even if this global overhaul of IP regimes was meant to stimulate research and development (R&D) in the private sector, its impact has been strongly felt by public research institutions that are themselves intellectual property producers. Some countries have instituted IP reforms that go beyond the statutory changes mandated by international agreements and that are specifically targeted to the public sector. See the Appendix for an in-depth discussion of legal and institutional changes in the United States, Japan and Europe.

An intellectual property *regime*, we should remember, is more than the set of national laws specifying what novel ideas one can claim rights to and what these rights entail. Technically, a regime is defined as a set of “principles, norms, rules, and decision-making procedures.”⁴ The *principle* that agents can obtain rights on useful ideas and innovations and the *norm* that these agents may legitimately prevent others from using their IP, or may charge them for this privilege at a price determined by the market, are widely accepted by OECD countries. While this may seem common sense, it is still a matter of controversy in developing countries. Even in the advanced world, if we turn the clock back just 20 years, the principle that individuals or institutions could own intellectual property derived from government-funded research was roundly criticized. The norm was to place government-sponsored research results in the public

domain through publications. Attitudes in the OECD about the public sector have since become far more profit oriented.

While the principles and norms guiding IP regimes are essentially the same across OECD countries, there remain substantial variations in the *rules* and decision-making *procedures* used in each country, and these differences may be the subject of future international harmonization efforts. Reforming the rules and decision-making procedures is one of the more direct means that governments can use to change the incentives for actors, and thus influence the social and economic outcomes of the IP regime.

Rules – The legal definitions of the types of protection offered, the categories of inventions or ideas that are protectable, the requirements for obtaining and maintaining this protection and the measures available against infringement.

Decision-making Procedures – The procedures involved in evaluating, allocating, challenging and defending IPRs. These procedures usually are administered by institutions such as a patent office, a copyright depository, or the judicial system.

Governments have a number of policy instruments at their disposal to influence how intellectual property generated from public funds is exploited. Establishing a modern, affordable and predictable intellectual property regime is a precondition to encouraging the domestic exploitation of public research results. Further changes to the intellectual property regime itself — for example, expanding protection to categories of invention or expression with origins in PROs, reducing the cost of protection or improving the enforceability of rights granted — have altered the incentives of PROs to protect their innovations. Indeed, over the course of the last two decades, IP regimes have been statutorily strengthened (for example, terms of protection have been extended); subject matter has been broadened to include various categories of biotechnological inventions, diagnostic or surgical methods, software innovations, Internet business methods; and administrative procedures have been simplified (for example, through electronic filing) in most OECD countries.

Perhaps more important to the commercialization of public research, however, are two other categories of instruments. First, as major investors in the creation of intellectual property through the financing of universities and research institutions, the promotion of public-private partnerships, and the public procurement process, governments can impose conditions on the ownership and exploitation of research results. Japan and many European countries are increasingly choosing to grant title to public sector innovations to higher education institutions (HEIs) and public laboratories. In exchange, these institutions must commit to exploiting the innovation, through the sale or licence of

the invention. Countries are also clarifying that any profits resulting from the exploitation of publicly funded research are to be shared with the researcher, the laboratory and the home institution. Many countries are also experimenting with grant conditions that require the disclosure of inventions and the development of commercialization plans.

Second, governments can give publicly funded research institutions greater freedom to engage in active IP protection and management. In Europe and Japan in particular, regulations prohibiting profit-making activities for public institutions and civil servants have been relaxed, while the rules governing public-private collaborations have been standardized. Furthermore, new institutions are being created specifically for IP administration, often with government support. The Japanese government is facilitating the establishment of technology transfer organizations at universities by waiving some patent maintenance fees for academic inventions filed by technology transfer organizations. Across the OECD, there is a well recognized need for dedicated professional technology transfer organizations that identify and evaluate ideas and inventions with commercial promise, and search for partners to develop them. Indeed, professional associations are being formed, sometimes on their own or with government help (the European Commission has supported two such associations through its Patent Academia program),⁵ in order to exchange information and develop best practices related to IP management — legal environment, financing of technology transfer, creation of incubators and start-ups, negotiation of licences and other contractual matters.

The Appendix describes the key IP regime reforms and associated public sector IP management changes that have occurred in the United States, Japan, and Europe over the past two decades. National trends are toward both stronger IP regimes and more explicit incentives for public research organizations' involvement in the commercialization of IP. These reforms have raised awareness about the potential benefits to be gained by PROs from protecting their inventions, but pitfalls are also becoming more apparent.

THE DELICATE BALANCE OF IP MANAGEMENT

SINCE THE EARLY 1980S, OECD governments have actively tried to transfer to the private sector technology and knowledge developed in public research organizations. If governments were once content to passively realize the benefits from funding basic research (for example, spillovers such as those generated by the movement of scientists and researchers into industry or the publication of research results in academic journals), the determination to be part of the knowledge-based economy has driven OECD countries to extract greater direct benefits from publicly funded research.

Critics fear that the pendulum has shifted too far in favour of commercial goals. Stronger IP regimes may have undesirable consequences for public research or for the economy more generally. In theory, it is possible that the new emphasis on claiming and defending intellectual property rights, and the closer ties to industry, could affect:

1. the orientation, openness, and accessibility of research results;
2. the terms of competition and collaboration both *within* academia and *with* the private sector;
3. the existence of trusted, independent research organizations in defence of the public interest;
4. the organization of public research bodies and the objectives of science programs;
5. the ability of governments to direct public research into areas that are judged to be social, economic, security or health priorities.

Certainly, the new orientation of PROs creates winners and losers. The winners include universities and laboratories that generate profits from their technology commercialization efforts, researchers in commercially relevant fields, and the public who may see an accelerated return from its R&D investments. Strong protection of public sector research results also reduces the uncertainty faced by firms in developing and commercializing technology from public research. The gains from a more active protection of PRO IPRs include:

For Universities/Public Research Institutions — Protection of intellectual property ensures that firms do not appropriate the inventions of researchers and universities without compensating inventors and taxpayers. In addition, for researchers and universities in general, a patent held by a firm, an individual or another university guarantees that the underlying knowledge is published and, thus, available for future research. It could be argued that protection is even more important to universities than to firms insofar as the alternative, secrecy, undermines the very mission of research institutions and universities: the broad diffusion of scientific knowledge generated through public funds.

For Firms — Without clear rules of ownership and adequate protection, a firm that participates in a collaborative project, purchases title to a patent or enters into a licensing agreement with a public research institution exposes itself to a high risk in terms of the time, money and litigation. The development and commercialization of a technology may be blocked if poorly protected IP is challenged by other proprietary rights or is easily infringed.

Firms in research intensive areas rely disproportionately on their IP as a source of present and future revenues. In biotechnology companies, for example, most revenues come from marketing and manufacturing licensing activities. This is especially important for start-ups and spin-off firms from university research, which rely on IP as a proxy for potential returns to investments and use their IP portfolios to attract seed funds and later-stage venture capital.

For the Public — Because the know-how protected by patents must be disclosed in exchange for a temporary monopoly right on the use of the invention, the diffusion of the underlying information yields social returns. Public benefits may also include a better or more rapid dissemination of innovations to the private sector.

On the other hand, the losers may include the same cast of characters: universities or research laboratories that do not generate enough commercially relevant intellectual property or that do not recoup the costs of their technology transfer activities; scientists and professors in fields that do not have commercial relevance and do not benefit from increased funding; researchers who must pay for access to research results and face publication delays; firms that face higher costs for doing business with PROs; a public that likewise perceives it is paying twice for research results — through taxes and through higher priced products due to royalties.

Just as national IP regimes put in opposition conflicting goals, the task of managing intellectual property in the public sector requires balancing each organization's various social and economic goals. The problem intellectual property regimes try to resolve is how to encourage investments in and disclosure of innovations, which are public goods — easily replicated and non-rivalrous — in spite of the fact that once innovations are made public, others are able to replicate and use them at much lower cost. Intellectual property rights partly resolve this discrepancy between social and private returns to innovation by *re-introducing* scarcity. By giving rights holders the ability to exclude others from using the innovation in exchange for its disclosure, the IP regime allows knowledge to be exchanged through competitive markets. It is the allocation of price to knowledge (and the resultant flow of rents to its owner) that provides the incentive for scientists and artists to create and invent new knowledge.

The problem for public sector organizations in this period of transition is finding a manageable balance between continuing social and new economic goals. PROs are simultaneously asked to increase the economic relevance of their R&D, encourage commercial activity, contribute to the local economy, minimize conflicts of interests, protect against abuses of power, participate in

the advancement of science, and bolster public confidence in science — a complex and sometimes conflicting list of priorities.

As commercial activities are increasingly accepted and expected of PROs, few countries have reached a consensus on the principles that should guide public investments in scientific research and technological development or on the norms of acceptable PRO behaviour.⁶ Some business-science arrangements have raised backlash from researchers, students, the public and even corporations. Proceeding backwards, in a sense, the public sector has found it necessary to adopt rules and decision-making procedures that minimize conflicts of interests, facilitate the broad dissemination and use of IP with a public good character, encourage the local exploitation of publicly funded R&D results, and disseminate benefits across both winners and losers. Institutions themselves, and in some cases national authorities, are trying to mitigate negative reactions by creating a framework in which commercial activities can take place.

For many OECD countries, the first priority is to develop a more professional and pro-active management of intellectual assets in the public sector. That objective dominates discussions about reforms to the IP regime, the legal environment in which PROs operate, and the support research institutions need to engage in technology transfer. However, changes to the IP regime and to the administration of PROs do disturb the balance that guides investment in research, the dissemination of results and their use. In crafting policies to extract greater direct benefits from public research, governments may find that they need to counterbalance their policies in order to:

- maximize economic spillovers, through a more rapid dissemination and broader use of new technologies;
- minimize conflicts of interests within public research institutions and with private sector partners.

Even as national trends lead toward both stronger IP regimes and more explicit incentives for the involvement of PROs in the commercialization of IP, governments and individual institutions are experimenting with new policies to encourage widespread, but domestic, economic spillovers and to reduce conflicts of interests within public research institutions and with their private sector partners. The following sections discuss the nature of some of the tensions that accompany present trends, as well as emerging best practices to achieve a balance between the various social and economic objectives placed by society on the public research system.

INCREASING ECONOMIC SPILLOVERS FROM PUBLICLY FUNDED RESEARCH: THE ROLE OF IPRs

AS GOVERNMENTS PUSH FOR THE COMMERCIALIZATION of public research results and industry funds a greater proportion of public research, strong IP protection and clear rules about ownership and exploitation are essential to generate private and social returns from investments in R&D. Many OECD governments are debating whether to create uniform rules on the allocation of ownership, revenue sharing, and the contractual conditions for access to or use of publicly funded research. Most countries distinguish between public and private universities and various national laboratories in setting such standards. In addition, despite the inherent difficulty, a further distinction is often made between publicly funded and contract research in assigning ownership.

Governments try to determine whether they need to create safeguards to ensure that publicly funded innovations are indeed exploited and, if necessary, broadly disseminated. Public pressure against the granting of title to a firm for a publicly funded innovation, or against the negotiation of exclusive licences, is balanced by private sector arguments about the need for title or an exclusive licence. Private sector justifications are especially compelling when potential licensees are scarce, which tends to be the case with PRO innovations. In their efforts to reap more rewards from R&D investments, governments are often tempted to include stipulations for domestic economic development either in the patent laws themselves or in the conditions for receiving public R&D funds. For example, several countries require the domestic working of patents.

Finally, governments can amend the breadth or strength of patents in order to protect the ability of researchers to use patented inventions in their R&D. Perhaps of lesser concern to PROs, the existence of blocking patents or patent thickets can nonetheless impede basic research and certainly discourage public-private partnerships in specific areas. In most cases, the private sector develops its own strategies to deal with these situations. More rarely, governments will make legal or administrative reforms, as was the case with the revised *Utility Examination Guidelines* of the U.S. Patent and Trademark Office for gene-related inventions.⁷

LICENSING: THE KEY TO GENERATING ECONOMIC RETURNS

THERE IS AMPLE EVIDENCE that granting performing research institutions the ownership of IP has been associated with higher patenting and licensing activity in universities (OECD, 2000a,b). But ownership rights do not *automatically* result in significant private and social returns. It is the licensing of IP that allows the development and commercialization of research results. Licensing creates revenue streams for universities and public institutions and generates new

investments, new products, processes and services, as well as employment and tax revenue.

There is some debate about whether exclusive licences should be granted, or title to patents assigned, to firms for discoveries that have benefited from public funds because this limits the diffusion of technologies. On the other hand, evidence shows that start-ups and spin-off firms often require exclusive licences. From a policy point of view, the question becomes how to promote licensing practices that generate the greatest benefits to society. Generally, an exclusive licence conveys the rights to manufacture, exploit or sell the invention to only one licensee. A non-exclusive licence conveys all or a portion of these rights to multiple licensees. For example, non-exclusive licences can be restricted by field of use or geographic territory. In theory, universities and public research institutions may tend to prefer non-exclusive, but royalty-bearing, licences, while large and small firms would prefer exclusive licences in order to offset the high risks of development. Anecdotal evidence shows that the share of exclusive licences in the portfolio of research-performing organizations is significantly higher than that of non-exclusive licences, reflecting the fact that firms often require exclusive rights, particularly in sectors where product development is lengthy and highly capital intensive (OECD, 2000a,b).

The decision to license on an exclusive or non-exclusive basis generally devolves to the title holder. The basis on which either option is decided depends to a large extent on market demand for the patented technology and its stage of development. In the United States, under the *Bayh-Dole Act*, agencies must determine (and disclose to the public) whether granting an exclusive licence is necessary to promote the development of an invention with potential public benefits. In some cases, the patented invention may have multiple applications such that granting exclusivity to one agent may *prevent* the development of other applications. Some technologies that are at an embryonic stage may likely be developed only through non-exclusive licences, whereby firms will compete in their development. Market structure and firm size also play a role. In the case of research-based spin-off firms, for example, universities and public research institutions often prefer to license inventions on an exclusive basis in order to attract the external financing required for the spin-off firm to develop, commercialize and market the technology. In some cases, a non-exclusive licence may nevertheless translate in exclusive use due to a large firm's dominant market power. The advantages and disadvantages of exclusive vs. non-exclusive licences are summarized in Table 1 below.

TABLE 1		
EXCLUSIVE VS. NON-EXCLUSIVE LICENSING OF PATENTS FROM PUBLIC RESEARCH		
	EXCLUSIVE	NON-EXCLUSIVE
For Public Research		
Advantages	▪ Speeds technology transfer ▪ Effective in attracting investors, especially for spin-offs	▪ Fosters broader diffusion ▪ Broader revenue base from royalties ▪ Reduces risk of conflicts of interests
Disadvantages	▪ May limit diffusion of knowledge ▪ Raise obstacles to research requiring patented knowledge ▪ Review process may be slow ▪ Risk of litigation	▪ Requires more resources to manage and advertise licensing opportunities
For Firms		
Advantages	▪ Reduces risk of development ▪ Generates monopoly returns	▪ Larger firms benefit from market power
Disadvantages	▪ Small firms may be disadvantaged ▪ Higher share of royalty	▪ Competitors may develop technology first
Source: OECD, 2000a.		

INCREASING NATIONAL SPILLOVERS

AS THE MAIN STAKEHOLDERS IN PUBLIC RESEARCH, central and local governments are eager to ensure that commercialization activities, including licensing, generate economic and social benefits for the regional and national economies. As mentioned earlier, these benefits often take the form of licensing revenues but, more importantly, they materialize in the *induced* investments generated by the development and marketing of the technology or the creation of spin-off firms (i.e. additionality effects). Moreover, a significant part of these licensing revenues is reinvested in the educational and research activities of universities. Governments may also take active measures to target specific economic spillovers such as job creation or improving the innovative capacity of small firms (i.e. preference requirements for licensing to small- and medium-sized firms).

However, the globalization of R&D, and of public R&D institutions, raises additional challenges to secure domestic economic spillovers from public IP. Firstly, strong IP protection is a pre-requisite to attract R&D-related foreign direct investment that can generate domestic investments and employment for researchers. In fact, access to public R&D laboratories is one of the main reasons foreign firms establish research units in the United States. But strong protection is also important for the outward commercialization activities of firms and public research institutions — IP must be enforceable in the country exploiting a foreign patent or copyright. Generally, reciprocity of access to foreign

research and licensing is one of the conditions for granting licences to foreign partners. Other rules include:

National Use Clauses – Public funding of industry-science partnerships or collaborative R&D programs, and licensing of resulting IPRs to foreign partners, may be subject to restrictions on manufacturing and employment, export controls, foreign protection of IP, etc. A general problem with requirements for national economic benefits is that they tend to be interpreted very differently by the various stakeholders. Also, conditions such as domestic manufacture requirements may deter global firms whose production is organized around global supply chains.

Mandatory Licensing – Governments may require the IP owner to grant a licence to a third party if it, or a judicial body, determines that terminating the monopoly of the patent holder is in the national interest for security or public health and safety reasons. Governments may also retain preemptive licensing rights in the case of collaborative or sponsored research (for example, *march-in rights* in the United States for exclusive licences from public laboratories).

Patent Buy-outs – Governments may buy out patents and place them in the public domain, but this measure is rarely used and it requires that governments estimate the private and social value of patents.

Anti-trust Guidelines – Governments may invoke anti-trust guidelines to make sure that exclusive licensing rights do not constitute unfair barriers to access by competitors or, alternatively, to break up cross-licensing agreements that lead to market collusion or cartel situations.

EMERGING ISSUES IN THE LICENSING OF PUBLIC RESEARCH RESULTS

THE EXPANSION OF IP PROTECTION DISCUSSED at the outset and the concurrent surge in patenting activity by firms has spurred a new debate on whether extensive patenting by firms that rely on public research has resulted in a *patent thicket*: an overlapping set of patent rights forcing parties who seek to develop and commercialize a new technology to obtain multiple licences (Shapiro, 2000). This not only raises new issues concerning the cost and access to research for firms or barriers to entry for competitors, but also has implications for public research institutions. Patent thickets may result in lost licensing opportunities for public research institutions insofar as potential clients must secure multiple licences in order to exploit a patent. There is a further concern that patent thickets could increase the financial and administrative costs of performing public research in cases where the patents relates to commercial research tools owned by many firms (or by another university).

Box 1**CROSS-LICENSING IN BIOTECHNOLOGY****Human Genome Sciences and Transgene S.A.**

Two genes were selected under a 10-year agreement that Human Genome Sciences (HGS), of the United States, and Transgene S.A., of France, entered into in March 1998, whereby the two firms work together to identify genes of interest for gene therapy. Transgene has the right to license up to 10 genes for development and commercialization for gene therapy applications, while HGS will receive milestone and royalty payments for each gene therapy product. Under the agreement, the two firms may choose to share development of late-stage clinical trials and subsequently co-market the products. In such cases, commercialization rights will be held by HGS for North America and by Transgene for Europe and will be shared equally for markets in the rest of the world. Also, as part of the original agreement, HGS owns 10 percent of Transgene's current equity.

Source: HGS Annual Report, 1999.

Cross-licensing agreements have long been used by businesses to get around the problem of overlapping or blocking patents. While such agreements are common in the semiconductor and telecommunications industries, they are now becoming more important in the area of biotechnology as firms seek to avoid patent litigation through co-operation. (See Box 1.) If public research institutions also hold licences, to what extent does cross-licensing represent a solution or a challenge to public research IP?

CONFLICT MANAGEMENT: THE MAKING OF MODELS AND GUIDELINES

ACROSS THE OECD, PUBLIC RESEARCH ORGANIZATIONS are increasing their ties to industry — through licensing, contract research, collaborations, spin-offs, etc. As a by-product, two major sources of conflicts emerge. The first relates to conflicts of interests faced by individual researchers, laboratories, departments, and even entire institutions as they form relationships with the private sector. The second concerns intra-organizational conflicts. For example, as funding and power relations among researchers or disciplines shifts, institutions must decide whether to address the inequality among disciplines or departments — whether to shore up areas of research that have less industrial appeal. Both governments and institutions individually have a role to play in reducing the incidence of internal and external conflicts.

A top-down, rigid approach to defining the types of activities or arrangements that are permitted or forbidden is unlikely to work. Many OECD countries are experimenting with model contracts and guidelines from which institutions can adapt to particular situations. The U.S. National Institutes of Health (NIH) have issued a Materials Transfer Agreement, while the private

Association of University Technology Managers (AUTM) provides updated model agreements. These not only create standards that the private sector can expect to find nation wide, they are also critical for institutions that are new to technology transfer and for whom the consequences of various provisions protecting their core research may not be obvious. In either case, PROs gain bargaining power in the process. In addition, individual institutions should consider developing their own internal, but well-publicized, conflict of interest guidelines and procedures. These policy issues are further examined below.

CONFLICTS OF INTERESTS

A CONFLICT OF INTEREST IS DEFINED as a “situation where a primary duty co-exists with a secondary duty or interest. For example, integrity of research is a primary duty and personal financial interest is a secondary interest” (Cho, 2000).

Potential conflicts involve personal wealth, misuse of public equipment and facilities, or improper influence on graduate students. In general, universities apply rules and procedures to avoid such conflicts. However, especially in the biomedical fields where industry support for academic research is considerable, concern over the role of public research’s ties with industry has evolved from a purely theoretical discussion into a real debate as data is beginning to show just how industry influences academic science by slowing or biasing publications and increasing secrecy.

Secrecy – Protecting research results and materials by not sharing them with others is on the rise and may ultimately slow the dissemination of knowledge. Recent studies show that 8.9 percent of biomedical researchers report having refused to share information or materials, often to protect their financial interests. Moreover, 19.8 percent report having delayed publication of research results for over six months in order to file a patent application (Cho, 2000; Campbell, Weissman, Causino and Blumenthal, 2000). According to another recent study, 82 percent of pharmaceutical firms indicated that they require academic researchers to withhold publication until a patent application has been filed, and 56 percent admit that they often ask that research be kept secret for longer periods of time for competitive commercial reasons.⁸ In the United States, public sector researchers enjoy a *grace period* of one year before filing for a patent during which they can publish their research results. In Europe, however, any disclosure means that an invention is put in the public domain. Given the global nature of potential markets, scientists in all countries with links to industry are equally likely to delay publication for commercial reasons. (See Box 2 below.)

Box 2**PUBLICATION DELAYS****Hoechst Marion Roussel – CNRS/INSERM/CEA/Pasteur Institute**

In 1997, the multinational pharmaceutical firm Hoechst Marion Roussel created a public-private consortium (*groupement d'intérêt public*) under the auspices of the French Ministry of Research to finance and perform research in the decoding of the human genome. The public research teams under contract with Hoechst agreed to defer publication for a maximum of six months, the time necessary for filing a patent. Hoechst maintains a right of first refusal for an exclusive commercial and industrial application. The firm also retains co-ownership of the research results. As for commercialization, the firm pays royalties to the public firms involved in accordance with practices in the pharmaceutical sector.

Research Bias – In the biomedical sector, evidence shows that there is a significant difference in the objectivity of drug studies depending on whether the team studying a new therapy received industry support (Cho, 2000). This raises real concerns about the prospect that financial considerations may compromise investigators' professional judgement and/or their independence in the design, conduct, or reporting of research.

Are there ways to mitigate these tendencies or their most detrimental manifestations? Increasingly, research institutions, grant-giving bodies, professional associations, and publications establish written guidelines that prescribe:

- disclosure of financial interests;
- limits to shareholding (equity) and external earnings (in the form of salaries, consulting fees, royalties, etc.);
- rules concerning gifts, gratuities, favours and bribery.

The objective is to prevent researchers from using their position to make improper private financial gains. When conflicts of interests emerge, they need to be managed, reduced, and preferably eliminated. For many research institutions, this probably requires establishing a review board, and processes for bringing cases to its attention, setting penalties for violators and enforcing its decisions. In addition, a more pro-active stance would consider reviewing possible public-private relationships *a priori* and determining when the following measures might be judged necessary to avoid a conflict of interest (Cho, 2000):

- mediation;
- abstention (for example, recusal from specific situations);

- divestiture (for example, removal of secondary interest);
- prohibition (for example, permanent withdrawal from activities in which there is a secondary interest).

Grant-giving institutions are in a particularly strong position to demand timely publication and financial disclosure, and to restrict the types of licence clauses that can be negotiated with private firms. See Box 3 below which describes an attempt by the NIH to put into the public domain human genome sequence data resulting from research. The European Commission provides a model contract to its grant recipients.

However, institutions do want to maintain a balance. If conflict of interest guidelines are too stringent, they may discourage research staff or stifle commercial output altogether. In fact, as the science-industry interface is not uniform in all disciplines, many universities have adopted different conflict of interest policies across departments so as to address their particular concerns.

BOX 3

NIH GENE SEQUENCE DISCLOSURE POLICY

Policy

It is the intent of the National Human Genome Research Institute (NHGRI) that human genome sequence data, generated by the projects funded under RFA HG-95-005, should be released as rapidly as possible and placed in the public domain where it will be freely available. In order to implement this policy, NHGRI will require that grantees adopt a policy of rapid release of data to public databases. This policy will be made a condition of the award.

According to the NHGRI, raw human genome DNA sequence, in the absence of additional demonstrated biological information, lacks demonstrated specific utility and therefore is not appropriate material for patent filing. Furthermore, the NIH is concerned that patent applications on large blocks of primary human genome DNA sequence could have a chilling effect on the development of future inventions of useful products, by making it difficult for companies to protect the fruit of subsequent inventions resulting from real creative effort. However, the grantees have the right to elect to retain title to subject inventions and are free to choose to apply for patents should additional biological experiments reveal convincing evidence for utility.

Monitoring

NHGRI will monitor grantee activity in this area to learn whether attempts are being made to patent large blocks of primary human genome DNA sequence. During this pilot period, NHGRI will be soliciting opinions and collecting evidence from the broad scientific and commercial sectors to allow an evaluation of whether the approach described above is sufficient to ensure that sequence data generated by these grants is maximally useful to the research and commercial sectors. If not, the NIH will consider a determination of exceptional circumstance to restrict or eliminate the right of parties, under future grants, to elect to retain title.

Source: U.S. National Institutes of Health.

PUBLIC MISSIONS AND PUBLIC CONFIDENCE

IN ADDITION TO MANAGING CONFLICTS OF INTERESTS, public research institutions also have to manage their reputation as an objective source of scientific knowledge. Investments in public research are justified in part because they create a national resource — a public asset — which is especially useful when evaluating public health risks, for example. But if their ties to industry are deemed too strong, the privileged position of HEIs and PROs is jeopardized.

Several sweeping agreements between a research institution and a private firm have raised public ire. One such example is the innovative 1998 agreement between UC Berkeley and Novartis (see Box 4, below). An entire department entered into a multi-year, multi-million dollar contract that provided unrestricted funds in exchange for collaboration and first rights on a fraction of the department's research results. The academic community questioned this agreement because it was deemed to wed a state institution to the concerns of a single firm. While the public may accept individual agreements with the private sector, and policies that encourage collaboration with the private sector, it is less forgiving when an institution or a large part thereof is involved with a single private interest. Public sector institutions should consider how they might prevent or manage similar public relations crises.

How can HEIs and PROs sell their research while giving assurances to the public that they are indeed maintaining an open research environment and encouraging publications and dissemination of research results? One solution is

BOX 4

MAINTAINING PUBLIC MISSIONS

Agreement Between the University of California (UC) at Berkeley and Novartis

In 1998, the Department of Plant and Microbial Biology at the UC Berkeley College of Natural Resources negotiated a \$25 million five-year agreement with the Novartis Agricultural Discovery Institute to support basic research in agricultural genomics. The College of Natural Resources had sent out a request for proposals that essentially auctioned to firms the right to support research in exchange for access to the department's research results. Novartis was selected because it agreed to provide \$25 million in unrestricted funds to be allocated for meritorious research by a faculty peer review group. In addition, the company agreed to provide access to proprietary technology and DNA databases not available in the public sector which would enhance the university's ability to do research at the forefront of plant genomics. In exchange, Novartis scientists would work closely with UC Berkeley researchers and the company would receive first rights to negotiate for a fraction — about 30 to 40 percent — of the discoveries made in the department. This fraction corresponded to the proportion of the department's total research budget provided by Novartis and would vary from year to year. 30 out of 32 professors in the department signed the agreement in order to receive research funds. Novartis agreed to pay patent costs, licence fees and royalties associated with the commercialization of the research, but the university would retain the patents and collect royalties on their use.

Source: Mena and Sanders, 1998; Rausser, 1998 and 1999.

to make more transparent the institutional policies or best practices used by public research organizations and higher education institutions in formulating contractual agreements. Exclusive and non-exclusive licences were discussed above. Other issues to address may include:

- the assignment of title to research results in joint research;
- the length of confidentiality agreements, during which research is not to be published or divulged;
- the mechanism by which individual firms are given first rights to review inventions;
- the granting of research through rights (for example, rights to inventions derived from research using a licensed research tool).

Technology transfer offices (TTOs) and technology licensing offices (TLOs) might want to individually articulate for the broader community how they balance commercial interests with the institution's research mission. Alternatively, government departments might consider formulating best practice guidelines, especially if TTOs/TLOs are still going through a learning phase. However, such guidelines must be flexible as the nature of public-private relationships is rapidly evolving and can differ significantly from one discipline to the next. Furthermore, relationships with individual firms may have multiple facets — contract research, licences, grants — and must be nurtured carefully over time.

INSTITUTIONAL ORIENTATION AND COMPENSATION

UNIVERSITIES AND RESEARCH ORGANIZATIONS may find that commercial imperatives can change the orientation of research, as funds flow into areas that have commercial applications. Indeed, many believe that public and private research strategies are converging. The creation of research-based spin-offs, and the fact that universities increasingly hold equity in these firms, is one sign of the overlap between the two sectors. In some cases, governments encourage more industrially relevant research by tying access to public funds to funding obtained from outside (non-governmental) sources. The German Fraunhofer Institutes, whose research is applied, have important external funding targets, for example. Other countries fear such an approach could destroy the comparative advantage of public research and prefer to allocate funding primarily based on the merits of research projects and peer reviews. In addition, there is a tension between those who see involvement in industrial research as a distortion of the educational mission of universities and those who see benefits in having

TABLE 2**ROYALTY PAYMENTS TO STANFORD UNIVERSITY SCHOOLS, 1998-99**

School of Medicine	\$5,795,000
School of Engineering	\$764,000
Humanities and Sciences	\$470,000
Dean of Research	\$175,000
Vice Provost for Student Affairs	\$134,000
Athletics (Trade-marks)	\$90,000
School of Earth Sciences	\$8,000

Source: Stanford University, Office of Technology Licensing, 1998-99 *Annual Report*.

graduate students exposed to commercial imperatives and linked to a larger research network.

Within a given university, disparities in the ability to raise outside funds may also cause tension. Commercial interests are broadening the gap in available resources for different disciplines. Table 2 shows royalty payments collected by Stanford University schools. Clearly, biomedical applications generate far more income than any other area. Even more revealing is the fact that of the net royalties accruing to Stanford in 1998-99, 85 percent came from recombinant DNA licences. This imbalance in licensing revenues is found in all research institutions, and is also reflected in the patent, spin-off and contract research activities.

One solution to this serious imbalance in external funding is to reallocate some of the revenues toward institution-wide activities. For example, if the title to intellectual property is owned by the institution, it can use part of the royalty payments to support fellowships or developmental work in other disciplines, as a sort of redistribution mechanism. Universities and PROs may need to consider what sort of compensation scheme should be contemplated for the *losers* in the new system.

INSTITUTION BUILDING

FINALLY, GOVERNMENTS HAVE A ROLE TO PLAY in helping to build the complementary infrastructure to intellectual property regimes. Part of this infrastructure is physical. In Europe and Japan, regional and national governments are helping to establish professional technology transfer and licensing offices, which are both expensive and likely to incur losses initially. Part of the infrastructure is information-based. Governments can help formulate guidelines and best practices, or even offer training and courses, in order to improve the management of intellectual assets in the public sector. Most often, however, the

diffusion of this type of information occurs only after a number of PROs have already experimented with technology transfer.

SUPPORTING TECHNOLOGY TRANSFER

TECHNOLOGY TRANSFER AND LICENSING OFFICES are expensive undertakings. They require an experienced technical and scientific staff, with some legal training in intellectual property rights, contract negotiation and finances, as well as a strong network of client firms. Furthermore, patent applications can cost a couple of thousand dollars in the United States, while in Europe, with translation costs, the figure is around US\$20,000. Thereafter, the patent holder must pay annual maintenance fees. Furthermore, TTOs/TLOs incur legal fees, both for the negotiation of licences and contracts and to defend their IPRs. In 1998-99, Stanford University, which admittedly has had exceptional success, incurred US\$2.7 million in legal fees and US\$3.7 million in unlicensed patent expenses, in addition to an annual operating budget of US\$ 2.3 million. In fact, many institutions operate at a loss, at least in the start-up years. In Australia, the Commonwealth Scientific and Industrial Research Organization (CSIRO) makes a small profit. In 1997-98, it spent \$4.7 million in legal and patent portfolio management costs, against an income of \$5.26 million from its patent holdings.

Countries who wish to promote the creation of TTOs/TLOs in the public research system might consider providing:

- estimates of the costs associated with exploiting and defending IPRs;
- subsidies or other funds for the establishment of TTOs/TLOs;
- studies of costs and benefits of various models of technology transfer and development activities, including: in-house, semi-public, private/contracted out, co-operative or networked, and on-line models. (See OECD, 2000a; Matkin, 2001.)

MODELS, GUIDELINES AND INCENTIVES

AS AN AID TO HEIS AND PROS, governments can provide guidelines and workshops to help institutions build the know-how, rules, procedures and bodies necessary to manage intellectual property, its future revenues, potential conflicts of interests, and public relations crises. For their part, institutions must identify how they will deal with:

- invention disclosure;
- conflict of interest guidelines and procedures;

- rules regarding equity investments;
- IP revenue sharing rules;
- model contracts or suggested best practices for public-private sector agreements.

BUILDING A BETTER IP CULTURE

FINALLY, THERE IS A STRONG ROLE for government to play in building a more generalized entrepreneurial and IP-aware culture. OECD countries are experimenting with different strategies, trying to incorporate IP issues in scientific and business programs and linking research units with industry or legal advice. Examples include the requirement in Switzerland for doctoral students to complete a course in IP, and the Bournemouth University (United Kingdom) practice of linking law and engineering students for advice on IP issues relevant to the research projects engineers are engaged in. Furthermore, governments have a role to play in skills training, re-tooling, and recruitment of managers of public sector IP portfolios. Several OECD countries have estimated the impact of productivity increases on direct and indirect tax revenues.

ECONOMIC IMPACTS AND OUTCOMES

GOVERNMENTS AND INSTITUTIONS seeking to increase the commercialization of PRO research results will likely find it difficult to assess the success of their policies. The easiest indicators are those relevant to individual PROs — patent application and acquisition rates, licensing and royalty revenues, return on equity, and creation of spin-off firms. In many countries, such data is not yet available across institutions, so performance trends cannot be compared. To wit, in 2001, the Association of European Science and Technology Transfer Professionals (ASTP) gathered for the first time data on licensing revenues from 100 universities in Northern Europe. Of equal interest to PROs is the impact of contract research and patenting and licensing activities on research productivity and performance. In other words, how is the new orientation affecting these institutions' *core* mission? Unfortunately, even at the level of individual organizations, very few studies are available to help assess the impact on research agendas and commercial orientation, and the indicators required are not easily accessible to the OECD, national governments, and even research institutions themselves.

Finally, what concerns national governments is the impact of PRO intellectual property on firm performance, and ultimately on the broader economy. OECD countries have been eager to gather data on new technology-based firms, the creation of spin-off ventures, and the jobs they directly generate.

There is very little information on the development and sales of new products and processes or on productivity increases. A few countries (Canada and Australia) have modelled tax revenues based on IP licensed by the public sector.

The last section of the study reviews what measures can be used by governments to evaluate the success of their new IP management strategies, including indicators showing the impact on the local and/or national economy of increased public sector investment in intellectual property. It also looks at how these indicators could be improved for more analytical accuracy and greater policy relevance. Certainly, governments and statistical agencies could improve the collection of data on public research activities in order to understand how indicators could be standardized to increase comparability between institutions, regions and countries.

While numerous economic studies have examined the impact of R&D on economic growth and productivity, few have looked at the role of public IPR activities in stimulating R&D, or measured its effects on employment and firm performance. Measuring the outcomes of specific IP arrangements and licensing practices on the commercialization activities of public research institutions is of major importance to policy-makers seeking to assess the overall impact of public research to the economy.

Assessing these effects requires linking IP arrangements to the economic performance of firms and the research performance of institutions. It also requires defining a set of input and output indicators, such as the cost of licensing activities, the number of patents, revenues collected from licences, and the number of spin-off firms and related turnover. In what follows, we describe briefly some of the most common output indicators.

Impact on Research Institutions

Patents – While patents granted are a useful indicator of the ability and willingness of public research institutions to *protect* their IP, they are not an effective measure of research productivity or economic output as they do not directly reflect the value of the knowledge protected. In addition, some patents may never be exploited or may lapse or be invalidated by subsequent or earlier patents. The citations included in patent applications may nevertheless provide information on related sources of knowledge (public or private). Combining data on the number of patents with data on renewals and litigation may improve the usefulness of patents in economic impact analysis.

Licensing – Income from licences generally takes two forms: fixed fees and royalties. In some cases, so-called *milestone* payments may be provided when the licensee reaches a given stage in the development process or a given level of product sales. However, data on licensing generally reflect

revenue streams from *active* and *exclusive* licences, so the impact of non-exclusive licences is not captured. In general, the duration of a licence and its terms and conditions have a strong bearing on the revenue streams generated. Because some licences may not be exercised until years later (i.e. option agreements), revenues may be understated in any given year.

Equity Revenue – Equity investments by public research institutions and universities may be a useful indicator of the additional income generated by public IP in cases where equity is granted in lieu of licences, as is the case for many spin-off or start-up firms. While a common practice among North American universities, equity participation by public research institutions is prohibited in many countries such as Germany, Italy and Japan, although it is permitted in France in some cases (mainly for public research institutions).

Training of Graduates and Researchers – While difficult to measure, one of the most important qualitative effects of IP and commercialization activities is the training of graduates and researchers. These individuals and institutions benefit from skills acquired in entrepreneurship, collaborative research, business and the law. Society also benefits as they contribute to the broad diffusion of knowledge between the public and private sectors.

Impact on Firm Performance

Innovation and Market Development – The introduction of new products and services developed under licences from public research is one measure of the impact on innovation performance at the firm level. Data on sales and market shares for products developed under public licences offer additional information. While firms created from public research may easily provide such data, it may be more difficult to obtain from firms that have no or few links with public research institutions.

Profitability – Investments by firms on licences or research from public institutions, like other investments, impact on their bottom line. A question for policy-makers is whether firms that use public IP are more profitable than others. Answering this question is problematic because it requires linking specific public research licences to income and expense streams, and controlling against firms in the same sectors that do not have access to similar licences from public research.

Impact on the Economy

Spin-off and Firm Creation – Licensing may have a more observable impact on the economy via the creation of new firms, many of which are established by

the inventor and supported by the research institution (through equity agreements as well as incubator facilities) specifically to develop and commercialize a technology. Data on the number of spin-off firms directly created to commercialize public IP (and on their survival rate) generally come from surveys, but their comparability may be limited due to definitional and data source issues, especially at the international level.

Job Creation – The effects of licensing activities on job creation and the establishment of spin-off firms are both direct and indirect. The number of spin-off firms from public research has increased, and with it the direct employment generated, especially for highly skilled personnel in science and technology. Many more jobs may be created in ancillary firms, such as suppliers and customers.

Tax Revenue – Firms that create jobs and develop products from public research generate tax revenue for local and national governments.

CONCLUSIONS

IN THE OECD, most countries already have in place, or are well on the way to establish, strong IP regimes. This is a prerequisite for nurturing innovative industries and protecting innovation in both the public and private sectors. IP regimes are also being harmonized in various international fora. Of course, governments will have to adapt their IP regimes to new technologies. However, this is not the level of intervention at which government policy can have the most impact on improving the commercialization of publicly funded research.

Central governments have a very important role to play in setting clear guidelines for the assignment of title to publicly funded research results. In many countries, there is still great diversity among institutions as to the ownership of, and sharing of revenues from, publicly funded research. In Canada, there is a split between universities that retain title and universities that give title to the inventor. In Germany, title depends both on the institution and on the source of funding. To the extent that such variation represents a barrier to the commercialization of research results, governments should review the impact of different ownership arrangements.

To generate the largest economic spillovers from the commercialization of research in HEIs and PROs, many countries still need to create a basic infrastructure, which may require legislative changes and a long-term financial commitment. Central governments can provide incentives for the establishment of technology licensing and transfer offices, or extend the services of their patent offices. Individual institutions are faced with the difficult task of building up multi-disciplinary expertise, legal structures, and the large financial resources necessary for marketing and protecting their IP. Promoting a broad-based IP

culture is another task to tackle. Central governments can also formulate rules or guidelines to help individual institutions develop appropriate commercialization strategies. For example, conflict of interest guidelines and model licensing contracts could help public research institutions avoid common pitfalls.

Public research institutions themselves must go beyond simply administering their IP portfolios to strategically manage them. In the process, they must develop safeguards that keep in balance their new commercial orientation with their public mission. This requires establishing procedures with regard to the limits imposed on public dissemination of research results, maintaining independence in the conduct of research, defining rules for financial conflicts of interests and their resolution, and managing growing disparities in funding across disciplines.

Finally, there is a lack of information to help policy-makers assess the social and economic benefits of reforms to IP regimes and their impact on the commercialization strategies of public research institutions. In OECD countries, most assessments of the effects of licensing activities take place at the institution's level, generally on an *ad hoc* basis. Existing organizations such as the AUTM in North America and the more recent ASTP in Europe offer a platform for public research institutions to share best practices and systematically collect information on related economic benefits. Data on practices and on the impact of patenting and licensing in the public sector are difficult to gather in many OECD countries. Government agencies may have a role to play in promoting harmonization of data collection at public research institutions and in the development of methodologies to assess economic and social benefits.

APPENDIX: IP REGIME REFORMS

UNITED STATES

THE UNITED STATES WAS THE PIONEER in reforming incentives for the commercialization of intellectual property in the public sector. From the mid-60s to the 90s, university patenting in the United States has increased more rapidly than overall patenting, and more rapidly than university research spending (Henderson, Jaffe and Trajtenberg, 1995). The number of universities and related institutions acquiring patents has grown six-fold. A recent OECD study notes that "U.S. universities have more than doubled their propensity to patent during the 1990s, as did also U.S. public laboratories" (OECD, 2000a).

Particularly important for the rise of patenting at universities and public laboratories were several changes in federal legislation to facilitate technology transfer of publicly funded research to industry. Most famous is the 1980

University and Small Business Patent Procedure Act (Bayh-Dole Act), which gave universities, non-profit institutions, and small businesses the right to retain the property rights to inventions arising out of federal research grants. It stipulated that in exchange for invention disclosure, proceeds from any invention should be shared between the inventor and his or her institution. A 1984 amendment allowed research institutions to assign their property rights to third parties for further development.⁹ In effect, the legislation simplified and streamlined federal policies on technology transfer, allowing universities “greater flexibility in negotiating licensing agreements” and making firms more willing to enter into agreements with them (Seigal, Waldman and Link, 1999). Similarly, the 1980 *Stevenson-Wydler Innovation Act* (amended in 1986 by the *Federal Technology Transfer Act*) authorized federal laboratories to participate in co-operative research and development agreements with private firms and to assign any resulting patents to these firms.

Since 1980, U.S. policy has been to strengthen intellectual property regimes. The United States was the first country to extend patent protection to many novel technologies and techniques closely linked to fundamental research. In 1980, the U.S. Supreme Court determined that a genetically engineered bacterium capable of breaking down crude oil was patentable, thus opening the door to patent protection for life forms.¹⁰ The first multicellular organism (polyploid oysters) and animal (the Harvard *oncomouse*) patents followed suit in 1987 and 1988. Patents are now granted for engineered organisms, methods of transforming cells and expressing proteins, genes and even gene fragments. The rapidity with which the United States has extended protection to biological inventions has probably benefited universities, whose upsurge in patenting since the 1980s is very much focused on biomedical sciences.¹¹ Over 50 percent of biotechnology patent applications from 1971 to 1998 have been filed by universities and research institutions (Morifuji, 2000). Similarly, the United States has also been at the forefront of countries granting patent protection to software programs and Internet-based business methods, another field with strong ties to universities. The number of U.S. patents granted in software-related patent classes has increased three-fold from 1990 to 1999 (OECD, 2000b). The United States has also improved the ability of IPR holders to defend their rights by establishing, in 1982, of a Court of Appeals for the Federal Circuit with special expertise in intellectual property disputes.

Of course, changes to the U.S. IP regime did not occur in a vacuum and so cannot be held solely responsible for the upsurge in university patenting. New industrial R&D practices, perceived federal R&D budget constraints and the proliferation of technology transfer offices have also played a role. Nor has a seamless transfer of technology from the public to the private sector been fully achieved. A recent paper (Hall, Link and Scott, 2001) shows that the lead participants in 32 percent of government-funded Advanced Technology Partnerships

claimed that IP issues were an insurmountable barrier to forming a partnership with a university — especially if the outcome of the research is relatively certain but the appropriability of the results low. Nevertheless, over the past 20 years, the United States has instituted a wide range of IP reforms, many of which have had a real impact on how public sector research institutions manage their IP portfolios.

Following the U.S. lead, most OECD countries have also instituted IP reforms, as well as clarified and modernized their laws regulating ownership of publicly funded research results in order to facilitate commercialization.

JAPAN

OVER THE PAST 30 YEARS, Japan has made radical improvements to its intellectual property regime. As the country became a lead producer of technology, there was growing pressure to strengthen its IP regime and harmonize it with those of other advanced industrialized countries. Among the major changes in the field of patents, Japan has:

1. broadened the scope of patentable subject matter, through laws and practice;¹²
2. reduced costs and increased flexibility, by allowing multiple claims in a single patent application, reducing patent fees (especially for academia and start-up firms), adopting an electronic application system and accepting English-language applications;
3. simplified patent application procedures, by loosening the requirements for the description of specifications (which is especially helpful in new fields and technologies) and simplifying appeal and trial procedures;
4. extended patent life, by adopting a post-patent grant opposition system, shortening the examination period, extending the term of the patent right and making patent terms TRIPs compliant;
5. strengthened the rights of patent holders by raising the criminal penalties for infringement, reforming the damage and compensation system as well as the remedy measures against infringement.

The net result has been that the Japanese IP regime has become far more *pro-patent* in 2000 because the protection afforded is broader in scope and easier to obtain and defend (Morifuji, 2000).

In addition, the Japan Patent Office (JPO) has extended protection to new technologies relatively quickly. For example, it gradually granted patent protection to software programs. In the early 1980s, software-based inventions

for micro-computer controlled devices and hardware control were patentable, and patent protection was extended to conversion programs, then to programs stored on a particular medium. In addition, Japan has always allowed patents for business methods, which is especially relevant for e-commerce. The JPO has actively advertised this because it feared that many industries were not aware that their business method innovations could be protected. In biotechnology, Japan has extended protection to single, multicellular and animal inventions, and to gene-based inventions as long as there is a clear inventive step.

In the late 1990s, the Japanese government began to create conditions for better IP management in public research organizations. For one, national research institutes, and possibly national universities thereafter, will soon become independent administrative legal entities with much greater freedom in their business activities. Already, while the government owns in principle intellectual property resulting from research performed at national research institutes, *joint* IP ownership between the government and researchers has recently been permitted. In 1998, NRI researchers co-owned 14.4 percent of the organization's patents (Shimoda and Goto, 2000). Nevertheless, government consent is still required for the exploitation of IP by third parties, which may slow the commercialization process.

In universities, the ownership of an invention is determined by a committee, which often decides in favour of the researchers. In 1998, invention committees gave title to researchers in 77.9 percent of cases (Shimoda and Goto, 2000). New initiatives have been taken to better support the commercialization of inventions held by individual researchers. Firms that contract research from universities are now allowed to own a part (up to one half) of the rights to patents originating from the contracted research. Furthermore, in 1998, the *Technology Transfer Law* granted subsidies and reduced patent fees for technology licensing organizations that met certain criteria and received approval by the Ministry of Education and the Ministry of International Trade and Industry. By December 2000, 17 such organizations had received approval. It is hoped that they will improve the effectiveness of technology commercialization.

Furthermore, in 1998, Japan Science and Technology (JST), a government-affiliated organization, began to acquire and commercialize inventions developed in universities and national research institutes. For university research, rights to the invention are transferred to JST, which bears the costs of the patent application and subsequent maintenance. If the commercialization is successful, JST returns 80 percent of royalties back to the researchers. In the case of national research institutes, patent applications provide for joint ownership between JST and the government. JST subsidizes initial product development work at a private firm, and only asks for repayment and royalties from the firm when the project is deemed successful according to pre-agreed technical criteria (Shimoda and Goto, 2000).

TABLE 3

NUMBER OF PATENT APPLICATIONS BY JAPANESE NATIONAL UNIVERSITIES

	1994	1995	1996	1997	1998	1999
Domestic	26	25	35	75	138	191
Foreign	21	23	22	34	73	93

Source: Shimoda and Goto, 2000.

Despite these radical changes to the Japanese IP regime, the impact on public sector research remains relatively modest. While contract research and donations increased 162 percent from 1988 to 1998 (stabilizing in the mid-90s), patenting in universities and national research institutes was relatively low (Shimoda and Goto, 2000). It is hard to get trend data as university researchers own title to their research, and technology transfer to third parties often takes an informal character and is not officially recorded. However, between 1997 and 1999, invention disclosures at Japanese national universities almost tripled, going from 650 to 1,721, while patent applications increased two-and-a-half times (Shimoda and Goto, 2000). See Table 3.

In sum, the Japanese IP regime has undergone major transformations, but its influence on public sector intellectual property has lagged. Novel policies have recently been put in place at national universities and research institutes to try to incite them to produce, manage, and transfer technology to the private sector. These policies seem to have an effect on invention disclosures, but only time will tell how well they will succeed.

EUROPE

THE EUROPEAN SYSTEM for protecting intellectual property is also in transition, with pressures to create a uniform and eventually unitary system of protection propelling European intellectual property practices and statutes forward. In Europe, each country maintains a national system of IP protection. Since 1977, there is also a centralized patent grant (and opposition) system administered by the European Patent Office (EPO), which was established to promote uniform practices across Europe.¹³ The EPO reviews applications and decides whether to grant a European patent. Patents granted are then transferred to and administered by the countries designated by the applicant. The EPO system is cost-effective if an applicant is seeking protection in three or more countries, but it is nonetheless considered relatively expensive, which is believed to be an obstacle to the widespread use of patents in Europe. Ongoing revisions to the European Patent Convention (EPC) and discussions about the creation of a standard Community patent should eventually have major implications for

public sector research organizations, especially as regards the possible introduction of a grace period and the harmonization of prior user rights.¹⁴ A European judicial system for settling patent disputes is also under consideration.

In terms of patentable subject matter, the multiplicity of legal systems within the European Union means that the Commission has an important role to play in promoting the harmonized adaptation of legislation to the evolving technological situation through directives and regulations.¹⁵ In Europe, there are express statutory provisions excluding some products and processes. To date, computer programs *as such*, and certain biotechnology inventions are not patentable according to the EPC, although in practice thousands of software-related patents have been issued (Hart, Holmes and Reid, 2000).¹⁶ Consultations to extend the current European patent system to software were roundly voted against at the recent Diplomatic Conference to Revise the EPC (held in November 2000). Nevertheless, developments in biotechnology, medical procedures, software and the Internet are continuing to put pressure on countries and the European Commission “to remove exclusions from patentability and to harmonize national rules” (European Technical Assessment Network, 1999). So, there is indeed movement toward modernization and harmonization of the IP regime in Europe, although it remains less statutorily *pro-patent* than the U.S. regime, and individual countries have less freedom to tinker with their own national IP regime in order to pursue innovation policy goals.

Compared to the United States, the output of patentable inventions from universities and public laboratories is low in Europe. Trend data are not easily available, so it is difficult to say what effect the modernization of the European IP regime may have had.

However, individual countries have jurisdiction over the rules concerning the ownership and exploitation of publicly funded or publicly performed research. In Europe, there are enormous differences across countries in both the assignment of ownership over research results and the sharing of future royalties or sales revenues between the state, the research organization and the researcher (OECD, 2000a). Tables 4 and 5 below give a comparison of European practices in this regard with those of other countries. Even within a country, various rules co-exist depending on the research fund granting and performing institutions involved. “This lack of clarity and diversity in national and institutional guidelines for IPRs can be a barrier to commercialization insofar as it increases the risk and transaction costs of cooperation for industry...” (OECD, 2000a). Some countries are considering more consistent rules to govern ownership of research results as one way of promoting commercialization. Indeed, an emerging consensus seems to be that granting researchers ownership may not be the most effective way to promote commercialization because researchers do not have the necessary know-how or financial resources to do so. The German government is rescinding the *professor's privilege*, as the Dutch government has

TABLE 4**OWNERSHIP OF IPRs FROM PUBLICLY FUNDED RESEARCH**

OWNER OF IPR	PERFORMERS OF RESEARCH			
	UNIVERSITIES	PUBLIC LABORATORIES		
Researcher	Austria Belgium ¹ Canada Germany ² Finland	Japan Iceland Italy Norway		
Research Institution	Austria Canada Israel United States	United Kingdom ³	Finland ⁴ Germany ⁵ Hungary Israel Korea Mexico Austria Belgium ⁷	Netherlands New Zealand Norway Poland United Kingdom ⁶ United States France Japan
Joint Ownership				
Source: OECD, 2000a, based on country answers to a questionnaire. Notes: 1 Flanders. 2 Use of institutional funds. 3 Exceptions exist. 4 Academy of Sciences. 5 Grant recipient. 6 BBRCs. 7 Wallonia.				

already done. The Danish government is considering a system that would increase the incentives for researchers to assign title to their institution. Ownership is probably best vested in institutions that are tasked with ensuring commercialization. To date, however, changes in this direction have been slow. And the European Commission is unlikely to push for harmonization because that question touches on sensitive national employment laws.

Other levers exist to influence public research institutions and many European countries have actively tried to change the incentive structures for the development and commercialization of intellectual property by promoting an entrepreneurial culture, establishing technology transfer offices and IPR centres, using inventor compensation schemes or loosening civil servant regulations (European Technical Assessment Network, 1999). As funder of research and facilitator of collaborations, the European Commission is also intervening in both the allocation of research results and in the types of contracts that institutions can subsequently engage in by establishing guidelines and model contracts (Foray, Steinmueller, Crede, Swann, Windrum and Antonelli, 1999).

TABLE 5

NATIONAL OR INSTITUTIONAL GUIDELINES FOR SHARING ROYALTIES FROM INTELLECTUAL PROPERTY RIGHTS

	APPLICABILITY	INVENTOR	SHARE OF ROYALTIES		NO SHARING
			LABORATORY/ DEPARTMENT	INSTITUTION	
Australia	Universities	33%	33%	33%	
Austria	General Practice				100% to Owner
Belgium	Flemish Universities	10 to 30%	50%	20 to 30%	
Canada	Federal Research	35% by Law	Variable	Variable	
France	Public Labs	25%	25%	50%	
Germany	Max Planck and HGF Centres	33%	33%	33%	
Hungary		0%	Undetermined	Up to 100%	
Israel	Hebrew University	33%	33%	33%	
	Weizmann Institute	40%	0%	60%	
Italy		0%	Undetermined	Up to 100%	
Japan	Universities				100% to Owner
Korea	KIST Institute	Up to 60%	0%	40%	
Mexico	Public Labs				100% to Owner
Netherlands	Public Labs				100% to Owner
Poland			No General Rule		
United Kingdom	BBRCs	Sharing Encouraged in Institute Guidelines			
United States	Universities	Sharing Required by Law			
	Stanford	33%	33%	33%	
Source: OECD, 2000a, based on country answers to a questionnaire.					

Source: OECD, 2000a, based on country answers to a questionnaire.

ENDNOTES

- 1 Based on the Background Paper prepared for the OECD TIP Workshop on the Management of IPRs from Public Research, held in Paris, December 11, 2000. (See Callan and Cervantes, 2000; and OECD, 2001). For information and presentations related to the Workshop, see: http://www.oecd.org/document/44/0,2340,en_2649_201185_2675244_1_1_1_1,00.html (accessed on April 22, 2005).
- 2 The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs) was negotiated as part of the Uruguay Round of the General Agreement on Tariffs and Trade (which became the WTO); it was signed in 1994 and came into force in 1996. Bilateral agreements usually involving either the United States or the European Union have also been important for standard setting, as have other multilateral agreements such as the North American Free Trade Agreement

- (NAFTA) or those negotiated through the World Intellectual Property Organization (WIPO) or the European Union.
- 3 In the TRIPs Agreement, mandatory protection was not extended to certain technologies and fields whose commercial relevance has since become more obvious and which continue to be treated differently across countries. These include: databases, software, a range of gene-based inventions, and satellite signals.
 - 4 Definition taken from Stephen Krasner.
 - 5 The European Association of Research Managers and Administrators and the Technology Transfer Institute. The Association of Science and Technology Professionals is a third independent grouping of technology transfer professionals.
 - 6 The emerging principle is that universities have three missions, or pillars (the so-called “triple helix”): education, research, and the rapid diffusion of research results within the economy. The debate is about how important this third pillar ought to be, and how much it should be allowed to overshadow the other two. Norms of behaviour which are now accepted in many countries include: researchers acting as consultants, board members and part-time employees of firms; investments by PRO in technology incubation, transfer/licensing and spin-offs; private sector funding of research accompanied by a variety of contractual rights to research results.
 - 7 The final Guidelines were published on January 5, 2001. For a copy of the Federal Register announcement see: <http://www.uspto.gov/web/offices/com/sol/notices/utilexmguide.pdf> (accessed on April 22, 2005).
 - 8 See Farrar, 2000.
 - 9 The *Bayh-Dole Act* also mandated that faculty members working on federal research grants disclose their inventions.
 - 10 Supreme Court of the United States, *Diamond v. Chakrabarty*, 447 US 303.
 - 11 See Mowery and Ziedonis, 2000.
 - 12 In 1975, to conform to TRIPs, Japan extended patent protection to chemical substances (not just the process by which they are made), and in 1995 it extended protection to the transformation of atomic nuclei. The practice at the Japan Patent Office has also gradually evolved to grant protection for software, business method and biotechnology innovations.
 - 13 The European Patent Office is an international patent granting authority, separate from the European Commission, established under the European Patent Convention (EPC) of 1973, which came into force in 1977.
 - 14 In addition to the EPO, there is a Community trade-mark. The European Community’s Office for Harmonization in the Internal Market was established in 1994 and is responsible for the registration and subsequent administration of Community trade-marks and future Community designs.
 - 15 See, for example, the 1996 Directive on the Legal Protection of Databases, the Biotechnology Directive, the 1993 Directive on Harmonizing the Terms of Protection of Copyright and Certain Related Rights, and the 1991 Directive on the Legal Protection of Computer Programs.
 - 16 These patents have been issued because the program was deemed an invention of a *technical character*.

BIBLIOGRAPHY

- Callan, Bénédicte, and Mario Cervantes. 2000. *Background Paper: Managing Intellectual Property Rights from Public Research*. TIP Workshop Room Document No. 5, Paris, OECD (December).
- Campbell, Eric, Joel Weissman, Nancyanne Causino and David Blumenthal. 2000. "Data Withholding in Academic Medicine: Characteristics of Faculty Denied Access to Research Results and Biomaterials." *Research Policy* 29: 303-312.
- Cho, Mildred. 2000. *Safeguarding the Freedom of Research and the Broad Diffusion of Knowledge*. Presentation at the Benchmarking Science-Industry Relations Joint German-OECD Conference. Berlin (16-17 October). Available at <http://www.industry-science-berlin2000.de/pages/frames.html>.
- European Technical Assessment Network. 1999. *Strategic Dimensions of Intellectual Property Rights in the Context of Science and Technology Policy*. ETAN Working Paper. European Commission, DG XII (June).
- Farrar, Steve. 2000. "Gag on Lab Talk Among Friends." *The Times Higher Education* (February 25), p. 30.
- Foray, Dominique, E. Steinmueller, A. Crede, P. Swann, P. Windrum and C. Antonelli. 1999. "Collective Invention and European Policies: Colline, Executive Summary." Unpublished paper.
- Hall, Bronwyn, Albert Link and John Scott. 2001. "Barriers Inhibiting Industry from Partnering with Universities: Evidence from the Advanced Technology Program." *Journal of Technology Transfer* 26, 1-2 (January): 87-98.
- Hart, Robert, Peter Holmes and John Reid. 2000. *The Economic Impact of Patentability of Computer Programs*. Report to the European Commission. London: Intellectual Property Institute. Available at: http://europa.eu.int/comm/internal_market/en/ind-prop/comp/studyintro.htm (accessed on April 22, 2005).
- Henderson, Rebecca, Adam Jaffe and Manuel Trajtenberg. 1995. *Universities as a Source of Commercial Technology: A Detailed Analysis of University Patenting 1965-88*. NBER Working Paper No. 5068 (March).
- Human Genome Sciences Institute. 1999. *HGS Annual Report*. Available at www.hgsi.com/invest/annual99/toc.htm
- Matkin, Gary. 2001. "Fostering High Tech Spin-off: A Public Strategy for Innovation." *STI Review* 26, 1, Paris: OECD.
- Mena, Jesus, and Robert Sanders. 1998. "Swiss Pharmaceutical Company Novartis Commits \$25 Million to Support Biotechnology Research at UC Berkeley." Public Affairs Press Release (November 23). Available at www.berkeley.edu/news/media/releases/98legacy/11-23-1998.html.
- Morifuji, Atsushi. 2000. "Patent Statistics" and "Business Method Patents." Unpublished papers. Japanese Patent Office (June).
- Mowery, David, and Arvids Ziedonis. 2000. "Academic Patent Quality and Quantity Before and After the Bayh-Dole Act in the United States." Unpublished paper. *International Conference on Technological Policy and Innovation*. Paris. (20-22 November).

- OECD. 2000a. *Industry Science Relations: Interim Report*. DSTI/STP/TIP (2000)6, Paris: OECD.
- OECD. 2000b. *The Software Sector: Growth Structure and Policy Issues*. DSTI/ICCP/IE(2000)8, Paris: OECD.
- OECD. 2001. *Workshop on the Management of Intellectual Property Rights from Public Research* DSTI/STP/TIP (2001)11, Paris: OECD.
- Rausser, Gordon. 1998. "Letter to the Editor." *The Chronicle of Higher Education* (December 21). Available at www.cnr.berkeley.edu/~reynolds/srr/rausser/chronicle.htm.
- . 1999. *Public Private Alliances*. Presentation to the AgBio Forum (April). Available at www.cnr.berkeley.edu/~reynolds/srr/rausser/publicprivate_alliances.htm.
- Seigal, Donald, David Waldman and Albert Link. 1999. *Assessing the Impact of Organisational Practices on the Productivity of University Technology Transfer Offices: An Exploratory Study*. NBER Working Paper No. 7256 (July).
- Shapiro, Carl. 2000. "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting." Policy Center, University of California, Berkeley. Paper CPC00-011 (May). Available at <http://repositories.cdlib.org/iber/cpc/CPC00-011>
- Shimoda, Ryuji, and Akira Goto. 2000. "Industry Science Relationships in Japan." Unpublished paper produced for the OECD.
- Stanford University. 1999. *Office of Technology Licensing, 1998-99 Annual Report*. Stanford. Available at <http://otl.stanford.edu/about/resources/otlar99.pdf>.

OTHER REFERENCES

- Jensen, Richard, and Marie Thursby. 1998. *Proofs and Prototypes for Sale: The Tale of University Licensing*. NBER Working Paper No. 6698 (August).
- OECD. 2003. *Turning Science into Business: Patenting and Licensing at Public Research Organisations*. Paris: OECD.
- Tsukamoto, Y. 2000. *IP Policy Approach in Japan*. Presentation to the Workshop on the Management of Intellectual Property Rights from Public Research. Paris: OECD (December 11).



Gilles Paquet & Jeffrey Roy
University of Ottawa

15

The Canadian Intellectual Property Office as Innovation Catalyst¹

MANDATE

THE MANDATE of the Canadian Intellectual Property Office (CIPO) is to help accelerate Canada's economic development by promoting the use of intellectual property systems and the exploitation of intellectual property information; encouraging invention, innovation and creativity in Canada; administering the intellectual property systems in Canada; and defending Canada's international intellectual property interests.

A challenging question is whether CIPO could do more in contributing to Canada's knowledge-based economy. This study assesses the broad context within which CIPO operates, the future directions one may conjecture as being of import for CIPO, and the prospective roles of CIPO in contributing to and nurturing Canada's knowledge-based economy.

... will intellectual property be struck by obsolescence with the advent of digital networks, or conversely could it become the foundation of the new information law that has to be developed in order to regulate the knowledge-based society of tomorrow?²

INTRODUCTION

CIPO'S MISSION IS TO HELP FOSTER Canada's economic progress by ensuring the highest and best use of intellectual property systems and intellectual property information.

This mission is increasingly difficult to discharge in a turbulent economic environment characterized by an ever faster pace of innovative activities, and accelerating technological change, that have transformed not only

the innovation patterns themselves, but also the nature of the coordination and governance processes underpinning them. Public authorities must also adapt their role to these new circumstances.

The central question is whether CIPO should modify its role, add to the array of services it provides, and increase its range of capabilities to contribute as effectively as possible to the progress of Canada's knowledge-based economy. The study will try to answer this question.

The challenges facing exclusive rights are becoming ever more critical and vexing in the 21st century, as e-business, digital products and new financial services take on more importance (new context), as ethical and environmental concerns become more encompassing (new concerns), and as consumer and stakeholder interests occupy a larger place in the forum (new stakeholders). For CIPO, such a transformed, dynamic, and fast-changing environment — characterized by heightened competitive pressures to innovate, stronger client responsiveness, and growing strategic discussions by all stakeholders around the role of intellectual property regimes — raises fundamental challenges.

In this turbulent environment where guideposts are constantly modified by evolving circumstances, the new centrality of social adaptive learning, and the new importance of collaborative networks as a necessary tool of accelerated social learning, together with the emergence of a new digital infrastructure that transforms the rules of the game by increasing the capacity to connect with or to disconnect at will, are likely to modify considerably CIPO's manoeuvrability margins. The latter must therefore become a learning organization and adapt as fast as possible to these changing circumstances.

The first section explores the underpinnings of the emerging knowledge economy, the role of intellectual property (IP) as a strategic determinant of innovation activities and industrial competitiveness, and the new governance challenges associated with these circumstances. The second section focuses on the intellectual property regime as a learning system in this dynamic setting and examines how it requires ongoing transformation to fulfil its critical role. The third section reviews very briefly how different countries have met these challenges. Finally, the fourth section puts forth a set of strategic options for the Canadian agency.

GOVERNANCE AND THE INTELLECTUAL PROPERTY REGIME IN A LEARNING ECONOMY

IN A KNOWLEDGE-BASED/LEARNING ECONOMY (KBLE), wealth creation is rooted in the capacity to mobilize and to make the highest and best use of collective intelligence in the production and dissemination of knowledge: learning is harnessing the collective intelligence of the community of practice

or team as a source of continuous improvement. This, in turn, commands new modes of production of knowledge and new modes of collegiality, alliances and sharing of knowledge, a degree of cooperation to take advantage of positive externalities, economies of scale and scope, and strong cumulative experience-learning processes.

The knowledge-based/learning economy modifies dramatically the rules of the game vis-à-vis what prevailed in the Industrial Age. One may identify three important ways in which the tonus of the new economy is affected: (1) the performance criteria are transformed, (2) the spatial coordinates are modified, and (3) the adoption/adaptation dynamics are dramatically altered. Each of these features impacts on IP and how it is created and disseminated within a particular jurisdiction.

(1) The drift toward a knowledge-based/learning economy has also transformed the performance metrics. In a resource-based economy, competitive advantage is derived from national endowments, while in an industrial economy, it is derived from productivity and efficiency. In the KBLE, these factors retain some importance, but competitive advantage must be earned much more fundamentally through creativity, the capacity to transform and learning. Learning and innovation are at the heart of economic success.

For the individual entrepreneur, the intellectual property regime sets the rules of the game that provides the necessary incentive and reward mix (when it works well) for creation and inventive activities. The same may be said about corporations — where innovative activity is a key driver of corporate performance. Patent portfolios are a key source of market credibility for emerging firms — and a key source of revenues for larger firms that are increasingly pursuing IP infringement as a source of revenue.

This entails a change in the metrics to be used. Since the creative commons is the source of competitive advantage, one must take into account the health of the creative commons in allocating property rights and privileges. Impact studies to ascertain whether some action is likely to facilitate or hinder innovation must be given some prominence in defining the scope and ambit of regulation (Lessig, 2001, p. 255).

(2) Governments have always felt pressures to be responsive to industrial clients and their changing needs, but their responses pertained largely to domestic issues. But as globalization prevails, new roles are emerging for national governments. The emergence of a transnational environment that seeks to expand rules-based governance regimes through global institutions such as the World Trade Organization (WTO) is forcing national governments to work at developing a fair understanding of *how differences across the still-dominant national systems may impact on productivity, competitiveness and innovation*.

In a small, open, and trade-dependent nation such as Canada, private firms must feel confident that their domestic setting provides an adequate base

from which to seek and penetrate foreign markets. The new transnational setting poses challenges to IP rules that focus largely on the national context. Part of the challenge is extra-mural compliance to national rules, but an equally and perhaps more important part is competitive intelligence — the need to understand what other countries are doing and why they are pursuing particular paths in order to determine what adjustments are required to Canadian rules to ensure that Canadian firms (private, public and civic) can compete effectively.

While global rules have been slow in crystallizing, regional and continental rules have emerged. Given Canada's trade concentration in North America, the North American Free Trade Agreement (NAFTA) and NAFTA-based governance rules [with or without the ominous shadow of the Free Trade Agreement of the Americas (FTAA)] are likely to exert immense pressure toward continental harmonization, or at the very least better coordination across countries on a widening range of policy issues and regulatory processes.

Nonetheless, these new cognitive realities are not confined to individuals or corporations. Innovation is increasingly nurtured through synergistic flows of knowledge that encompass networks of private firms, public institutions and civic intermediaries. Moreover, these systems of innovation are increasingly localized in nature, meaning that while there may be national parameters to keep in mind, the main drivers may tend to be much more localized. These new local systems of innovation obviously raise new challenges and new opportunities for intellectual property regimes that are nation-based but increasingly recognize the erosion of national boundaries.

(3) It is not sufficient to deal only with creativity and invention. One must strike a balance between rewarding invention and fostering dissemination. This balance is all the more important in the context of the KBLE since value-added may be less than optimal if new capabilities are prevented from being widely used, or if knowledge about new capabilities is not widely shared. There are often disagreements across cultures and industries on the precise nature of this balance.

The choice of national rules in any particular country will have an important impact on this balance. An undue bias toward rewarding invention and protecting the interests of inventors may translate into very poor use of their innovations (in a shared and systemic fashion) by other parties. Similarly, an undue bias toward dissemination will reduce incentives for parties to invest in research and more substantial innovations — for fear that insufficient protection may not allow for a sufficient payback.

In a reasonably static socio-economic environment, such a balance is easily arrived at through rule setting, compliance and enforcement, and a shared understanding of these rules and procedures across a limited range of key stakeholders. In a more turbulent setting, such as the KBLE, this balance is

more fragile and in a constant state of flux — its definition requires learning and the challenge is primarily one of governance to enable such learning.

The centrality of learning drives a need for an expanded usage of partnership-based governance. These new partnerships call for a subtle governance process in dealing with the production, protection and dissemination of new knowledge. The result of this shifting governance context is that coordination within the intellectual property regime is an increasingly complex and consequential challenge.

Governance connotes processes of effective coordination and decision-making in an environment where information, power and resources are widely disseminated. In the KBLE, the governance of the intellectual property regime underpins the performance of the socio-economy as a whole, as well as the performance of its individual organizations. This performance link is ascribable to the centrality of knowledge and learning, and the resulting complexity of coordination due to the relational dynamics of governance for the learning and innovation systems evolving within an intellectual property regime.

For an agency such as CIPO, the new governance challenges are tied to the need to find ways to cope effectively with four prevalent and inter-linked sets of forces — all of which are likely to reshape the governance of an intellectual property regime. They are globalization, commercialization, diffraction, and e-linkage.

Globalization – CIPO must effectively align its own procedures and processes with the international contours developed by a global rules-based regime. Moreover, CIPO can provide critical services to Canadian clients (particularly smaller firms) to increase their readiness for global competition.

Commercialization – Those seeking IP protection via CIPO do so in an increasingly competitive environment, and the process costs (i.e. search, maintenance, enforcement etc.) can play an important role. Moreover, the information accumulated by CIPO may be an important source of value for other clients in the economy seeking to make choices about their own potential paths to invention, or simply incremental innovation and improvement.

Diffraction – To improve its own learning capabilities and service-delivery abilities, CIPO must continuously consult with a variety of stakeholders, including direct and indirect clients, as well as intermediaries. This process challenge is crucial to the systemic effectiveness of the intellectual property regime.

e-linkage – The rise of e-governance is opening new opportunities for both online service delivery and stakeholder consultation, and it is beginning to raise new challenges and debates about the nature of IP protection in the KBLE.³

The specific impacts of these forces on CIPO are addressed in sections three and four below; yet, what is clear is that a new and increasingly strategic role is required in this governance setting, more focussed on being a catalyst for knowledge, innovation and collective action. The specifics of such a transition

require a broader understanding of learning governance, and how the intellectual property regime functions as a learning system.

THE INTELLECTUAL PROPERTY REGIME AS A LEARNING SYSTEM

IN THE NEW KBLE CONTEXT, learning is a critical element of good governance. This entails a triple challenge: first, to understand the learning dynamism in the new cognitive division of labour it wishes to interfere with; second, to master ever better the ways to facilitate knowledge production and dissemination in this system; third, to improve CIPO's ability to learn faster about how to deal with the first two challenges. Therefore, it is crucial for an agency whose mission is to enhance the performance of systems of production and dissemination of new knowledge to build on a good understanding of the learning system it is purported to be helping.

KNOWLEDGE MANAGEMENT AS THE BASIS

KNOWLEDGE MANAGEMENT (KM) is fundamentally about how an organization or a more encompassing governance system (such as a region or country) recognizes, captures, processes and deploys information and intuition, and makes the highest and best use of them to produce and disseminate new knowledge.

Many proponents of KM distinguish between *information* and *knowledge*. The former refers to all sources of data, useful and relevant or not, whereas the latter denotes something that represents or possesses a potential source of value. In other words, information can be about noise, particularly in a digital world where its availability is growing exponentially while knowledge is a subset of information that captures something more important that is value-adding.

KM is the capacity to sift through information, decide what is relevant, and transform selected information into knowledge. Knowledge is then deployed to add value to the organization — perhaps by creating new efficiencies, generating innovations or adding to organizational learning.

Intuition is also an important part of knowledge management — adding a critical and complex dimension to the KM equation. It is sometimes referred to as “tacit knowledge” because it is non-codified — it is accepted and used, often unwittingly, even if it is not and cannot be recorded in an explicit manner.

A central challenge is to determine how such tacit knowledge can be made explicit, and be more effectively tapped and shared. An important component of the emerging role for a public authority such as CIPO is to manage knowledge flows across the economy — seeking positive learning externalities for potential innovators along with adequate protection for inventors.

This underlines the triple-looped social learning of CIPO: the genius of the patent system is (1) to ensure in a decentralized way that an ever greater amount of new information and intuition is transformed into explicit transferable knowledge; (2) to ensure that this knowledge is ever more effectively transferred to all organizations capable of value adding with the help of such knowledge; (3) to ensure that CIPO itself as knowledge manager becomes capable of learning faster how to transform and re-invent itself to be able to accomplish both these contrasted tasks.

SOCIAL LEARNING AS THE OBJECTIVE

A LEARNING SYSTEM IS AN INFORMATION SYSTEM that has the capacity to produce new knowledge. The importance of social learning is beginning to permeate discussions around IP strategy and the role of public authorities in particular — both in a direct and relational sense. For instance, the *Journal of International Law* has recently organized a Symposium on Intellectual Property, and the conceptual framework underpinning these discussions emphasizes the importance of self-enforcement, on the part of private parties, for the sustainability of the intellectual property regime.

At the heart of the debate is the need for not only rules but also shared values. This underlines the dual nature of a resilient intellectual property regime: first, a basic sociality or ethos underpinning the capacity to build conventions and adherence to norms; second, a governance system or an incentive reward system able to ensure a willingness to partake in the process and to honour one's commitment.

The fostering of a shared ethos will be a critical determinant of the functioning of an intellectual property regime and of its contribution to innovation and prosperity — it will underpin the definition of acceptable and useful behaviour on the part of an agency like CIPO. To put this argument another way, public authorities must view their services and strategies as elements of a more encompassing system — within which interdependencies and relational governance determine their role.

Since one cannot presume that the sociality/ethos is very deep when different constituencies have irreconcilable interests (because one has then to presume that their ties are weak), the burden on the governance regime is heavy. It must succeed not only in balancing these interests (against one another and against those of other generations) but also in providing the right incentive reward system *ex ante* to generate the requisite self-enforcement of IP rules.

This will require extensive dialogue with all stakeholders in order to ascertain what mechanisms might be missing to ensure the needed compliance.

In this regard, it is useful to distinguish between organizational learning and collective learning. Organizational learning looks at the internal adaptive capacities of private, public or civic entities to manage different forms of knowledge (tacit vs. codified) and transform them into innovative strategies. In an environment of market uncertainty and technological change, adaptive capacities allow an organization to reach out to continually update its knowledge base and integrate that new knowledge to strengthen its internal performance.

Building on the work of Camagni (1991) and others, and the dynamics of an innovation environment, Lawson and Lorenz suggest that *collective learning* is the product of linkages between tacit knowledge flows and the region's innovative capacity. In other words, production and innovation systems are interdependent elements of a form of learning that rests almost exclusively on knowledge management mechanisms (1999).

This underlines two fronts on which the intellectual property regime must build the required mechanisms to support the most effective social learning.

CIPO AS ANIMATEUR

IN SUCH AN ENVIRONMENT, an IP organization such as CIPO must reframe its role as one of *animateur* within a fluid environment of uncertainty and change: what may be as important as the nature of services offered is the way in which such services are offered and the degree of learning that flows across stakeholders in a shared governance setting as a result of these services.

In a sense, the greater turbulence in the environment has transformed dramatically the role of CIPO. Instead of being a simple gatekeeper or a guardian of static privileges or entitlements, CIPO, in order to play its role properly, has to become a player in a game without a master. It has to intervene strategically in full awareness that its activities will trigger adjustments by stakeholders both in Canada and elsewhere.

Moreover, CIPO's role is not to act simply as an enforcer of rules that are ever more fluid and volatile, but as a pro-active agent intervening on behalf of national actors in a global game without absolute set rules, while being equally active in ensuring the maximum emergence of explicit patentable knowledge from the national cognitive base and the best protection of it.

Ryan (1999) provides a useful and effective discussion of the new context of an intellectual property regime — one of overlapping and interdependent institutional layers that shape innovation, competition, productivity and development. He points out that know-how and learning capabilities tend to become institutionalized as sector-specific knowledge, organizing principles and governance structures, and these patterns of sectoral competitiveness tend to establish their own path-dependent trajectories (Ryan, 1999).

Thus, a critical aspect of public action as a source of value creation (or positive externalities in the language of economists) is not only to provide a stable, transparent and responsive IP regime for those seeking protection, but also the ways in which it helps tacit knowledge emerge explicitly, provides ways to optimize the utilization and dissemination of knowledge gathered from these processes, and fosters sharing of this knowledge.

In other words, there is a critical knowledge management function emerging for public authorities that has yet to be fully executed.

THE E-GOVERNANCE WORLD AS AN DAUNTING CHALLENGE

THE NEW DIGITAL ENVIRONMENT built around the Internet is a disturbing element that shakes profoundly the foundations of the present intellectual property regime, yet it is also an enabling force that might foster a more effective knowledge management strategy.

As digital property and *informational goods* become more prevalent, the old intellectual property regime based on the protection against reproduction of intellectual property could appear quite deficient. It is not only a question of the cost of copying falling from quasi-zero to zero. The very quality of reproductions has improved in such a way in the digital world that differences between the original and the copy have been trivialized. Moreover, *copying* being de-territorialized, the traditional territory-based intellectual property regime has become considerably less effective.

To what extent can a system designed to protect against the unauthorized *material reproduction* of a virtual object be extended to a world in which there is no necessary material reproduction? What is required is the development of a law on informational goods to enrich the present legal system pertaining to material objects and meet the challenges of de-territorialization.

The intellectual property regime as a learning system calls for effective coordination across stakeholders to raise awareness about what is available, how it can be accessed and at what cost, and the expected benefits to stakeholders such as individual entrepreneurs who might otherwise be unaware of the opportunities. This entails nothing less than a redefinition of the *moral contracts* among producers, distributors and users in order to avoid appropriation systems that might turn out to be socially undesirable.

The shift from a language of rights to the language of moral contracts is not innocent. It underlines the need for CIPO to shift its focus from the simple implementation of a regime of rules defined elsewhere to the active negotiation and re-negotiation of the very nature of the regime of relations among stakeholders. This would fundamentally transform the role of CIPO: from that of registrar to that of *animateur*.

But there is no reason to believe that such negotiated settlement will necessarily materialize. Various, equally plausible other solutions could side swipe the intellectual property regime. One such scenario is the case where technical encryption means would be substituted for the intellectual property regime, providing a much more exclusive right structure to producers than what is available at present. Another possibility is the emergence of new economic and legal models based on access and personal relations that would marginalize dramatically the role of intellectual property rights, which could translate into pay-per-view systems that would also marginalize the intellectual property regime and constitute a form of robust exploitation that copyright maximalists have been dreaming about for some time (Warusfel, 2001, pp. 106-108).

For public authorities, the e-governance challenge is to strike a negotiated balance between the rights of producers, distributors and users that will neither unduly discourage inventive activity nor unduly limit the diffusion of useful information. The digital world is forcing CIPO to modify completely the relative importance of its two roles — as designer of the IP regime and as an implementer of its rules. In the more static and less ethereal world of industrial intellectual property, the second role was paramount; in the more ethereal digital world, the former role becomes central since the balancing act between stakeholders need to be constantly and continually revisited as technology finds ways to unbalance them.

This shift in the focal role of CIPO is largely linked to the fact that, in the digital world, the ground is in motion: one cannot count on the same material and territorial benchmarks that were good currency in the old economy. This requires a refurbished definition of the role of CIPO and new joint communication and consultation strategies: for communication, as a one way process of providing information or knowledge to educate, raise awareness and potentially shape behaviour, if it is to be effective, can only emerge from meaningful and legitimate consultations — with all relevant stakeholders.

The growing trend of IP agencies to pursue aggressive consultation exercises is indicative of movement in this direction. The United States, Australia, the United Kingdom and Denmark are among the countries engaged in efforts to spark and expand dialogue in these central directions.

A COMPARATIVE REVIEW

WHAT IS CRUCIAL TO CIPO'S evolving and changing role should not mainly be dictated by a sense of what other countries are doing now, but rather by a sense of what a national IP agency should position itself to do in an e-governance world where multi-level processes and jurisdictions are bound to prevail.

TOWARD AN ASYMMETRIC MULTI-LEVEL REGIME

ALTHOUGH AN IP REGIME has traditionally been defined as part of a national strategy, this reality is changing. National agencies are increasingly forced to consider their performance in terms of alignment with both transnational and sub-national realities. New governance regimes include global, regional, national and local policy regimes.

From a global point of view, although there is no such thing as a world patent, intellectual property protection is certainly moving toward increasing international coordination. In particular, the insertion of IP into the framework of the WTO is likely to continue to lend strength to a global legal regime, even if a single global market remains an elusive goal for the foreseeable future. Copyright is almost there; industrial property rights are bound to follow.

Notwithstanding the absence of a global patent, a widening scope for international protection is being facilitated by the Patent Cooperation Treaty, an agreement administered by the World Intellectual Property Organization (WIPO). Statistics provided by WIPO show a steady rise in the number of international patent applications — seeking protection coverage across a range of countries. The potential benefits of this wider scope are such that they would seem to more than compensate for the corresponding costs (increased transaction fees and processing times as the application must pass through each country sought on the application). It has been argued that each additional country in which a firm files for patent protection would increase the expected value of total foreign patent rights by 44 percent (Putnam, 1996).

The degree of cooperation among the patent offices of the United States, Japan and the European Union (accounting together for over 80 percent of the world's patent activity) is an early sign of an emerging global intellectual property regime — as the rules and approaches agreed to by these regional parties are bound to carry considerable weight within global institutions.

The major impact of this type of global cooperation is to downplay the importance of agencies operating within relatively smaller economies such as Canada. Irrespective of their nationality, large firms who may be operating in Canada are unlikely to file for IP protection in this country when they are already protected by leading regional agencies. Larger firms are likely to be targeting the U.S. market and will be inclined to seek protection there or via a country providing international searching authority capacity so as to ensure that its protection will be vouched for by smaller countries almost as a matter of course. But since Canada does not presently provide such a port of entry, it is unlikely to be used as such.

As IP rules tend to converge, it is less likely that formal differences in these rules will contribute much to overall economic performance in a country like Canada, unless international concerns choose to enter the newly defined

consensus through a Canadian portal. And they would not choose to do so unless CIPO could provide both a faster and more efficient service, and a greater capacity to ensure transnational recognition and protection.

Consequently, the most challenging task for Canada is the highest and best use it could make of the interplay between the international and regional frameworks, and the better capacity to position itself in a North American (and perhaps eventually an all-American) setting. This points to the need for CIPO to adopt an explicit and pro-active transnational strategy if it is to serve Canadian interests well.

REGIONAL SETS OF RULES

CANADIAN FIRMS ARE FIRST AND FOREMOST nested in the North American market. As the importance of synergies, alliances and cross-ownership of the most innovative sectors continues to increase, it is likely that Canadian firms will primarily consider their place in the U.S. market when making decisions about their IP. Corporate choices are likely to be in this direction if the venture capital market is predominantly skewed toward U.S. firms. Then, a U.S. patent portfolio would be favoured as a matter of course.

The current European experience is enlightening. Given the differences between political systems across the two continents, the lack of political integration in the short to medium term means that a separate Canadian system will continue to serve the interests of the national market much more than the sort of parallel experience underway in Europe might suggest.

In Europe, there is an important differentiation occurring between larger firms (increasingly European or international in both identity and operations) and smaller firms. This trend is particularly consequential in the context of the intellectual property regime: the creation of a unified European Patent Office offers an attractive scenario for firms, with the possibility of a single patent extending across some 19 countries (members of the European Union plus signatory countries to various reciprocal agreements).

In North America, this development presents a particular challenge to CIPO. Can it become a port of entry for North American intellectual property protection that might carry the same weight as the U.S. Patent and Trademark Office (USPTO)? What transformation in its role might give it with some source of competitive advantage for firms? How could it provide the sort of services that the USPTO might not provide? Could this port-of-entry potential lead CIPO to specialize in servicing certain types of firms, both Canadian and foreign, that may require such services?

The real challenge is to determine what might be done efficiently though a small-country portal that could not be accomplished by the dominant portal. There are dual directions that must be viewed as complementary

in scope: first, the challenge to become a port-of-entry of choice in North America, and secondly, the challenge of helping Canadian firms.

THE ROLE OF INTELLECTUAL PROPERTY REGIMES OF SMALL AND MID-SIZED COUNTRIES

THE QUESTION RAISED ABOUT CIPO within North America also faces many small economies in Europe and Asia. Is there a meaningful role left for national intellectual property regimes in smaller satellite countries? Denmark is a case in point and its experience may harbour some lessons for Canada. Australia faces the same sort of challenge in the Asia-Pacific region.

(1) After studying this environment and its impacts, the Danish IP agency feels a threat to its existence. The Danish position is not to reject European integration, which is viewed as a positive force toward achieving efficiency and productivity gains for key European industries (consistent with the notion of a single market). However, for smaller firms, the cost imposed by the European process is often viewed as prohibitive in the early stages of a firm's development, and so national protection remains an important vehicle.

The Danish analysis is particularly relevant for Canada, as it has been established that the Danish innovation system makes poor use of a potentially strategic role for its IP agency. The Danish strategy offers a vision of the *intellectual property regime authority of the future* essentially characterized as a transformation of its traditional passive, processing role ex post, to one that is more pro-active, ex ante and dynamic, focussed on being a catalyst for *cultural* improvements in innovation and corporate performance across the economy.

In the Danish context, this shift in role is central to the growing focus on new economic clusters, such as medical research and biotechnology. The innovation intensity of these industries is a critical source of growth in the Oresund region (linking Copenhagen, in Denmark, and Malmö, in Sweden), and the intellectual property regime represents a crucial variable in its development — particularly for the emerging small and medium enterprise (SME) base that represents the source of future growth.

To help guide its efforts and show the gaps in current operations, the Danish Patent Office has commissioned an in-depth study of the most innovative and IP-intensive firms in Denmark's economy, examining the management and evaluation of patents and trademarks. The findings of the study are particularly important in the SME context — revealing a low level of awareness and execution with respect to the ongoing maintenance and valuation of IP.

While smaller firms recognized the need for IP protection and its potential value as a form of asset recognition for outside parties such as market investors and potential research partners, the overall thrust of the IP portfolio is to simply

seek protection, such as obtaining patents, with little strategic thinking about their role and value.

This lack of awareness of the more strategic role of IP may limit the maximum potential of innovative activity for emerging firms. From this concern arises the strategic opportunity pursued aggressively by the Danish agency to evolve into a *knowledge broker* for Danish firms. Such a role involves more intensive training and education programs — particularly for smaller firms, greater links with post-secondary institutions and research facilities with interests in IP issues, and an aggressive new strategy to explore the ways in which SMEs can most benefit from the information and knowledge generated by Denmark's IP process.

The Danish approach geared toward responding more effectively to local concerns and opportunities while repositioning itself within a broader European system (and the European Patent Office) offers an interesting and relevant comparison for Canada in the North American context. Although the comparison should not be exaggerated (there is no North American patent office, for example, and large firms operating in Canada still rely on the Canadian Patent Office and system of IP protection), the growing focus on innovation in Canada and SME development creates an opportunity for the IP agency to play a more strategic role in these emerging directions.

(2) Within the Asia-Pacific region, a similar dynamic is apparent in Australia where the IP agency (IP Australia) has aggressive and clearly laid out plans to pursue these parallel roads: a global orientation, through an international search authority (ISA); a regional strategy designed to foster a stronger intellectual property regime across Asia; and a more domestic and localized emphasis on smaller firms through a new strategy known as *The Innovation Patent*.

The Innovation Patent (introduced in May 2001) replaces the previously used petty patent system — a system essentially offering protection for a shorter period of time through easier qualifying and maintenance requirements. This new vehicle is designed to protect inventions that are not sufficiently inventive to meet the threshold required for standard patents. The main audience is smaller firms seeking a relatively quick and cheap form of protection (its term of protection is 8 years rather than the standard 20 years).

The key difference between the previous system of petty patents and the new innovation patent lies in the threshold of invention: a petty patent required an inventive step (similar to a standard patent) but the innovation patent requires only an innovative step. Moreover, whereas an examination was automatic in the case of a petty patent, it is entirely at the request of the applicant in the case of an innovation patent — and not mandatory (nonetheless, subsequent enforcement does require having passed through an examination).

While the duration of a petty patent was 6 years (as opposed to 20 years for a standard patent), the innovation patent carries a maximum life of 8 years.

Another critical difference with the new innovation patent lies in the relative ease of issuance. Essentially, with no examination required, only a basic check of formalities is needed to gain approval. The process is so user-friendly that an SME located in a remote part of Australia can simply register and purchase online (with a credit card) a petty patent. The firm is then in possession of an innovation patent.

One important aspect of this new service is the fact that it is the direct result of stakeholder consultation. Part and parcel of IP Australia's Customer Charter and its focus on performance orientation is the view put forward earlier of an intellectual property regime as a learning system.

On this point, learning capacities across most countries are becoming an increasingly visible component of the intellectual property regime and of the specific role of an IP agency. There is growing recognition that fostering such capacities will be an important source of competitive advantage for firms, industries and nations. While there has always been close working relationships between the key players in the IP process, such as large firms, patent experts and government staff, what is changing is the recognition of a broader dialogue including new stakeholders that may not otherwise have been engaged in efforts to view IP as a strategic dimension of corporate or collective performance.

This translates again into a significant reframing of the role of IP agencies. Instead of being ex post registry offices charged with passive protection assurance, they become important partners in the innovation system. It has an ex ante, dynamic and pro-active role to play in educating stakeholders, helping transform tacit knowledge into patentable knowledge, improving the capacity to use the intellectual property regime, providing new services likely to be important to give a competitive advantage to local firms (especially SMEs), and acting as an adjuvant to the learning economy.

Such priority on learning is the only way to keep IP agencies focused on their original mandate — doing some social good — and to force them to modify the intellectual property regime in line with the objective of maintaining as much free access as possible to ideas and intellectual objects, while protecting the creators from commercial piracy of their output and maximizing the tonus of creativity.

STRATEGIC OPTIONS FOR CIPO

IF CIPO IS TO PLAY FULLY ITS ROLE, it cannot do so without implementing a series of transformations to enable it to be effective on multiple fronts. Accordingly, the agency must undertake to redefine fundamentally its vision of what business it is in. From intellectual property registrar, CIPO must become a partner in knowledge management. This entails a modification of its technologies and structure to make it effective in intervening to improve knowledge use.

In terms of options for CIPO in this dynamic environment, our premise is that work is necessary on three levels.

REFRAMING: FROM INTELLECTUAL PROPERTY PROTECTION TO INTELLECTUAL RESOURCES MANAGEMENT

A CRITICAL COMPONENT OF CIPO'S EFFORTS to ensure its relevance and increase its importance is the need to redefine its role in a fundamental way as a partner in knowledge management, and to create a basis for social learning between itself and its various stakeholders. An online presence and new online capacities are already moving many national IP authorities in this direction. In terms of online capacity, CIPO presents itself as an extremely effective communicator in providing information about the IP process and the traditional services it delivers, but more can be done to harness the input and feedback of stakeholders.

Currently, most countries appear to be at an early stage in developing broader learning forums. For example, if one visits CIPO's web site and inquires about consultation and discussion, the ensuing message that "there are no public consultations at this time" may send the wrong signal. While such a message is undoubtedly not indicative of the networks of engagement that exist between CIPO and its current stakeholders, the questions pertaining to online engagement speak to whether there is value in expanded forums of public and stakeholder participation — and if so, how is such value captured.

While online engagement may hold some promise, the real sources of social learning must arise from an agency reaching out to stakeholders and fostering processes of real-time engagement and ongoing conversation. Designing an effective multi-stakeholder platform must be an essential task of defining the way ahead, and such consultation should be institutionalized in the operations of the agency. Aside from the importance of being increasingly responsive to clients (a goal CIPO has already identified and is striving to attain), such consultation linkages are also key enabling forces for CIPO to fulfill its potential as a knowledge and innovation catalyst in the KBLE.

As the Danish case study makes clear, national IP authorities have not traditionally viewed themselves as partners with a role to play in shaping business and innovation culture. Such a shift is not likely to be an instantaneous transformation and thus requires a shared effort.

It may be said that some of the stakeholders — large corporations — already have access to all the information and intermediaries they need to ensure a sound management of their knowledge base. This is not the case for small- and medium-sized firms that continue to underinvest in knowledge management because of a lack of awareness and resources.

Therefore, particular emphasis must be placed on the SME component of the KBLE. As Industry Canada and Statistics Canada have demonstrated, small firms are the backbone of new economic activity today — and they are destined to shape Canada's growth and innovation prospects of tomorrow. For example, Statistics Canada (2001) reports that small firms make up 75 percent of the biotechnology sector in the country.

Yet, it is precisely this client group who may well be the most disconnected from CIPO due to the formality and cost of the IP protection process. Moreover, these SMEs are likely to be the most vulnerable in the face of large corporations equipped with strong IP teams and deep pockets. Such disconnect raises the importance of intermediaries (IP specialists) who play an important role in the process (and are often endorsed by national authorities as necessary actors in this process).

Given the huge number of patent filings across an increasingly global environment, it seems unlikely that the need for such intermediaries will diminish. As a result, the process of better engaging entrepreneurs, researchers and small firms should not be perceived as a threat by this particular constituency. In fact, a strengthening environment of more innovation will only increase the need for specialized services and their providers.

What is at play, then, is a new type of role — a knowledge management role which centres less on specific IP services for those actors seeking protection and more on making better use of the tremendous intellectual capital accumulated from such processes. The existence of this information alone does not ensure its use — particularly, when it is in highly technical and tedious forms that impose significant transaction costs on those seeking to use it.

Similar findings come out of Denmark and the United Kingdom. In the latter, the *Quinquennial Review of the Patent Office*, released in January 2001, provides the following assessment of the importance of learning and awareness, derived from consultations with individual inventors and small firms:

It was suggested that inventors require direction. Whilst they may have an underlying sense of the need to protect their invention they often lack understanding of the different forms of intellectual property rights and of the alternatives...this confirmed the need for awareness training and education... (p. 50).

RESTRUCTURING: FROM PASSIVE REGISTRATION TO ACTIVE INTERMEDIATION

WHAT FORMS OF KNOWLEDGE COULD BE OF USE to individuals and organizations? Will small organizations ever make use of this potential knowledge? What are the barriers to better usage? What is the role of other intermediaries

and institutions in the innovation process to make use of such information? Can other levels of government play a role in an effective dissemination strategy?

(1) On the first three questions, our own interviews with entrepreneurs and small firms reveal a near-unanimous view that presently, IP protection is a crucial and increasingly important variable in their growth prospects and performance. For most firms and entrepreneurs, the process of seeking and maintaining IP protection is considered both complex and costly, and the most likely course of action is to rely on external agents to fulfil this role.

The result of this situation is that in the present context and architecture, smaller firms are unlikely to view CIPO as a source of new knowledge and information. Instead, CIPO is a valuable partner, albeit one step removed via an external agent, in seeking protection for what is already invented and created.

Nonetheless, interviews also reveal that in innovation-intensive industries, small firms and start-ups understand that information gathered within the IP process is a potential source of value, but they indicate that in its current form it remains simply information, or data. The distinction here is that IP applications and maintenance reports contain significant amounts of information codified in a highly technical manner — and accessible only to experts or individuals with significant time available to devote to filtering and processing it. In order to be useful, this information, or data, would need to be transformed into a more knowledge-oriented form, quickly accessible and useful in the context of existing research and production processes.

In a country like Canada, with a certain stigma for under-investing in research and development relative to many other countries, the corresponding emphasis on knowledge sharing is crucial for dissemination. While more effort would be required to study the precise effects and outcomes, there is every reason to believe that a source of economic stimulus exists in IP information and its transformation into strategic knowledge.

(2) If such a role is to be exploited, the following two questions must also be addressed: First, what is the role of intermediary institutions? Second, is there a potential role for other levels of government?

As for intermediaries, CIPO should perhaps consider the development of a national network of local and regional agents linked to CIPO formally or informally. Today, the growing advent of partnership models creates opportunities for doing so, perhaps via universities, public research centres, other private sector associations or other levels of government.

With respect to universities, these research institutions are increasingly focused on technology transfer and commercialization processes. Although many SMEs have been created as spin-offs from universities in key research centres across the country, the range of proactive and reactive responses from post-secondary institutions varies dramatically nationwide. There is no coherent innovation strategy applied by all universities, and IP is often a differentiating factor.

Where the need is most acute is in entrepreneurial awareness and support for IP policies and protection options. For example, our own interviews with firms and parties — such as provincial Centres of excellence — engaged in research partnerships between the education sector and industry, reveal two points of relevance to this discussion: first, for larger firms, IP is nearly always one of the most contentious issues in acquiring research partners; secondly, for smaller firms, IP protection is often an after-thought for entrepreneurs, and there is rarely sufficient support in place to guide them toward a better understanding of IP (a situation which, *de facto*, provides an advantage to larger firms with sophisticated organizational structures).

As for research centres and private sector associations, the National Research Council (NRC) and The Canadian Advanced Technology Alliance (CATA) provide two prominent and relevant examples.

The NRC is an interesting example of a federal research facility that has made a concerted effort to federate its operations around regional and sectoral lines. The emphasis has been on decentralizing resource and research decisions and inserting NRC facilities into local and regional systems of innovation — and into the key clusters located in these systems.

The relevance of such a model for CIPO lies in the fact that it is extremely unlikely that a single, homogeneous strategy will apply across the country for any aspect of IP service delivery. In fact, CIPO recognizes the importance of national outreach and responsiveness:

The Office has a network of partners, or intermediaries, across Canada. These innovation centres, provincial research organizations, industrial associations, universities, and other provincial and federal agencies can help you learn more about intellectual property. They assist researchers and small and medium-sized businesses by arranging lectures and information sessions (www.cipo.gc.ca).

These linkages may well have played a passive role — providing information and seeking feedback of a general nature. Yet, over time there is every reason to believe that these networks will, in fact, underpin CIPO's capacity to innovate in order to spur greater innovation at the local and regional levels.

In Australia, the national IP agency has satellite offices in each state and is aggressively expanding the service capacities of these centres to better respond to regional realities (coupled with growing online capabilities, such as the possibility of purchasing an innovation patent online with a credit card, the intended effect is to foster new synergies with potential users and clients — of which SMEs are identified as the priority segment not currently well served by traditional administrative channels).

Similarly, CATA has not taken an active role in discussions of the relevance of Canadian IP practices for smaller firms. As the voice for emerging firms in the knowledge-based economy, a partnership of sorts between CIPO and this private sector association could spark a greater dialogue on what types of mechanisms and measures are most needed.

In the future, CIPO's transformation will continue as a fundamental shift from a largely passive role of preserving rights and responding to requests, to a much more enabling role where the agency will be a catalyst for knowledge and innovation management and learning. New organizational capabilities and individual skills will be required for this role, as the agency seeks to balance traditional functions (which will remain) with emerging opportunities.

The common trait across capacities and competencies is an emphasis on new forms of collaborative governance: consultation mechanisms will be expanded and strategies collectively designed. As such, CIPO's own staffing mix will need to evolve in line with its future directions, and many of the new skill requirements are similar to those facing the public service as a whole — organizational designers, facilitators and negotiators, and people able to best adapt to change and uncertainty will be as important as the technical experts that, nonetheless, shape the core competencies of the agency.

RETOOLING: PRODUCT DIFFERENTIATION AND SERVICE DELIVERY

IT IS NOT SUFFICIENT TO TRANSFORM one organization's perspective or to develop collaboration with other stakeholders. What is also required is to modify the toolbox of specific techniques and programs to ensure that the knowledge management task can be performed. Some key areas stand out for consideration in the short term.

(1) There is clearly a need to broaden the range of options open to firms in dealing with intellectual property. The notion of a petty patent — a lower-tier form of patent protection — does not currently exist in Canada, and its feasibility should be carefully considered. It may also be that the form of any such product may vary: for example, at a time when the concept is disappearing from Australia, launching such an initiative in Canada may not make a good deal of sense. Yet, the Australian view is that there is clearly a need to tailor something new and specific to the SME segment (innovation patent), and the same argument may have considerable merit in Canada as well.

Firms of all sizes will increasingly seek various forms of recognition, and it may well be that for the smallest, most early stage start-ups, *quick and partial forms of protection* offer a useful alternative to standard patent measures. The Australian response has been to replace the petty patent with a new product, the innovation patent. Based on research undertaken by the Australian

government, this type of product was viewed as necessary, despite the fact that the previous system of petty patents failed to achieve its objectives:

Through a wide consultation process the Advisory Council on Industrial Property (ACIP) identified a demand for industrial property rights for those incremental or lower level innovations that would not be sufficiently inventive to qualify for standard patent protection.... ACIP concluded that Australia would benefit from adopting a second tier patent system to provide cheap, fast, limited rights for lower level or incremental inventions, particularly as Australian SME would be the main users of this system.

The defined rationale for moving in this direction is the strategic attention devoted to the SME community — and the belief that a niche product granting quicker recognition in exchange for more limited protection would serve smaller firms well through expanded efforts at innovation:

By providing an exclusive right for lower level inventions, the innovation patent should encourage Australian businesses, particularly SME, to develop their incremental inventions and market them in Australia. Increased use of the system will also increase the amount of technological information available to businesses, as the invention covered by each application is published. Moreover, modifying the petty patent system so that SME find it cheaper and easier to use should not add to the regulatory burden on third parties above what is already imposed by the present patent system...the proposed changes will decrease the compliance burden on the direct users of the system.

From the point of view of firms, the Australian review process provides some limited evidence to suggest that this type of niche product is likely to be of interest to SMEs (which are aware, by and large, of the importance of IP, often in an indirect manner via a professional intermediary). The Australian experience of the past few years shows a steadily declining level of activity for petty patents — a trend that the innovation patent is meant to reverse.

From the point of view of professional patent agents and other intermediary actors, one might expect a level of interest in new products — since it would generate more business opportunities through increased demand for their specialized services. Yet, the user-friendly aspects of the system, implying a process free of intermediaries, might lead to some concerns of disintermediation by experts. Such concerns are nonetheless offset by the reality that SMEs are currently not the primary target market of most specialists, and perhaps more importantly, that greater activity by SMEs would ultimately expand the need for professional services — as emerging firms grow.

From the point of view of the public interest and the economy as a whole, the central question, then, is whether the existence of a petty or innovation-type patent would promote greater IP awareness and knowledge — particularly across the SME community. Our assessment is that there is little existing evidence to demonstrate conclusively such a positive correlation — but what is of central importance is the need to experiment with either new products and services, or new channels of engagement and delivery.

The Australian case will, of course, be an important source of learning. Already, the Australian conclusions about their own lack of success in serving and stimulating the SME community are consistent with our own interviews with emerging firms (for reasons discussed above). They also appear consistent with the current reflections of CIPO on how to find new ways to better serve SMEs, particularly as they face the new challenges of the knowledge economy.

One significant risk of introducing an innovation patent-type product in Canada would be its place and perception in a North American context. With an eye to growth based on North American markets being a reality in nearly all parts of Canada, would this type of lower-level protection be viewed as an inferior form of protection relative to standard patents — (and the international protection offered by a multi-country variety)?

More consultation and market research is clearly required — but the point that seems to resonate through most mid-sized countries, notably Denmark and Australia, is the need to innovate (in serving SMEs) to produce more innovation collectively. The existence of such a product in Canada is unlikely to lead entrepreneurs to locate elsewhere, and there is some rationale in presuming that instead of the more expensive and time-consuming process of applying in the United States for a standard patent, a milder form of protection may constitute a useful interim step. If such a measure is promoted and accepted, it could serve as an important source of recognition for innovators and firms themselves, and an important source of knowledge exploitation for the Canadian economy as a whole.

(2) Another area of concern is the lack of an ISA for international patent applications in Canada. It would seem clear that either such a capacity will be required over time or, in its absence, some form of strategic alliance with the U.S. agency might be explored.

In the European Union, the European Patent Office offers this capacity. In the absence of deepening North American political integration, and therefore of the likely emergence, at least in the short term, of such joint political-administrative structures as a joint patent office, this lack of international search capability in Canada could become a handicap for Canadian industry.

In terms of offering the services associated with an ISA, it would seem that CIPO has three options in positioning itself within the North American

context: first, the status quo; secondly, become an ISA unilaterally; third, explore some form of strategic alliance with IP authorities in the United States.

If there is an advantage to the first route, it lies in its simplicity and lack of resource requirements, as large Canadian firms today are clearly able to find this service elsewhere. Nonetheless, the drawback of the status quo is the considerable risk that innovation-related knowledge will shift elsewhere, as more and more patent applications — particularly those requiring international search processes — are handled there. The trend toward a growing number of international patent filings, consistent with globalization in general, suggests that such danger may increase over time.

There are many reasons why a local ISA might be advantageous for Canadian firms: it would lower the cost of obtaining international patent information; it would help especially the SMEs in this regard as it would provide more convenient service; it might help trigger some clustering of firms built on similar capabilities in Canada; finally, it might contribute to keep local innovation in Canada and generate exports.

The second option may well be the most expensive and risky in terms of CIPO's capacity to develop unilaterally an in-house ISA; the risk lies in the possibility that many large Canadian firms will continue to use U.S. or international search authorities, minimizing the target market for such a services. Conversely, the opportunity lies in the growing SME community that may well benefit from such a capacity closer to home, and it could be an important strategic factor in promoting Canadian-owned emerging firms in the new economy.

For Canada, the third option could be the most compelling. To explore the viability of a strategic alliance between CIPO and its U.S. counterpart may constitute the first step in a two-step strategy leading Canada to become eventually a search authority itself.

From a U.S. perspective, the logic of such an alliance might be to alleviate the growing workload of authorities in that country, as well as the possibility of establishing an alliance for French-language processing of IP applications (perhaps not a huge consideration for the United States since most firms undoubtedly seek to apply in English in North America; from a Canadian perspective, however, having such a channel may be an important access point for francophone firms in Canada seeking access to the North American market). As the United States wants to operate globally in a triangular alliance with Japan and the European Patent Office, a regional affiliate strategy may offer some appeal.

From a Canadian perspective, the North American alliance can reinforce the capacity of smaller Canadian firms in particular to seek IP protection on both a continental and global scale. Clearly, export flows dictate the predominance of the U.S. market for the growth of Canadian firms, and on a global scale the danger is that an increasingly congested WIPO, weighed down by growing numbers of international applications with search components, will

likely extend its processing delays — lengthening the period of uncertainty for Canadian firms.

Such delays, though more manageable for larger firms, could be strategically pivotal to the growth prospects of emerging Canadian firms — particularly start-ups in knowledge-based sectors whose IP portfolio may be a significant factor in their ability to raise capital, retain talent and prepare for ongoing expansion.

(3) As for emerging opportunities, there is a clear public interest at stake in generating greater awareness about IP in Canada and in ensuring the existence of a critical mass of IP experts in the domestic market. The former may be most urgent, given the North American penchant for litigation — and the real threat posed by large U.S. firms who literally view IP enforcement as a source of revenue. CIPO can play a role in raising the collective intelligence of all stakeholders in the KBLE in terms of how to prepare for, and protect interests in, such an environment.

A separate, albeit related viewpoint is the general degree of confusion that characterizes many small businesses in today's economy, as they are quite different from those traditionally defining themselves as *inventors* (this latter group often has a good grasp of IP possibilities and the reasons why protection should be sought). For many small firms, IP competencies may be weak and costs of accessing specialists are often high; as a result, more effective communication and consultation could lead to more informed choices about how to proceed.

The present situation points to the need for more active training and education programs aimed at all segments of Canadian society. This would entail an educational/epistemic function for CIPO, one that might be developed through partnerships with universities, research laboratories, city-regions, technological associations, etc., to acquire a better grasp of knowledge management in general and of the array of tools available to catalyze the social learning processes. This could be done by means of public seminars, on-line tools, partnerships, etc.

Clearly, delivering knowledge more effectively, and in more effective forms, can be viewed as both a service and a capacity issue. New services may well be required, but they are most likely to be defined when underpinned by a capacity for engagement, learning and adaptation. For this reason, it is not possible to dissociate capacity issues from specific service delivery initiatives — better processes will lead to better outcomes.

This section has underlined the central importance of CIPO in changing mindsets and frames of reference to deal with knowledge management. CIPO's role, through consultation and dialogue, is not only to enable firms to make better use of knowledge, but to act as an agent of change to ensure that intellectual capital is given its appropriate place in the management of enterprises.

Providing new instruments and fostering new alliances may be regarded as intermediate outputs. The ultimate output is to educate a new generation of leaders in taking intellectual capital seriously.

RECOMMENDATIONS

BASED ON THE PRECEDING ANALYSIS, we provide a set of recommendations that nonetheless must not be taken as definitive solutions to the complexities of the topics and challenges at hand. Indeed, for each recommendation there are a number of outstanding issues that can only be resolved through ongoing dialogue and reflection — both within CIPO and amongst the various stakeholders in Canada and elsewhere.

Recommendation I – A renewed CIPO vision must be collectively defined by all stakeholders. Central to this vision is an emerging role for the agency as an innovation catalyst through partnerships to increase capacities for knowledge management and social learning.

One step toward better learning capacities between CIPO and its various stakeholders is the creation of an advisory body. An example is the U.K. Standing Advisory Committee on Industrial Property (SACIP), comprising a wide array of organizations that provide impartial advice on all aspects of intellectual property. Similarly, IP Australia hosts two meetings per year with the Advisory Council on Industrial Property (ACIP). The Council is composed of members from industry, academia and the industrial property profession, and it reports to the Minister for Industry, Science and Resources — providing specific advice on performance issues.

Other more specific suggestions include:

- An expansion of client surveys and outreach programs aimed at SMEs in order to better understand their perspective on innovation and invention and identify their specific needs. The U.K. Patent Office has performed similar surveys, and IP Australia undertook an extensive consultation exercise before launching its new innovation patent.
- Routine and regular follow-up with clients after delivering services. This is an effective means of gathering feedback for improvement. The U.K. Patent Office performs such consultation regularly.
- Mechanisms for recording formal and informal client complaints. Highlighted areas can then be explicitly addressed and feedback provided to users (a practice of the U.K. Patent Office).

- Staff suggestion schemes within CIPO might be further leveraged as means to encourage new insights to foster a culture of response and a commitment to growth and improved internal business learning (an approach also followed by the U.K. Patent Office).

While our own consultations reveal strong and positive ties between CIPO and traditional stakeholders, namely IP specialists, the critical challenge is to broaden the dialogue to affected parties that may not otherwise give thought to IP-related issues. Such outreach is hardly a threat to specialists and agents who already have ties with CIPO based on services provided to clients. An expanded culture of innovation and a larger set of users of CIPO services can only increase the need for specialized services.

Recommendation II – To better facilitate both continental and global reach for Canadian innovators (particularly small businesses), CIPO should undertake a detailed study of the costs and benefits of becoming an international search authority.

As reflected by the creation of new relationships between the EPO and various national patent offices in the European Union, globalization is creating new alliances across various jurisdictional levels. Sweden and Spain already have strategic alliances with the EPO, and Denmark has recently commissioned a review of its own capacities to potentially subcontract portions of quality control work from the same organization.

The question for CIPO is what type of role would make the most sense in the North American context, and whether there is potential in becoming an international search authority in that setting. First, an international search authority capacity, even in the domestic context, may serve the public interest by better engaging a broader range of SMEs in IP readiness (and by extension, international awareness for their innovations and market opportunities).

Yet, as discussed, there may also be significant opportunities through potential alliances with continental IP authorities, especially in light of growing processing volumes in the United States since the U.S. market represents a key target country for many applicants. The specific parameters of such arrangements, and their rationale and potential cost and benefit flows are beyond the scope of this study, but our assessment is that they merit further attention and analysis — and careful consideration.

Recommendation III – As CIPO operates within a multi-level context, responding to global and regional alignment internationally, and provincial and local differences domestically, an expanded set of partnerships must

be a central element of CIPPO's ongoing efforts to improve capacities for both information dissemination and knowledge management.

CIPPO must obviously take into account the actions of WIPO. WIPO's initiatives will necessarily impact on innovation processes in Canada. However, WIPO is bound to remain for quite some time an ex post traditional registrar organization. CIPPO must work hard at the level of this global institution to defend the interests of Canadian firms, but also to ensure that the appropriate margins of manoeuvrability are protected for agencies like CIPPO attempting to play a more dynamic role at the national level.

Yet, one of the most critical shifts in the KBLE is the increasingly strategic importance of intellectual property for firms of all sizes. In order to more effectively engage the SME community, CIPPO should consider strategic opportunities for working in a concerted fashion with local, provincial and federal authorities engaged in efforts to assist in new business creation, entrepreneurship and SME development.

A practical starting point in embarking on such a path is a horizontal discussion across Industry Canada, and indeed the federal government, as to how CIPPO's own efforts in this regard may best be aligned with a broader strategy of business development and innovation activity. An additional priority for CIPPO should be to undertake a detailed study of current information flows within the Canadian intellectual property regime. A consultation process aimed specifically at the SME community and individual inventors may also be warranted.

Recommendation IV – In line with the examples of many other countries, most notably Australia and Denmark, CIPPO must further improve its efforts to better serve the SME community via existing and yet to be created channels.

Although further consultation and analysis is warranted, the notion of an innovation patent, along the lines of what is being introduced in Australia, has considerable appeal to further innovation across Canada in general, and the SME community in particular. The Australian example also offers an important source of learning for other countries — and one of the key measures of its success will be the degree to which this new instrument is successful in broadening the involvement of young firms in seeking IP protection and widening the body of knowledge about innovative activities across Australia.

Other countries, like the Netherlands, have gone the opposite way and simply abandoned their patent office. While this might be a useful route for a small country that has had immense success at building a transnational empire, this would not appear to be a desirable strategy for Canada. However, one should not discard other ways to stimulate creativity besides the information-

animation-regulation role of CIPO. The Innovation Agenda might provide an opportunity to explore these parallel roads.

Recommendation V – Within Canada, CIPO must expand its efforts to foster a culture of innovation (as well as invention) and a higher degree of appreciation for the strategic value of IP in the 21st-century economy.

CIPO should expand its development of partnerships and networks with professional and academic institutions for the purpose of preparing and delivering seminars and workshops on the topic on intellectual property. For example, IP Australia and the Danish Patent Office offer a variety of seminars to private organizations and academic centres on the following topics:

- Using intellectual capital as an asset;
- General information on IP and protection mechanisms;
- Watching competitors;
- Information session on legislation;
- Patent strategy in a business enterprise.

The growth of the Internet as an online communication and learning platform means that while not a panacea for all training needs, select training initiatives could be delivered by CIPO through an expanded online presence. Once again, other stakeholders providing support and information to small firms should be engaged in the design of new initiatives in this area.

Recommendation VI – In line with the Canadian government's agenda for delivering services online and the expansion of the Internet, CIPO must carefully examine both new means of service delivery, and the new policy and IP quandaries emerging in an increasingly digital world.

As a starting point, it is clear that the web portal will become the public face of service delivery agencies such as CIPO. Its effectiveness in interacting with those well versed in IP as well as with novices is paramount. Here are a few relevant observations for CIPO based on our online review of other jurisdictions:

- A critical goal for public authorities in designing web portals is to effectively educate stakeholders and the general public by providing simple, straightforward and complete information.
- Access to online learning and awareness can be improved by the creating an online library of publications, similar to the one available on IP

Australia's web site (where a consolidated references section contains relevant information on intellectual property, as well as online manuals and samples of applications).

- Online consultation forums can be enhanced to better educate and involve stakeholders as well as to collect feedback. The consultation and discussion forums can be upgraded to include more interactive tools such as a survey form, a discussion area, and a comments board.
- Targeting individual innovators and small businesses: This segment of the population requires access to non-technical yet complete information, including background information on patents, trade-marks and copyright. CIPO might explore specific channels of information catering to specific needs of independent inventors and entrepreneurs.
- The web portal of the U.S. Patent and Trademark Office also includes an interesting section for children — a welcoming introduction to innovation and protection and a useful gateway for young students seeking background information. Such seemingly mundane steps are nonetheless important in an ongoing process of cultural evolution.

The growth of e-commerce and the expansion of e-government mean that new opportunities for service delivery mechanisms and for rethinking their nature are timely topics for consideration. CIPO would certainly not be misguided in investing resources now in thinking about the new opportunities for online transactions, consultations and management in a digital world.

CONCLUSION

UNDERTAKING NEW ROLES IS never a straightforward challenge. Taking on such new knowledge management responsibilities in a turbulent world, where intellectual property takes on growing importance in today's economy, is all the more difficult because of two conflicting trajectories: the first seems to call for a rigid, transparent and legalistic set of rules designed to ensure fairness in balancing protection for the inventor and the value of knowing and utilizing for other parties; while the second emphasizes the potential benefit of creating a dynamic learning system where IP is a loose, flexible and strategic asset to be created, nurtured and shared.

The most challenging task facing IP agencies around the world is to address both of these trajectories in a synergistic fashion. Yet, what is called for by the first set of imperatives would appear to clash with what is required by the second. Therefore, there is much need for reframing perspectives and creativity. This represents a major governance challenge as the resources, power and

information necessary for moving forward in this game without a master are in no one's hands in particular.

In order to continue to adapt and design an organizational architecture that is capable of responding to these multiple pressures, CIPO is right to say loud and clear that what is needed is *changing the way we do business*.

ENDNOTES

- 1 Revised version of a paper prepared for the Industry Canada Conference on Intellectual Property and Innovation in the Knowledge-based Economy, hosted by the Centre for Innovation Law and Policy, Toronto, May 23-24, 2001.
- 2 See Warusfel, 2001.
- 3 A recent example of this latter challenge is the decision of the U.K. Patent Office to study the feasibility of patent protection for software and Internet-based trading methods. Following a public and stakeholder consultations process, the study concluded: i) that there should be no significant change to the patentability of software; ii) the law is not clear enough, and urgent European action is required to clarify many points; and iii) business methods should remain unpatentable.

BIBLIOGRAPHY

- Camagni, R.(ed.). 1991. *Innovation Networks: Spatial Perspectives*. London: Belhaven Press.
- Lawson, C., and E. Lorenz. 1999. "A Collective Learning, Tacit Knowledge and Regional Innovation Capacity." *Regional Studies* 33, 4: 305-318.
- Lessig, L. 2001. *The Future of Ideas – The Fate of the Commons in a Connected World*. New York: Random House.
- Putnam, J. 1996. "The Value of International Patent Rights." Ph.D. Dissertation. Yale University.
- Ryan, M.P. 1999. "Markets, Institutions, Intellectual Property Rights, and Development in a Knowledge-based World Economy." In *Competitive Strategies for the Protection of Intellectual Property*. Edited by O. Lippert. Vancouver: The Fraser Institute.
- Statistics Canada. 2001. *Innovation Analysis Bulletin* (May).
- Warusfel, Bertrand. 2001. *La propriété intellectuelle et l'Internet*. Paris: Flammarion.

OTHER REFERENCES

- Anderson, R.D., and N.T. Gallini (eds.). 1998. *Competition Policy and Intellectual Property Rights in the Knowledge-Based Economy*. Calgary: University of Calgary Press. Industry Canada Research Series.
- Anonymous. 1999. "Intellectual Property is Increasingly Valuable." *Financial Executive* 15, 3: 10.
- . 1999. "Reforms Ready to Roll." *Managing Intellectual Property* 87: 34.
- . 1999. "Reforms Will Cost Patent Owners." *Managing Intellectual Property* 87: 7.
- . 1999. "Winners in the Patent Wars." *Managing Intellectual Property* 90: 18.
- . 1999. "WIPO Tackles the Net." *Managing Intellectual Property* 93: 12.
- . 2000. "Leaders: Who Owns the Knowledge Economy?" *The Economist* 355, 8165: 17.
- . 2001. "Special Article: The Knowledge Monopolies: Patent Wars." *The Economist* 355, 8165: 75-78.
- Aylen, D. 2001. "Knowledge Management: Harnessing the Power of Intellectual Property." *Ivey Business Journal* 65, 4: 58-64.
- Baechtold, L.R. 2000. "Harmony or Dissonance: In Which Direction Is the US Going?" *International Tax Review*: 96.
- Becerril, F. 1999. "Intellectual Property and e-Commerce." *Managing Intellectual Property* 93: 31.
- Berman, C. 1999. "A Global Patent Solution Comes into View." *Managing Intellectual Property* 93: 70.
- Bosotti, L. 1999. "Past, Present and Future of the Patent Profession." *Managing Intellectual Property*: 93: 3.
- Braga, C.A.P., C. Fink and C.P. Seopulveda. 1998. "Intellectual Property Rights and Economic Development." Technet Working Paper.
- Capello, R. 1999. "A Spatial Transfer of Knowledge in High-Technology Milieux: Learning Versus Collective Learning Processes." *Regional Studies* 33, 4: 353-366.
- Castells, M., and P. Hall. 1993. *Technopoles of the World: The Making of 21st Century Industrial Complexes*. New York: Routledge.
- Clark, D. 2000. "IP Rights Protection Will Improve in China – Eventually." *The China Business Review* 27, 3: 22-26.
- Cooper, J. 2000. "Turning Knowledge into Value." *CMA Management* 74, 8: 22-28.
- Correa, M.C. 2000. "Reforming the Intellectual Property Rights System in Latin America." *The World Economy* 23, 6: 851.
- Courchene, T.J. 1995. "Globalization: The Regional/National Interface." *Canadian Journal of Regional Science* 18, 1: 1-20.
- Deveau, D. 2000. "Minds Plus Matter: Knowledge is Business Power." *Computing Canada* 26, 8: 14-16.
- Eggleston, R.C. 1999. "IP Collateral: An Emerging Financing Tool." *Managing Intellectual Property* 92: 83.
- Fassin, Y. 2000. "Innovation and Ethics – Ethical Considerations in the Innovation Business." *Journal of Business Ethics* 27, 1-2: 193-204.
- Festl-Wietek, W., and A. Bogsch. 1999. "Intellectual Property: The Strategic Value of IP Rights." *International Financial Law Review* (July): 21.

- Fitzgerald, B. 2001. "Intellectual Capital and Law in the Digital Environment." *Ivey Business Journal* 65, 4: 22-28.
- Fitzgibbon, C. 1999. "Intellectual Property Rights – Their Tax Treatment." *Asset Finance International* (June): 17.
- Ford, J.R. 1999. "How What You Know Can Hurt You." *EDN* 44, 13: 50-53.
- Forger, R.G. 1999. "Patent Protection – Not Exactly!" *Modern Materials Handling* 54, 13: 7.
- France, M. 1999. "Why We Don't Need Patent Reform – Yet." *Business Week* 3660: 54. Industrial/Technology Edition.
- Garten, E.J. 2001. "Intellectual Property: New Answers to New Problems." *Business Week* 3726: 28. Industrial/Technology Edition.
- Gerardo, R.U. 1999. "The Emerging Knowledge-based Economy." *IEEE Spectrum* 36, 5: 60-66.
- Germeraad, P. 1999. "Intellectual Property in a Time of Change." *Research Technology Management* 42, 6: 34-40.
- Granstrand, O. 2000. "Corporate Management of Intellectual Property in Japan." *International Journal of Technology Management* 19, 1-2: 121.
- Greco, J. 1999. "What is a CKO – And Should You Have One?" *The Journal of Business Strategy* 20, 2: 20.
- Guerrero-Cusumano, J.-L. 2001. "Correlates of Intellectual Property Violation." *Multinational Business Review* 9, 1 (Spring): 59.
- Harvey, I. 2000. "Taking on the IP Critics." *Managing Intellectual Property* 95: 3.
- Keeble, D., and F. Wilkinson. 1999. "A Collective Learning and Knowledge Development in the Evolution of Regional Clusters of High-Technology SMEs in Europe." *Regional Studies* 33, 4: 295-304.
- Kokonis, D.J. 1999. "Patent Law Disputes – Litigation Process in Canada." *Managing Intellectual Property* (September): 14.
- Lanjouw, O.J. 2001. "Characteristics of Patent Litigation: A Window on Competition." *The Rand Journal of Economics* 32, 1: 129-142.
- Lippert, O. (ed.). 1999. *Competitive Strategies for the Protection of Intellectual Property*. Vancouver: The Fraser Institute.
- Maskus, K. 1998. "The International Regulation of Intellectual Property." *Weltwirtschaftliches Archiv* 123, 2: 186-208.
- . 2000. *Intellectual Property Rights in the Global Economy*. Washington (D.C.): Institute for International Economics.
- . 2000. *Regulatory Standards in the WTO: Comparing Intellectual Property Rights with Competition Policy, Environmental Protection, and Core Labour Standards*. Working Paper. Institute for International Economics and University of Colorado.
- Marron, B.D. 2000. "Which Countries Protect Intellectual Property? The Case of Software Piracy." *Economic Inquiry* 38, 2: 159-175.
- Michalski, W. 1999. "The Future: What Policy-makers Have to Think About." *The OECD Observer* 217/218: 26-29.
- Miller, W. 1999. "Building the Ultimate Resource." *Management Review* 88, 1: 42-46.
- Möisé, E. 1999. "Intellectual Property: Rights and Wrongs." *The OECD Observer* 216: 35-39.

- Moore, J.F. 1996. *The Death of Competition – Leadership and Strategy in the Age of Business Ecosystems*. New York: Harper Collins.
- Mullaney, T.J., and S. Ante. 2000. "Info Wars; In the New Net World, It's Not Who Owns Information Who Wins. It's Who Can Exploit It First – And Most Profitably." *Business Week* 3684: EB106. Industrial/Technology Edition.
- Muralidharan, R. 1999. "International R&D Activity of US MNCS: An Empirical Study with Implications for Host Government Policy." *Multinational Business Review* 7, 2: 97-106.
- Nicholson, M.W. 2000. *Intellectual Property Protection, Internalization, and Technology Transfer*. Working Paper. University of Colorado, Department of Economics.
- Nurton, J. 1999. "Coming Together." *Managing Intellectual Property* 93: 18.
- Paquet, G. 1997. "States, Communities and Markets: The Distributed Governance Scenario." In *The Nation-State in a Global Information Era: Policy Challenges*. Edited by T.J. Courchene. Kingston (ON): John Deutsch Institute for the Study of Economic Policy. The Bell Canada Papers in Economics and Public Policy, No. 5, pp. 25-46.
- Perlman, S.H. 2000. "Taking the Protection-access Tradeoff Seriously." *Vanderbilt Law Review* 53, 6: 1831-1841.
- Pickering, J.F. 2000. "Managing Patents for Competitive Advantage." *Journal of General Management* 25, 3: 15.
- Pooley, J. 1999. "Putting Together a Global Enforcement Solution." *Managing Intellectual Property* 94: 16-19.
- Prencipe, W.P. 2001. "Exchanges Give Bright Ideas Chance to Shine." *InfoWorld* 23, 9: 30.
- Rivette, K.G. 2000. "Discovering New Value in Intellectual Property." *Harvard Business Review* 78, 1: 54-69.
- Ronkainen, A.I., and J.-L. Guerrero-Cusumano. 2001. "Correlates of Intellectual Property Violation." *Multinational Business Review* 9, 1: 59-66.
- Sheraton, H. 1999. "Europe's Patchwork Patent Enforcement." *Managing Intellectual Property* 94: 27.
- Smith, W.M. 1999. "Bringing Developing Countries' Intellectual Property Laws to TRIPs Standards: Hurdles and Pitfalls Facing Vietnam's Efforts to Normalize an Intellectual Property Regime." *Case Western Reserve Journal of International Law* 31, 1: 211-252.
- Spears, M. 2000. "Patent Game's Bad Throw." *Upside* 12, 2: 204. U.S. edition.
- Stahl, S. 1999. "Asset Protection vs. Knowledge Sharing." *Information Week* 722: 149.
- Swamy, M.R.K. 1999. "Is There any Functional Relationship Between Knowledge – as an Asset-Management and Intellectual Property Rights?" *Journal of Financial Management and Analysis* 12, 2: 88-99.
- Takanashi, N. 1999. "Japan." *Managing Intellectual Property* 91: 45.
- Tiessen, H.J. 1999. "Developing Intellectual Capital Globally: An Epistemic Community Perspective." *International Journal of Technology Management* 18, 5,6,7,8: 720-731.
- Vardi, N. 2001. "Me-Too Patents." *Forbes*: 058.
- Velazquez, A. 1999. "Enforcing Rights in Mexico." *Managing Intellectual Property* 92: 41.
- Wagman, R.G. 1999. "The Competitive Advantage of Intellectual Property." *S.A.M. Advanced Management Journal* 64, 3: 4-10.

- Watts, J. 2000. "Seeking More Creativity, Japan Overhauls IP Laws." *Research Technology Management* 43, 5: 4-6.
- Weigmann, S. 2000. "Update to Researching Intellectual Property Law in an International Context." Boston University School of Law, from the Law Library Resource Xchange website: www.llrx.com/features/iplaw.htm (accessed on April 22, 2005).
- Zawada, C.A. 1998. "Buying and Selling Intellectual Property." From the website of Wallace, Meschishnick, Clackson, Zawada (Saskatoon law firm): [<http://www.wmcz.com/articles/Buying%20and%20Selling%20Intellectual%20Property.pdf>] (accessed on April 22, 2005).
- Zumbo, F. 2001. "Intellectual Property and Competition Policy: Emerging Issues." *Australian Business Law Review* 29, 2: 170.

COUNTRY-SPECIFIC RESOURCES

AUSTRALIA

IP Australia. *About IP Australia*.

[Available on-line: <http://www.ipaustralia.gov.au/about/index.shtml> (accessed on April 22, 2005)].

———. *Industrial Property. IP Activity in Australia and the Asia-Pacific Region*.

[Available on-line: www.ipaustralia.gov.au/library/L_resrc1.htm#org].

———. *Industrial Property Statistics 1998-99*.

[Available on-line: www.ipaustralia.gov.au/library/L_resrc1.htm#org].

———. *IP Australia Organizational Structure*.

[Available on-line: www.ipaustralia.gov.au/about/A_who.htm].

———. *Library: IP Australia's Library of Forms and Publications*.

[Available on-line: http://www.ipaustralia.gov.au/resources/forms_index.shtml (accessed on April 22, 2005)].

———. *Our Corporate Plan – Strategic Directions 1999-2003*.

[Available on-line: www.ipaustralia.gov.au/library/L_resrc1.htm#org].

———. *What is Intellectual Property?*

[Available on-line: <http://www.ipaustralia.gov.au/ip/index.shtml> (accessed on April 22, 2005)].

———. *1999 Corporate Report*.

[Available online: www.ipaustralia.gov.au/library/L_resrc1.htm#org].

———. *2001 Corporate Profile*.

[Available on-line: www.ipaustralia.gov.au/library/L_resrc1.htm#org].

CANADA

Canadian Intellectual Property Office. *About Us – Corporate Information and News*.

[Available on-line: http://strategis.ic.gc.ca/sc_mrksv/cipo/corp/corp_main-e.html].

———. *Annual Report 1998-1999*.

[Available on-line: http://strategis.ic.gc.ca/sc_mrksv/cipo/corp/allreport-e.html (accessed on April 22, 2005)].

———. *Statistics 1996-97, 1995-96*.

[Available on-line: http://strategis.ic.gc.ca/sc_mrksv/cipo/corp/corp_main-e.html (accessed on April 22, 2005)].

Competition Bureau, Government of Canada. (2000). *Intellectual Property Enforcement Guidelines*.

Industry Canada. *Industry Canada Policy Initiatives in the Area of Intellectual Property*. [Available on-line: <http://strategis.ic.gc.ca/SSG/ip01078e.html>].

DENMARK

Danish Patent and Trademark Office. *Industry Policy in Denmark*.

[Available on-line: <http://www.dkpto.dk/> (accessed on April 22, 2005)].

EUROPE (European Patent Office)

European Patent Office. *EPO Member States*.

[Available on-line: www.european-patent-office.org/epo/members.htm (accessed on April 22, 2005)].

———. *Facts and Figures 1999*.

[Available on-line: http://annual-report.european-patent-office.org/facts_figures/_pdf/facts_figures_99.pdf (accessed on April 22, 2005)].

———. *International Cooperation with the EPO*.

[Available on-line: www.european-patent-office.org/intcop/index.htm (accessed on April 22, 2005)].

———. *European Patent Office Annual Report 1999*.

[Available on-line: www.european-patent-office.org/epo_general.htm (accessed on April 22, 2005)].

JAPAN

Commission on Intellectual Property Rights in the Twenty-first Century. 1999. *Towards an Era of Intellectual Creation: Challenges for Breakthrough*. Report of the Commission. (April 7). [Available on-line: www.jp-miti.go.jp/html].

Japanese Patent Office. *The Role of the Japanese Patent Office*.

[Available on-line: http://www.jpo.go.jp/shoukai_e/index.htm (accessed on April 22, 2005)].

———. *Annual Report 1999*. [Available on-line: www.jp-miti.go.jp/html].

———. *Frequently Asked Questions*.

[Available on-line: www.jp-miti.go.jp/shoukaie/faqOutline.htm].

———. *Outline of Industrial Property Systems*.

[Available on-line: <http://www.jpo.go.jp/shoukaie/tgaiyoe.htm> (accessed on April 22, 2005)].

———. *WIPO Asian Regional Forum on Intellectual Property Policy Development*.

[Available on-line: http://www.jpo.go.jp/shiryoe/toushin_e/kenkyukai_e/policy.htm (accessed on April 22, 2005)].

———. *Troubles Relating to Rights*.

[Available on-line: www.jp-miti.go.jp/shoukaie/howto.htm].

———. *Trends of Industrial Property Right Applications and Registration*.

[Available on-line: www.jp-miti.go.jp/tousie/218.html].

———. *The Number of Applications and Registrations in 1999*.

[Available on-line: http://www.jpo.go.jp/shiryu_e/toukei_e/report_a_r_e.htm (accessed on April 22, 2005)].

———. *Progress of Requests for Examinations.*

[Available on-line: www.jp-miti.go.jp/tousie/sinsarue.htm].

———. *Decisions of Registrations.*

[Available on-line: www.jp-miti.go.jp/tousie/sateirue.htm].

———. *Granted and Registered.*

[Available on-line: www.jp-miti.go.jp/tousie/tourue.htm].

Planning Subcommittee of the Industrial Property Council. 1998. *Report of the Planning Subcommittee of the Industrial Property Council – To the Better Understanding of Pro-patent Policy.* (November).

[Available on-line: http://www.jpo.go.jp/shiryu_e/toushin_e/shingikai_e/report.pdf (accessed on April 22, 2005)].

NETHERLANDS

Netherlands Intellectual Property Office. *Overview.*

[Available on-line: <http://www.bie.nl/engels/index.htm>].

SWEDEN

Swedish Patent and Registration Office. *Annual Report 1999.*

[Available on-line: <http://www.prv.se/eng/about/index.html> (accessed on April 22, 2005)].

TRILATERAL COOPERATION (EUROPE, UNITED STATES, JAPAN)

Trilateral Cooperation. *About Trilateral Cooperation.*

[Available on-line: www.uspto.gov/web/tws/gen-1.htm (accessed on April 22, 2005)].

———. *Trilateral Project.*

[Available on-line: www.uspto.gov/web/tws/gen-2.htm (accessed on April 22, 2005)].

———. *Trilateral Statistical Report 1999.*

[Available on-line: <http://www.european-patent-office.org/tws/tsr99/tsr.htm> (accessed on April 22, 2005)].

———. *Trilateral Statistical Report 1998.*

[Available on-line: http://www.european-patent-office.org/tws/tsr_98/ (accessed on April 22, 2005)].

UNITED KINGDOM

The U.K. Patent Office. *About Us and Policies.*

[Available on-line: www.patent.gov.uk/about/ippd/whatwedo/index.htm (accessed on April 22, 2005)].

———. *Annual Report and Accounts 1999-2000.*

[Available on-line: www.patent.gov.uk/about/reports/index.htm (accessed on April 22, 2005)].

———. *Corporate Plan 2000.*

[Available on-line: www.patent.gov.uk/about/reports/index.htm (accessed on April 22, 2005)].

———. *Corporate Plan 2001*.

[Available on-line: www.patent.gov.uk/about/reports/index.htm (accessed on April 22, 2005)].

———. *Quinquennial Review of The Patent Office*. (Stage Two Report, January 2001).

[Available on-line: www.dti.gov.uk/patent_office/stage2report.pdf (accessed on April 22, 2005)].

UNITED STATES

United States Copyright Office. *United States Copyright Office: A Brief History and Overview*.

[Available on-line: <http://lcweb.loc.gov/copyright/>].

United States Patent and Trademark Office. *Patent Cooperation Treaty*. [Available on-line: www.uspto.gov/web/offices/pac/dapps/pct/ (accessed on April 22, 2005)].

———. *General Information. Trilateral Statistical Report 1999*.

[Available on-line: www.uspto.gov/web/menu/menu4.html (accessed on April 22, 2005)].

———. *USPTO Organizational Structure*.

[Available on-line: <http://www.uspto.gov/web/menu/offices.html> (accessed on April 22, 2005)].

———. *General Information Concerning Patents*.

[Available on-line: <http://www.uspto.gov/web/offices/pac/doc/general/> (accessed on April 22, 2005)].

———. *Disclosure Document Program*.

[Available on-line: www.uspto.gov/web/offices/pac/disdo.html (accessed on April 22, 2005)].

———. *A Patent and Trademark Office Review. Fiscal Year 1999*.

[Available on-line: www.uspto.gov/web/offices/com/annual/index.html (accessed on April 22, 2005)].

———. *Frequently Asked Questions about Trademarks*.

[Available on-line: www.uspto.gov/web/offices/tac/tmfaq.htm (accessed on April 22, 2005)].

———. *Patent and Trademark Depository Library Program*.

[Available on-line: www.uspto.gov/web/offices/ac/ido/ptdl/index.html (accessed on April 22, 2005)].

———. *Automated Financial or Management Data Processing Methods*.

[Available on-line: www.uspto.gov/web/menu/busmethp/index.html (accessed on April 22, 2005)].

———. *Independent Inventor Resources*.

[Available on-line: <http://www.uspto.gov/web/offices/com/iip/> (accessed on April 22, 2005)].

———. *USPTO Web Patent Databases*.

[Available on-line: www.uspto.gov/patft/index.html (accessed on April 22, 2005)].

OTHER RESOURCES

World Intellectual Property Organization. www.wipo.org (accessed on April 22, 2005).
World Trade Organization – Agreement on Trade-Related Aspects of Intellectual
Property Rights (TRIPs). www.wto.org/english/tratop_e/trips_e/trips_e.htm
(accessed on April 22, 2005).



Steven B. Garland & Jeremy E. Want
Smart & Biggar
Barristers and Solicitors

16

The Enforcement of Intellectual Property Rights in Canada

INTRODUCTION

Today, the strength of a nation is measured not by the weapons it wields, but by the patents it produces; not by the territory it controls, but by the ideas it advances; not only by the wealth of its resources, but by the resourcefulness of its people.¹

INTELLECTUAL PROPERTY (IP) is a term used to refer to various types of intangible property related primarily to innovation and creativity. This paper focuses on the enforcement of intellectual property rights (IPRs) in Canada, and in particular, the enforcement mechanisms available for the three primary forms of IPRs, namely patents, trade-marks and copyright. However, it should be noted that there are numerous other forms of protectable, commercially valuable, IPRs in Canada.²

Innovation is a driving force of a strong economy. A country that generates new products, ideas and technologies stands at the forefront of the ever developing and expanding knowledge-based global economy of the present and the future. The Prime Minister of Canada has made the following comment:

In the new, global knowledge economy of the 21st century prosperity depends on innovation which, in turn, depends on the investments that we make in the creativity and talents of our people. We must invest not only in technology and innovation but also, in the Canadian way, to create an environment of inclusion, in which all Canadians can take advantage of their talents, their skills and their ideas; in which imagination, skills and innovative capacity combine for maximum effect.³

A strong IP system, including a strong IP enforcement component, fosters and protects research, development and innovation. Overall, it is now widely recognized that such an IP system can positively influence the economy of a country, especially in the knowledge-based and technology-driven economy of the future. For example, in a report entitled *Intellectual Property and Canada's Commercial Interests*, the then acting Minister of Consumer and Corporate Affairs Canada commented as follows:

The intellectual property found in new products, processes and services is essential for a modern, competitive Canadian economy. Innovation must continue: to surmount new challenges, to provide greater variety, to achieve more efficient production. Intellectual property rights are the framework in which innovation and creativity can flourish in a growing Canadian marketplace, amid complex and rapidly shifting world trade.⁴

The authors of the report concluded:

The [...] findings dramatize the growing importance of IPRs to industry performance, business operations, cultural development, technology transfer, Canada's two-way trade and the achievement of a broad range of public policy objectives. Without strong IP laws in Canada and also among our major trading partners, Canada's gross domestic product and international trade would be significantly reduced [...].⁵

Similarly, in a report entitled, *Making IP Policy a Competitive Asset for Canada in the Global Knowledge-Based Economy – The Policy Setting: Canada's Innovative Challenge*, Industry Canada stated:

Intellectual property crystallizes knowledge to provide the foundation for investment, partnership and growth opportunities. Leading edge industries are intensive users of intellectual property regimes, ensuring that their investment in innovation earns the fullest dividends.⁶

Finally, in a paper entitled "What's Driving Patent and Trade-mark Application Filings", Riordan (2000) concluded as follows:

[...] theory suggests that efficient intellectual property protection systems can themselves be a significant influence on the economy and help maintain growth and dampen cyclical tendencies. Clearly, the more important technological innovation becomes for the United States and other economies, the more central intellectual property protection becomes to economic progress.⁷

In general, the IP system in Canada may be thought of as having two branches: an administrative branch and an enforcement branch. The administrative branch, consisting primarily of the Canadian Intellectual Property Office (CIPO),⁸ is responsible for granting and administering IPRs. The enforcement branch, consisting of various courts and quasi-judicial tribunals, including the Supreme Court of Canada, the federal and provincial Superior Courts, the Trade-marks Opposition Board, and the Patent Office, are the means by which parties can seek to enforce or challenge those rights.

While Canada has the full range of necessary statutory and common law provisions pertaining to the granting of various IPRs, the exclusive rights obtained are only as strong as existing mechanisms to protect those rights against infringers. Overall, an analysis of the various enforcement provisions and procedures available in Canada, as well as the statistics on the successful enforcement of IPRs, supports the view that generally, Canada has a strong IP enforcement system, though perhaps not as progressive as some other jurisdictions, most notably the United States.

PATENTS

IN CANADA, THE PATENT SYSTEM is governed by the federal *Patent Act*.⁹ The *Patent Act* grants an inventor a 17- or 20-year monopoly in the subject matter of the patent.¹⁰ In return for the monopoly, the inventor must publicly disclose the subject matter with sufficient technical detail so that it becomes part of the knowledge base of the particular field of science or technology to which the patent is related, so as to permit those skilled in that field or technology to successfully practice the invention upon expiry of the patent. The Supreme Court of Canada has described this relationship as follows:

Section 36 of the Patent Act [now sub-sections 27(3) and (4)] lies at the heart of the whole patent system. The description of the invention therein provided for is the *quid pro quo* for which the inventor is given a monopoly for a limited term of years on the invention. As Fox points out in *Canadian Patent Law and Practice* (4th ed.) ... the grant of a patent is in the nature of a bargain between the inventor on the one hand and the Crown, representing the public, on the other hand. The consideration of the grant is twofold: first, there must be a new and useful invention, and secondly, the inventor must, in return for the grant of a patent, give to the public an adequate description of the invention with sufficiently complete and accurate details as will enable a workman, skilled in the art to which the invention relates, to construct or use that invention when the period of the monopoly has expired.¹¹

The 17- or 20-year monopoly period is intended to give the patentee the opportunity to fully develop, market and profit from the subject matter of the patent. The underlying basis for the patent system is the belief that the potentially

lucrative period of monopoly serves as a key incentive for the investment of time and money in the development of new technology and the public disclosure of that technology. However, a strong and effective patent system must balance the positive benefits of encouraging the development and disclosure of new technology with the search for a fair and competitive market.¹²

The *Patent Act* provides that the Commissioner of Patents shall grant a patent for an invention if all requirements for issuance of a patent under the Act are met.¹³ A patent application is filed with the Canadian Patent Office (part of CIPO, which is part of Industry Canada). The application is examined by an examiner on behalf of the Commissioner of Patents. If the examiner objects to part or all of the application, he or she will set out the objection(s) in a letter to the applicant or the applicant's agent, who is given a chance to respond. If the objections are not overcome, the application will be refused. The applicant can appeal the refusal by right to the Trial Division of the Federal Court and, if necessary, subsequently to the Federal Court of Appeal.¹⁴ If there are no objections, or if the objections are overcome, the Commissioner will issue a Notice of Allowance, and the application will issue to patent upon payment of the final fee.¹⁵

An invention is defined in the *Patent Act* as "any new and useful art, process, machine, manufacture or composition of matter, or any new and useful improvement in any art, process, machine, manufacture or composition of matter".¹⁶ However, the Commissioner of Patents and the Canadian courts do not always take as proactive an approach toward new forms of potentially patentable subject matter as that taken in other countries. For example, in the United States, patents have been available for many years for higher life forms. Although the Federal Court of Appeal in Canada has recently held that the patenting of higher life forms is permissible under the Canadian *Patent Act*,¹⁷ the Commissioner of Patents is appealing this decision to the Supreme Court of Canada,¹⁸ and current Canadian Patent Office practice is to refuse all claims to higher life forms pending the outcome of that appeal.¹⁹ Similarly, while methods for doing business are patentable in the United States, the Canadian Patent Office does not presently permit such patents in Canada.²⁰ With respect to computer software²¹ and methods of medical treatment,²² the United States is again more permissive from the standpoint of patent protection.

INFRINGEMENT OF PATENT RIGHTS

THE PATENT ACT PROVIDES THAT A PATENTEE is granted the exclusive right, privilege and liberty of making, constructing and using the invention and selling it to others to be used, subject to adjudication.²³ While the *Patent Act* does not provide a definition of what constitutes an "infringement" of a patent, the courts have held that any act that interferes with these exclusive rights is

an infringement.²⁴ Accordingly, it is an infringement to make, construct, use or sell a patented invention in Canada without the authorization of the patent owner. There are a number of other activities which may constitute infringement, including:

- importing into Canada infringing articles manufactured abroad;
- importing articles manufactured abroad by a process that is patented in Canada;²⁵
- knowingly inducing another to infringe a patent in Canada.

ENFORCEMENT OF PATENT RIGHTS

UNLIKE SOME OTHER JURISDICTIONS (for example, the United Kingdom and Japan), Canada does not have a specialized patent court. As such, a patentee who believes that his/her patent is being infringed can institute an action for patent infringement in either the Federal Court of Canada or the appropriate Superior Court in the province in which the alleged infringement occurred.²⁶ However, in practice, most patent infringement actions are brought in the Federal Court. As a result, although the Federal Court is not a specialized patent court *per se*, it has acquired a certain degree of familiarity and experience with patent cases over the years.

In an action for patent infringement, the court must first construe the claims of the patent in order to determine whether the patent has been infringed. In two recent decisions, the Supreme Court of Canada has set out the key factors to be considered when construing the claims of a patent.²⁷ Briefly stated, the claims must be given a “purposive construction” with a view of distinguishing the essential elements of the claimed invention from the non-essential elements, having regard to whether or not it would have been obvious to a worker skilled in the art to which the patent relates at the time the patent was published that a variant of a particular element would not make a difference to the way the invention works.

In practice, the courts have adopted an initial approach toward the construction of a patent that is pro-patentee. The Supreme Court of Canada has commented as follows:

We must look to the whole of the disclosure and the claims to ascertain the nature of the invention and methods of its performance [...] being neither benevolent nor harsh, but rather seeking a construction which is reasonable and fair to both patentee and public. There is no occasion for being too astute or technical in the matter of objections to either title or specification for, as Duff C.J.C. said, giving the judgment of the Court in *Western Electric Co. et al. v. Baldwin Int'l Radio of Canada Ltd.* ... “where the language of the specification, upon a reasonable view of it, can be so

read as to afford the inventor protection for that which he has actually in good faith invented, the Court, as a rule, will endeavour to give effect to that construction". Sir George Jessel spoke to like effect at a much earlier date in *Hinks & Son v. Safety Lightning Co.* (1876), 4 Ch. D. 607. He said the patent should be approached "with a judicial anxiety to support a really useful invention".²⁸

After construing the claims, the court must determine whether the activity of the defendant infringes upon those claims. As set out by the Supreme Court of Canada in *Free World Trust*,²⁹ if the defendant's product or process contains each of the essential elements of the patented product or process, there is infringement of the patent. In addition, there will be infringement if a non-essential element is substituted or omitted. On the other hand, there is no infringement if an essential element is different or omitted.

There are several statutory based defences available to a party with respect to certain activities that might otherwise be found to infringe a patent. For example, Section 56 of the *Patent Act* provides that any person who has acquired the invention prior to the relevant date³⁰ has the right to use and sell the invention without being accountable to the patentee. In addition, Section 55.2(1) of the *Patent Act*, discussed in the context of pharmaceutical patents, *infra*, provides that it is not an infringement for any person to make, construct, use or sell a patented invention solely for uses reasonably related to the development and submission of information for regulatory purposes.

ROLE OF INSTITUTIONS IN CHALLENGING PATENT RIGHTS

THERE ARE TWO POSSIBLE WAYS TO CHALLENGE the validity of a patent in the courts. First, and most commonly, a defendant in an action for patent infringement will challenge the validity of a patent as a defence or by way of counterclaim. Second, Section 60(1) of the *Patent Act* provides that "any interested party"³¹ can apply to the Federal Court to have a patent or any claim in a patent declared invalid or void (known as an impeachment action).³² Note that only the Federal Court has the jurisdiction to hear an impeachment action and declare a patent invalid *in rem*, although the appropriate provincial Superior Court may declare a patent invalid as between the parties.³³

Many of the tests the courts apply in considering the validity of a patent can be difficult hurdles for a defendant to overcome. For example, the test for obviousness and anticipation can be very difficult to satisfy. In *Beloit Canada Ltd. v. Valmet OY*, Mr. Justice Hugessen commented on the test for obviousness as follows:

The test for obviousness is not to ask what competent inventors did or would have done to solve the problem. Inventors are by definition inventive. The classical touchstone for obviousness is the technician

skilled in the art but having no scintilla of inventiveness or imagination; a paragon of deduction and dexterity, wholly devoid of intuition; a triumph of the left hemisphere over the right. The question to be asked is whether this mythical creature (the man in the Clapham omnibus of patent law) would, in the light of the state of the art and of common general knowledge as at the claimed date of invention, have come directly and without difficulty to the solution taught by the patent. It is a very difficult test to satisfy.³⁴

In the same case, Mr. Justice Hugessen commented on the test for anticipation as follows:

It will be recalled that anticipation, or lack of novelty, asserts that the invention has been made known to the public prior to the relevant time. The inquiry is directed to the very invention in suit and not, as in the case of obviousness, to the state of the art and to common general knowledge. Also, as appears from the passage of the statute quoted above, anticipation must be found in a specific patent or other published document; it is not enough to pick bits and pieces from a variety of prior publications and to meld them together so as to come up with the claimed invention. One must, in effect, be able to look at a prior, single publication and find in it all the information which, for practical purposes, is needed to produce the claimed invention without the exercise of any inventive skill. The prior publication must contain so clear a direction that a skilled person reading and following it would in every case and without possibility of error be led to the claimed invention. Where, as here, the invention consists of a combination of several known elements, any publication which does not teach the combination of all the elements claimed cannot possibly be anticipatory.³⁵

There are also several quasi-judicial procedures available to challenge the scope of some or all of the claims of a patent or a pending application pursuant to the *Patent Act*. For example, Section 34.1 of the *Patent Act* provides that any person may file with the Commissioner of Patents prior art consisting of patents, published applications, and printed publications that the person believes has a bearing on the patentability of any claim in a pending application. Similarly, Section 48.1 of the *Patent Act* allows any person to request a re-examination of any claim of an issued patent by filing prior art and submitting written representations.³⁶ In practice, for legitimate strategic and tactical reasons, these provisions are seldom used.

Pursuant to Sections 65 and 66 of the *Patent Act*, the Attorney General or any interested person can apply to the Commissioner of Patents to allege an abuse by the patentee of the exclusive rights granted by the patent. The Commissioner may choose to grant a compulsory licence or revoke the patent altogether if it is determined that the patent is being abused. However, historically,

Sections 65 and 66 have not been relied upon to any great extent in Canada.³⁷ In addition, many of the grounds upon which a court could deem a patent was being abused were repealed effective October 1, 1996.³⁸

Finally, a similar abuse provision is available pursuant to Section 32 of the *Competition Act*.³⁹ Section 32 provides that a patent cannot be used:

- to limit unduly the facilities for transporting, producing, manufacturing, supplying, storing or dealing in any article or commodity which may be the subject of trade or commerce, or
- to restrain, or injure, unduly, trade or commerce in relation to any such article or commodity, or
- to prevent, limit or lessen, unduly, the manufacture or production of any such article or commodity or unreasonably to enhance the price thereof, or
- to prevent or lessen, unduly, competition in the production, manufacture, purchase, barter, sale, transportation, or supply of any such article or commodity.

Pursuant to Section 32, the Federal Court may grant any relief as necessary, including the revocation of the patent.⁴⁰

PHARMACEUTICAL PATENTS

IN CANADA, PHARMACEUTICAL PATENTS have traditionally been subject to unique considerations.⁴¹ For example, a compulsory licence scheme for pharmaceutical patents was first instituted in 1923, pursuant to which the Commissioner of Patents was granted the authority to issue a compulsory licence to third parties for the use of a patented process to manufacture a medicine in Canada. In 1969, this authority was expanded to include the power to issue a compulsory licence to import a patented medicine from outside Canada.⁴² The purpose behind the compulsory licence scheme was a stated desire to ensure that pharmaceutical products were available to consumers at reasonable prices.⁴³

In 1987, the *Patent Act* was amended in two respects relating to the pharmaceutical industry. First, the Act was amended to provide a system of compulsory licence deferrals, whereby compulsory licensing rights to import patented medicines were deferred for a period of time after the medicine had received government approval.⁴⁴ The effect of the deferral system was to delay the introduction of generic products into the marketplace. Second, the *Patent Act* was amended to create the Patented Medicines Prices Review Board (PMPRB). The PMPRB was given the mandate to review the prices of patented medicines and to collect information from patentees relating to expenditures on research

and development and revenues from sales. The purpose of the PMPRB was to help ensure that patented medicines were being sold at fair market value, and to monitor pharmaceutical research and development investment in Canada.

The system of compulsory licensing for patented medicines was abolished by the *Patent Act Amendment Act, 1992*.⁴⁵ In return, a number of new sections in the *Patent Act*, and companion regulations,⁴⁶ were enacted to provide some protection to the generic drug industry in Canada. For example, Section 55.2(1) of the *Patent Act* provides that it is not an infringement to make, construct, use or sell a patented invention solely for uses reasonably related to the development and submission of information required under any law that regulates the manufacture, construction, use or sale of the product. This would include activity related to obtaining a Notice of Compliance (NOC) from the Minister of National Health and Welfare, discussed in more detail below. In addition, Section 55.2(2) of the Act provided that it was not an infringement for those individuals coming within Section 55.2(1) to manufacture and stockpile articles intended for sale after the date on which the term of the patent expired. The *Manufacturing and Storage of Patented Medicines Regulations* provided a 6-month period during which the manufacture could take place, such period to expire immediately preceding the date on which the patent expired.

Sections 55.2(1) and 55.2(2) of the Canadian *Patent Act* were both recently challenged by the European Community and its member States before the World Trade Organization (WTO), who upheld the exception to infringement provided by s. 55.2(1) of the Act, but ruled that s. 55.2(2) was inconsistent with Canada's obligations under the WTO TRIPs Agreement.⁴⁷ As a result, s. 55.2(2) of the *Patent Act* was repealed effective July 12, 2001.⁴⁸

At present, the pharmaceutical industry in Canada is governed by the *Patented Medicines (Notice of Compliance) Regulations*, known simply as the NOC Regulations. Under the NOC scheme,⁴⁹ a notice of compliance must be obtained from the Minister of National Health and Welfare before a drug can be marketed in Canada. Drug manufacturers who hold patents, or licences under subsisting patents, are called first persons. First persons may file patent lists with the Minister, setting out the drugs for which they hold notices of compliance. A second person, who files a submission for a notice of compliance in respect of a drug that is already the subject of a notice of compliance (for example, a generic drug manufacturer), must either state that it accepts that the notice of compliance will not issue until the patent expires, or assert one or more of the following allegations in a notice of allegation: (i) that the first person is not the owner; (ii) the patent has expired; (iii) the patent is not valid; or (iv) the second person's product or process does not infringe upon the claims of the patent.

The first person has 45 days after the notice of allegation has been served to apply to a court for an order prohibiting the Minister from issuing a notice of compliance until after the expiration of the patent that is the subject of the notice of allegation. If the court finds that none of the allegations are “justified”, the court will issue an order of prohibition. In essence, such an application typically serves as a summary form of patent infringement/validity action based on affidavit evidence. The application to the court results in a 24-month delay of the NOC proceedings.⁵⁰ However, the first person may be liable to the second person for any loss suffered during the delay if the application to the court is withdrawn or discontinued, or is ultimately dismissed by the court.⁵¹

REMEDIES FOR PATENT INFRINGEMENT

THERE ARE A NUMBER OF REMEDIES available to a patentee who is successful in an action for infringement, including the patentee’s damages or an accounting of the defendant’s profits, punitive, exemplary or aggravated damages (in appropriate circumstances), a permanent injunction, and delivery up or destruction of the offending products. Furthermore, a successful patentee may also be entitled to its legal costs (including a portion of its attorney fees) and to post and pre-judgment interest. In practice, the issue of damages or accounting of profits is often the subject of a reference after the issue of liability has been determined.

There are several interlocutory remedies which may also be available to a patentee depending on the circumstances. For example, a patentee might seek an interlocutory injunction to restrain the defendant from engaging in the allegedly infringing activity prior to trial.⁵² The Supreme Court of Canada in *RJR-Macdonald Inc. v. Canada (A.G.)*⁵³ set out three requirements that must be met before an interlocutory injunction will issue, namely, the applicant must demonstrate that there is a serious issue to be tried, that it will suffer irreparable harm if the application is not granted, and that the balance of convenience favours the applicant. In practice, this test is often difficult to satisfy in a patent case because in most instances any loss sustained prior to trial could likely be adequately compensated by an award of damages.⁵⁴ Other interlocutory remedies which could be granted include an *Anton Piller* order⁵⁵ or a Mareva injunction.⁵⁶

As a point of contrast, the remedies available to a successful patentee in the United States are generally similar with some significant differences. In that country, a successful patentee is not entitled to the remedy of the defendant’s profits nor typically entitled to its attorney fees. However, the U.S. *Patent Act* does grant the court discretion to “increase the damages up to three times the amount assessed.”⁵⁷ The decision to increase damages is most often awarded in cases of wilful infringement. There is no similar provision in the Canadian statute. In the United States, the prospect of an award of triple damages may serve

as a disincentive to potential infringers in that it can lead to potentially large damage awards.⁵⁸

TRADE-MARKS

A TRADE-MARK IS A WORD, LOGO, a combination of the two, or some other element used to distinguish one trader's wares and/or services from the wares and/or services of other traders. Historically, the main function of a trade-mark was to indicate the source from which the goods or services emanated. However, in light of modern commercial practices, such as the wide spread use of trade-mark licensing and franchising, the more modern view is that trade-marks are not so much an indication of origin, but rather serve more as an indicia of the quality of the goods and/or services being offered or sold.⁵⁹ In this way, a trade-mark provides protection to the public by ensuring that the quality of the product being purchased in association with that trade-mark will be of a particular standard.

A trade-mark may be, amongst other things, a simple word (*Blue*), a slogan ("Don't leave home without it"), a design (the *Nike* swish), a combination of a word and design (*McDonald's* and the golden arches design) or the shape of a container or packaging of the wares (the *Realemon* lemon⁶⁰).⁶¹ The value of a trade-mark to a business cannot be overestimated. Of the top 10 global trade-marks in 1999, *Coca-Cola* ranked first with an estimated value of 83.8 billion dollars.⁶² *Microsoft* ranked second with an estimated value of 56.6 billion dollars. Given the actual or potential value of a party's trade-mark rights, the ability to protect those rights is naturally of great importance to trade-mark owners.

Trade-mark law in Canada is governed by the federal *Trade-marks Act*⁶³ and by the common law of passing off. The registration of a trade-mark in association with wares or services under the *Trade-marks Act* gives the owner the exclusive right to use the trade-mark in association with those wares or services throughout Canada.⁶⁴ However, it is not essential that a trade-mark be registered in order to obtain some rights in the mark. The common law action of passing off can be used to protect unregistered trade-marks that have some level of reputation.⁶⁵ Nevertheless, there are several advantages to registration, including the exclusive right to use the trade-mark anywhere in Canada, the right to institute causes of action for infringement (not available to unregistered trade-marks), and the right to register the trade-mark in foreign countries that adhere to the Paris Convention.⁶⁶

INFRINGEMENT OF TRADE-MARK RIGHTS

Registered Trade-marks

IN CANADA, A TRADE-MARK APPLICATION is filed with the Canadian Trade-marks Office (part of CIPO, which is part of Industry Canada). The application is examined by a trade-marks examiner on behalf of the Registrar of Trade-marks to ensure that it meets the preliminary requirements for registration.⁶⁷ If the examiner objects to part or all of the application, he or she will set out the objection(s) in a letter to the applicant or the applicant's agent, who is given a chance to respond. If the objections are not overcome by the response, the application will be refused. The applicant can appeal the refusal by right to the Trial Division of the Federal Court and, if necessary, subsequently to the Federal Court of Appeal.⁶⁸ If there are no objections, or if the objections are overcome, the application will be advertised in due course in the Trade-marks Journal. The advertisement of the application acts as a notice to members of the public, who then have the opportunity to oppose the application.⁶⁹ If the application is not opposed, or if opposition proceedings are ultimately decided in favour of the applicant, the application will proceed to registration.

Section 19 of *Trade-marks Act* provides that the registration of a trade-mark in respect of any wares or services, unless shown to be invalid, gives to the owner of the trade-mark the exclusive right to the use of the trade-mark in respect of those wares or services throughout Canada. The application of this section is generally limited to cases where the infringing trade-mark is identical to the registered mark, and is being used in association with the same wares and/or services as those listed in the registration. However, Section 20(1) of the *Trade-marks Act* will protect the owner of a registered trade-mark from use of a different mark or where the trade-mark is used in association with different wares and/or services. It provides that the rights of the owner of a registered trade-mark are deemed to be infringed by a person who sells, distributes or advertises wares or services in association with a "confusing" trade-mark or trade-name. Finally, Section 22 of the *Trade-marks Act* prevents the use of a trade-mark registered by another person in a manner that is likely to have the effect of depreciating the value of the goodwill attaching to the registered mark.

The *Trade-marks Act* provides that a trade-mark or trade-name is confusing with another trade-mark or trade-name if the use of both in the same area would be likely to lead to the inference that the wares or services associated with those trade-marks or trade-names are manufactured, sold, leased, hired or performed by the same person, whether or not the wares or services are of the

same general class.⁷⁰ In determining whether trade-marks or trade-names are confusing, all surrounding circumstances can be considered, including:⁷¹

- the inherent distinctiveness of the trade-marks or trade-names and the extent to which they have become known;
- the length of time the trade-marks or trade-names have been in use;
- the nature of the wares, services or business;
- the nature of the trade; and
- the degree of resemblance between the trade-marks or trade-names in appearance or sound or in the ideas suggested by them.

Passing Off

The common law action for passing off will protect the owner of an unregistered trade-mark from a trader misrepresenting its wares, services or business for those of the owner of the trade-mark. Overall, the scope of protection afforded the owner of a non-registered trade-mark is limited to the geographical area in which the owner of the trade-mark has established a reputation in respect of that mark.⁷²

The Supreme Court of Canada has set out three requirements that must be met in order to establish a case of passing off:

- a goodwill or reputation must attach to the plaintiff's goods or services in the mind of the public such that the name in question is identified with the goods or services of the plaintiff;
- the defendant must have made a misrepresentation leading or likely to lead the public to believe that the goods or services are those of or authorized by the plaintiff; and
- the plaintiff must have or is likely to have suffered damage.⁷³

It is also possible to institute a similar action under Section 7(b) of the *Trade-marks Act*. This section provides that no person shall "direct public attention to his wares, services or business in such a way as to cause or be likely to cause confusion in Canada, at the time he commenced so to direct attention to them, between his wares, services or business and the wares, services or business of another". Section 7(b) has been referred to as the codification of the common law action of passing off.⁷⁴

ROLE OF INSTITUTIONS IN ENFORCING TRADE-MARK RIGHTS

AN ACTION FOR INFRINGEMENT can only be brought in respect of a registered trade-mark. Such an action can be brought in the Federal Court of Canada or in any provincial Superior Court of competent jurisdiction.⁷⁵ In practice, as with the case with patents, most actions for infringement are brought in the Federal Court. In the case of unregistered trade-marks, it is important to note that an action for passing off under the common law must be brought in a provincial court of competent jurisdiction. The Federal Court has no jurisdiction over such an action. However, an action pursuant to Section 7(b) of the *Trade-marks Act* can be brought in the Federal Court.

ROLE OF INSTITUTIONS IN CHALLENGING TRADE-MARK RIGHTS

AS DISCUSSED ABOVE, members of the public have an opportunity to oppose an application for trade-mark once it has been advertised. Opposition proceedings can be commenced by anyone who files a statement of opposition with the Registrar of Trade-marks.⁷⁶ The statement of opposition can be based on one of four grounds, namely:

- the application does not conform with the requirements of Section 30 of the *Trade-marks Act*,⁷⁷
- the trade-mark is not registrable,
- the applicant is not the person entitled to registration of the trade-mark, or
- the trade-mark is not distinctive.⁷⁸

In an opposition proceeding, evidence is provided by way of affidavits and cross-examinations on those affidavits. Parties submit written arguments to the Registrar in respect of the issues and evidence raised in the opposition, and there is also typically an oral hearing before a Trade-marks Office hearing officer.⁷⁹ After considering the evidence and the submissions of the parties, the hearing officer, on behalf of the Registrar, will render a decision to either allow or reject the application.⁸⁰ The decision of the Registrar can be appealed as of right to the Trial Division of the Federal Court and, subsequently, to the Federal Court of Appeal.⁸¹

Once a trade-mark is registered, there are three possible ways for a party to challenge the validity of that registration. The Federal Court has the exclusive jurisdiction, on application by a person interested,⁸² to order that any entry on the Trade-mark Register be struck or amended where the entry does not accurately express or define the existing rights of the person appearing to be the registered owner of the trade-mark (referred to as an application for “expungement”).⁸³

Such an application may be commenced as a separate proceeding or may be brought by way of counterclaim in an action for trade-mark infringement. There can be no infringement if the registration is invalid, even though the two trade-marks may otherwise have been found to be confusing.⁸⁴ An application for expungement may be based on a number of different grounds, including that the trade-mark was not registrable as of its date of registration or that the mark was not distinctive as of the date that proceedings were instituted in court.

Pursuant to Section 45 of the *Trade-marks Act*, a registration may also be expunged or varied for lack of use in Canada. This section provides a procedure under which any person can request that the Registrar give notice to the registered owner of a trade-mark to furnish evidence proving use of the trade-mark in association with the wares or services listed in the registration at any time during the three-year period preceding the date of the notice. If there has been no use of the trade-mark within the relevant time period, the owner must state the date the trade-mark was last in use and the reasons for the absence of use. If the Registrar is satisfied that the absence of use was due to special circumstances, the registration may be maintained or amended. In the absence of use or special circumstances, the registration will be expunged. The decision of the Registrar can again be appealed to the Trial Division of the Federal Court and, subsequently, to the Federal Court of Appeal.⁸⁵ Section 45 has been referred to as a means for clearing *deadwood* from the Register.

A trade-mark registration can also be expunged pursuant to Section 32 of the *Competition Act*. Section 32(1) provides that when the exclusive rights that accompany a trade-mark registration are used in a manner that contravenes the section,⁸⁶ an action can be commenced in the Federal Court on information exhibited by the Attorney General of Canada. Section 32(2) sets out the various forms of relief available, and includes, *inter alia*, an order directing that the registration be expunged or amended. However, to date, the authors are not aware of a single case where this section has been utilized to expunge a registered trade-mark.

REMEDIES FOR TRADE-MARK INFRINGEMENT

THERE ARE NUMEROUS REMEDIES AVAILABLE to a trade-mark owner who has been successful in an action for trade-mark infringement, including an order for a permanent injunction, an order for damages or an accounting of profits, or an order for the delivery up or destruction of any offending wares, packages, labels or advertising material, as well as the means to produce them.⁸⁷ Similar remedies are available in actions for passing off. As in the case of patents, the issue of damages or accounting of profits is often the subject of a reference after trial.

The owner of a registered trade-mark might choose to bring an application for an interlocutory remedy in connection with the action for infringement, such as an interlocutory injunction, an *Anton Piller* order or a Mareva injunction, depending on the circumstances. However, with respect to interlocutory injunctions, and in particular the issue of irreparable harm, the Federal Court of Appeal has imposed an onerous burden on trade-mark owners. The Court has held that evidence of confusion will not automatically result in a loss of goodwill, and a loss of goodwill will not automatically establish irreparable harm; irreparable harm must be established by “clear evidence”.⁸⁸ As such, an interlocutory injunction in a trade-mark case is now typically difficult to obtain in the Federal Court.

OTHER TRADE-MARK ISSUES

Dilution

DILUTION IS THE GRADUAL WHITTILING AWAY of the distinctiveness of a trade-mark by the use of the mark on unrelated wares or services. The harm that dilution can cause to a famous trade-mark cannot be overestimated:

Though subtle and gradual, dilution harm to a famous trade-mark, an intangible asset of often incalculable value, can be enormous.⁸⁹

Where a registered trade-mark is used by a third party on dissimilar wares or services, the trade-mark owner may not be able to demonstrate a likelihood of confusion. As a result, the trade-mark owner might not be able to succeed in a cause of action for infringement under Section 19 or 20 of the Canadian *Trade-marks Act*. In the United States, a trade-mark owner may still be protected in these circumstances.

The U.S. *Trade-mark Dilution Act of 1995*⁹⁰ was recently adopted to protect against the *whittling away* of the distinctiveness of famous trade-marks. In Canada, there is no equivalent protection. Although Section 22 of the Canadian *Trade-marks Act* precludes the use of a registered trade-mark in a manner that is likely to “depreciate the value of the goodwill in the mark”, the Federal Court of Appeal has recently made it clear that the doctrine of dilution does not apply. For example, in *United Artists Corp. v. Pink Panther Beauty Corp.*,⁹¹ the owner of the registration for the famous trade-mark *Pink Panther* (registered for use in association with “phonographic records; motion picture films; film leasing and distribution services; entertainment services by means of motion picture films”) was opposing the registration of the trade-mark by a third party (for use in association with a wide variety of hair care and beauty product supplies, and in the operation of a business related to the distribution of those supplies). The Federal Court of Appeal rejected the opposition, finding that there

would be no likelihood of confusion since the wares of the impugned application were so different from those described in the registration. The Court commented that there should not be an automatic assumption of confusion based solely on the fact that the *Pink Panther* trade-mark is famous.⁹² In so concluding, the Court essentially rejected the U.S. doctrine of dilution.⁹³

Counterfeit Wares

The owner of a well-known trade-mark in Canada may also have to face the possibility that unauthorized parties may be selling counterfeit wares bearing the trade-mark (also referred to as “knock-offs”). In the case of such goods, the trade-mark owner will not only suffer damages from lost sales, but may also suffer damage to the goodwill associated with the trade-mark, especially if the counterfeit goods are of inferior quality.

In the usual scenario, the party selling or manufacturing the counterfeit goods is difficult to identify and difficult to prosecute. It is common practice for the courts in such cases to issue *Anton Piller* orders to protect a trade-mark owner in these circumstances, including “John Doe” *Anton Piller* orders restraining unknown defendants from selling unauthorized merchandise.⁹⁴

It may also be possible for a trade-mark owner to initiate criminal proceedings in respect of counterfeit merchandise. The Canadian *Criminal Code* contains a number of provisions relating to the use of trade-marks, including, *inter alia*, provisions that make it a criminal offence to forge or falsify a trade-mark, to pass-off wares as and for those ordered or required, to use a description that is false in a material respect regarding the origin, kind or manufacture of the wares or services, or to deface or remove a trade-mark with intent to deceive.⁹⁵ If convicted, the counterfeiter could be sentenced to up to two years in prison and would be required to forfeit the goods in question. Depending on the circumstances, the *Criminal Code* could provide a trade-mark owner with a more cost-effective and expedient method for dealing with counterfeiters.⁹⁶

Trade-mark Rights vs. Domain Name Rights

An emerging issue with respect to the protection of IPRs is how trade-mark rights will affect the registration and use of Internet domain names and web sites. In the United States, the *Anticybersquatting Consumer Protection Act*⁹⁷ has been enacted to grant trade-mark owners a cause of action against “cybersquatters”, individuals who register famous trade-marks or derivatives of famous trade-marks as domain names in the hope of selling those domain names to the trade-mark owner for a profit. At present, there is no comparable legislation in Canada. As a result, a Canadian litigant is relegated to bringing actions against cybersquatters under the traditional heads of trade-mark infringement, passing off, or unfair competition, or to proceeding under the dispute resolution policies

implemented by the World Intellectual Property Organization (WIPO) or the Canadian Internet Registration Authority (CIRA), discussed below.

By way of a trade-mark infringement action, the Federal Court of Canada has granted interlocutory and interim injunctions to restrain cybersquatters. For example, in *Tele-Direct v. Canadian Business Online Inc.*,⁹⁸ the owner of the trade-marks *Yellow Pages* and *Walking Fingers* obtained an injunction against the registrant of a web site that used the expression “Canadian Yellow Pages on the Internet” alongside a representation of the *Walking Fingers* logo. In so holding, the Court commented as follows:

It may perhaps be said that the case before me is already one in which, notwithstanding the peregrinations of the Internet in terms of its seamless borders and its obtrusive presence across whole continents, the basic principles of property ownership require continuing protection. In so doing, the current historical doctrines surrounding the concepts of use, of making known, of distinguishing, of acquiring or losing proprietary interests in trade-marks, may require jurisprudential and statutory revision.⁹⁹

Similarly, in *Bell ActiMedia Inc. v. Puzo*,¹⁰⁰ on application by the owner of the registered trade-marks *Yellow Pages* and *Pages jaunes*, the Court granted an interlocutory injunction to restrict the defendant from using the domain name *www.lespagesjaunes.com*. In this case, the Court was influenced by the fact that the plaintiff's business generated large annual sales and that the trade-marks had been used for over 50 years. Finally, in other cases, the courts have granted interim injunctions to restrain parties from selling or transferring domain names or web sites until the issue of infringement has been determined by the court.¹⁰¹

Disputes relating to domain names and web sites often involve parties located in different countries. As a result, there may be some question as to the correct forum to hear those disputes. In a recent case in the United States, a Canadian company alleged that its trade-marks were being infringed by a Canadian who had registered two domain names with a company in Virginia.¹⁰² Pursuant to a unique provision in the U.S. *Anticybersquatting Consumer Protection Act*,¹⁰³ the Canadian company was able to sue the domain names rather than the individual defendant. The Virginia Court held that it was a more appropriate forum than Canada to hear the dispute, noting that Canada lacked a body of law equivalent to the U.S. anticybersquatting statute. This case is a noteworthy example of how one country may extend its laws in respect of Internet-related disputes to parties located in a different country.¹⁰⁴

As an alternative to bringing an action for trade-mark infringement, a Canadian trade-mark owner might seek to take advantage of the recently adopted Uniform Domain Name Dispute Resolution Policy (UDRP), as implemented by the Internet Corporation for Assigned Names and Numbers (ICANN). The UDRP provides WIPO with the authority to arbitrate domestic

and international disputes involving cybersquatters. A trade-mark owner first submits a complaint to WIPO, after which time the domain name owner has 20 days to respond. A one- or three-person panel will then rule on the matter. The Canadian Internet Registration Authority (CIRA) is in the process of instituting its own dispute resolution policy similar to ICANN's UDRP, which would also provide a forum for addressing cybersquatting complaints. It is expected that such a policy will be in place sometime in the near future.

COPYRIGHT

COPYRIGHT EXISTS IN THE EXPRESSION OF IDEAS, but not the ideas themselves. Copyright law in Canada is a creature of statute and is solely governed by the *Copyright Act*.¹⁰⁵ There is no common law of copyright, and no person is entitled to copyright other than under the *Copyright Act* or another Act of Parliament.¹⁰⁶

The *Copyright Act* protects two classes of subject matter:

- (1) original literary, dramatic, musical, or artistic works,¹⁰⁷ and
- (2) "neighbouring rights."¹⁰⁸

In Canada, an application to register copyright in a work is filed with the Canadian Copyright Office (part of CIPO, which is part of Industry Canada). However, unlike applications for patents or trade-marks, an application for copyright does not undergo a substantive examination prior to registration and a copy of the work is not filed with the Copyright Office. Copyright in the work will be registered if the application meets the basic requirements set out in the Act and is accompanied by the prescribed fee.¹⁰⁹

It should be pointed out that registration under the Act is not a prerequisite to obtaining copyright in Canada. In fact, copyright exists the moment an original literary, dramatic, musical, or artistic work is created. However, registration does confer certain benefits to the registered owner. For example, a certificate of registration creates a presumption that copyright subsists in the work and that the person registered is the owner of the copyright.¹¹⁰ Furthermore, registration of copyright serves as a constructive notice to third parties that copyright subsists in the work in question.¹¹¹

The author of a copyrighted work is also entitled to the protection of his or her "moral rights" in the work. This includes the right to protect the integrity of the work and the right, where reasonable, to be associated with the work as its author.¹¹² The *Copyright Act* provides that the author of a work cannot assign his or her moral rights in the work.¹¹³ However, moral rights can be waived in whole or in part.¹¹⁴

INFRINGEMENT OF COPYRIGHT

THE OWNER OF A COPYRIGHT IN A WORK is granted the sole right to produce or reproduce the work or any substantial part thereof in any material form, to perform the work or any substantial part thereof in public or, if the work is unpublished, to publish the work or any substantial part thereof.¹¹⁵ It is an infringement of copyright for any person to do, without the consent of the owner of the copyright, anything that, by virtue of the *Copyright Act*, only the owner of the copyright has the right to do.¹¹⁶

In order to be successful in a claim for copyright infringement, the plaintiff must prove copying of the work or a substantial part thereof.¹¹⁷ However, a person need not be the party who did the actual copying of the work in order to be found to have infringed copyright. It is also an infringement to authorize anyone to do that which is the sole right of the copyright owner.¹¹⁸ In addition, it is an infringement of copyright for any person to sell or rent out, distribute to such an extent as to affect prejudicially the owner of the copyright, distribute, expose or offer for sale or rental, or exhibit in public, possess, or import into Canada any material that the person knows or should have known infringes copyright.¹¹⁹

In the case of moral rights, any act or omission that is contrary to the moral rights of the author is an infringement of those moral rights, in the absence of consent by the author.¹²⁰ The author's right to the integrity of a work is infringed if it is distorted, mutilated, or otherwise modified, or used in association with a product, service, cause or institution, to the prejudice of the honour or reputation of the author.¹²¹

The *Copyright Act* provides a series of statutory exemptions for activities which would otherwise constitute an infringement of copyright.¹²² The Act sets out the various exemptions, which include, *inter alia*, "fair dealing" for research or private study, criticism or review, or news reporting, and the reproduction of copyrighted works for instruction in an educational institution.

ROLE OF INSTITUTIONS IN CHALLENGING COPYRIGHT

PROCEEDINGS FOR INFRINGEMENT OF COPYRIGHT or moral rights can be brought in the Trial Division of the Federal Court of Canada or the Superior Court of a province.¹²³ However, unlike actions for patent or trade-mark infringement, proceedings for the infringement of copyright or moral rights can be commenced by way of either action or application.¹²⁴ Proceeding by way of application provides a copyright owner with a less expensive and more simplified means for dealing with alleged infringers. There are several other provisions in the *Copyright Act* that provide a unique means for dealing with infringement, including the possibility of electing for statutory damages and the

possibility of commencing criminal proceedings, both of which are discussed below.

Should a party wish to challenge a copyright registration, the *Copyright Act* provides that the Federal Court may, on application by the Registrar of Copyrights or by any interested person, order the rectification of the Register of Copyrights.¹²⁵ Such an order could include the expungement of any entry made in or remaining on the Register.¹²⁶ In addition, an action can again be brought in the Federal Court under Section 32 of the *Competition Act* where a copyrighted work is being used in contravention of that section. The Federal Court may grant any relief as necessary, including, presumably, expungement of the registration.

REMEDIES FOR COPYRIGHT INFRINGEMENT

THE COPYRIGHT ACT PROVIDES THAT, where a copyright has been infringed, the owner of the copyright, subject to the Act, is entitled to all remedies by way of injunction, damages, accounts, delivery up and otherwise that may be conferred by law for the infringement of a right.¹²⁷ Similar remedies are available where moral rights have been infringed.¹²⁸ The Act also provides that where a person is found by the court to infringe, that person may be ordered to pay damages to the copyright owner as well as profits made from the infringement that were not taken into account in calculating the damages.¹²⁹ Finally, a copyright owner may be entitled to exemplary or punitive damages, depending on the circumstances.¹³⁰

It is interesting to note that the *Copyright Act* limits the type of remedies available in some circumstances, for example:

- where copyright has not been registered, an injunction is the only remedy available where the defendant was not aware and had no reasonable grounds to suspect that copyright subsisted in the infringed work;¹³¹ and
- an injunction is not available with respect to the construction of a building or other structure, which infringes or would infringe copyright, once construction has commenced (the copyright owner is also not entitled to an order for the demolition of the building or other structure).¹³²

Since October 1, 1999, a copyright owner may elect, at any time before final judgment is rendered, to recover, instead of damages and profits, statutory damages for all infringements involved in the proceeding.¹³³ Such damages could range from \$500 to \$20,000 per work infringed. However, this amount

may be reduced where the defendant was unaware and had no reasonable grounds to believe he was infringing copyright, or as the court considers just.¹³⁴

In addition to other remedies, the owner of copyright in a work may be entitled to seize all infringing copies of the work as well as all plates¹³⁵ used or intended to be used to produce the infringing copies.¹³⁶ A recent amendment to the *Copyright Act* provides that a proceeding for the seizure of infringing copies or plates may be brought before judgment.¹³⁷ This provides a copyright owner with a potentially powerful new enforcement mechanism. In fact, it may be preferable for copyright owners to proceed in this manner rather than bringing a motion for an interlocutory injunction, in that the tripartite test for an injunction may not need to be satisfied.¹³⁸ It would appear that all that the copyright owner may need to demonstrate is a *prima facie* case of copyright infringement.¹³⁹

In addition to civil remedies, the *Copyright Act* also contains criminal provisions whereby certain activities may be considered summary or indictable offences.¹⁴⁰ If convicted, the infringer could be subject to fines or imprisonment or both.¹⁴¹ In 1998, the Royal Canadian Mounted Police and the Department of Justice published an "Interim Copyright Enforcement Policy" which is presently subject to public consultation. In addition to the criminal provisions of the *Copyright Act*, the *Criminal Code* contains provisions which may be used to convict those who infringe a copyright.¹⁴²

CANADA HAS STRONG IPR ENFORCEMENT REGIMES

IN ADDITION TO THE VARIOUS CAUSES OF ACTION available to an IPR owner to protect his exclusive rights, there are other procedural advantages in Canada that contribute to the overall conclusion that the country has strong IPR enforcement mechanisms in place. Additionally, a review of available judicial statistics suggests that Canadian courts adopt a pro-IPR approach.

PROCEDURAL/PRACTICAL ADVANTAGES TO ENFORCING IPRS IN CANADA

IN 1996, IN A SURVEY OF PATENT OWNERS, Canada was selected as the best country in the world in which to litigate a patent.¹⁴³ This was likely due to a combination of substantive and procedural factors that make this country an attractive forum in which to litigate intellectual property rights, including the following:¹⁴⁴

- it can be far less expensive to litigate a patent in Canada than in many other jurisdictions, especially the United States;¹⁴⁵
- there is relatively broad documentary and oral discovery available to litigants in Canada;¹⁴⁶

- anti-trust or anti-competitive issues are almost never part of the litigation of a dispute; as a result, a patentee with a strong market position is rarely required to defend its business practices;¹⁴⁷
- there are a variety of legal and equitable remedies available in Canada to a successful plaintiff, including an accounting of profits;¹⁴⁸ and
- a successful litigant in Canada is routinely awarded its litigation costs, which can amount to between 30 and 50 percent of its legal fees, and all of its reasonable disbursements.

In addition, it is important to note that, in construing the claims of a patent, the courts in Canada are limited to considering the patent and cannot consider any extrinsic evidence.¹⁴⁹ For example, the courts may not consider any submissions made by the patentee during the prosecution of the application. This is in contrast with the situation in the United States, where a patentee is estopped from taking a position with respect to the scope of the claims that is contrary to the one taken during prosecution (known as the doctrine of “file wrapper estoppel”). The fact that the doctrine of *file wrapper estoppel* does not apply in Canada provides a distinct advantage for patentees if the patent is subsequently litigated.

STATISTICS FROM THE COURTS

THE COURTS AND QUASI-JUDICIAL TRIBUNALS referred to above play a key role in defining and protecting IPRs in Canada. In fact, it is the enforcement branch of the IP system which is entrusted with the everyday task of ensuring that the correct balance is achieved between the extent of the protection granted to the IPR holder and the interests of the general public. An analysis of statistics from the courts will help assist in determining the strength of the enforcement mechanisms in place.

Patents

i) Canada¹⁵⁰

TABLE 1				
PATENT INFRINGEMENT TRIALS SINCE 1971				
NUMBER OF DECISIONS	PATENTEE SUCCESSFUL ¹⁵¹	SUCCESS RATE (%)	VALID PATENT ¹⁵²	VALIDITY RATE (%)
105	63	60	74	70

TABLE 2						
APPEALS FROM PATENT INFRINGEMENT TRIALS SINCE 1971						
NUMBER OF DECISIONS	PATENTEE APPEAL ¹⁵³	APPEAL SUCCESSFUL	SUCCESS RATE (%)	DEFENDANT APPEAL ¹⁵⁴	APPEAL SUCCESSFUL	SUCCESS RATE (%)
62	40	14	35	35	6	17

TABLE 3		
SUCCESS OF PATENTEES IN FINAL JUDGMENTS SINCE 1971 ¹⁵⁵		
NUMBER OF DECISIONS ¹⁵⁶	PATENTEE SUCCESSFUL	SUCCESS RATE (%)
110	70	64

ii) *United States*

TABLE 4	
PATENT TRIALS IN THE U.S. FEDERAL DISTRICT COURTS FROM 1979 TO 1996 ¹⁵⁷	
NUMBER OF DECISIONS	PLAINTIFF SUCCESS RATE ¹⁵⁸ (%)
1,210	56

TABLE 5				
PATENT INFRINGEMENT APPEALS IN THE U.S. FEDERAL CIRCUIT FROM 1985 TO 1993 ¹⁵⁹				
NUMBER OF DECISIONS ¹⁶⁰	APPEAL SUCCESSFUL ¹⁶¹	SUCCESS RATE (%)	APPEAL IN FAVOUR OF PATENTEE ¹⁶²	SUCCESS RATE (%)
332	86	26	42	49

The results of patent infringement trials in Canada since 1971 indicate that patentees have been successful in about 60 percent of the cases that went to trial, in that at least one claim of a patent was found to be valid and infringed. With respect to appeals, 35 percent of the appeals brought by patentees were allowed compared to only 17 percent of the appeals brought by defendants. In addition, where an appellate court has overturned a decision of a lower court, it has done so in favour of the patentee in 70 percent of the cases.¹⁶³ Overall, a patentee has been successful in 64 percent of the final judgments in actions for infringement brought in Canada since 1971.¹⁶⁴

In the United States, the results show a similar trend in that the plaintiff in a patent trial has been successful in 56 percent of the cases in the District Courts between 1979 and 1996. With respect to appeals, where a decision of a lower court has been overturned, the appellate court in the United States has ruled in the patentee's favour 49 percent of the time between 1985 and 1993.

Trade-marks

*i) Canada*¹⁶⁵

TABLE 6		
TRADE-MARK INFRINGEMENT TRIALS SINCE 1971		
NUMBER OF DECISIONS	TRADE-MARKS OWNER SUCCESSFUL ¹⁶⁶	SUCCESS RATE (%)
44	28	64

TABLE 7						
APPEALS FROM TRADE-MARK INFRINGEMENT TRIALS SINCE 1971						
NUMBER OF DECISIONS	TRADE-MARKS OWNER APPEAL	APPEAL SUCCESSFUL	SUCCESS RATE (%)	DEFENDANT APPEAL	APPEAL SUCCESSFUL	SUCCESS RATE (%)
14	6	2	33	8	3	38

TABLE 8		
SUCCESS OF TRADE-MARKS OWNERS IN FINAL JUDGMENTS SINCE 1971 ¹⁶⁷		
NUMBER OF DECISIONS ¹⁶⁸	TRADE-MARK OWNER SUCCESSFUL	SUCCESS RATE (%)
45	28	62

ii) United States

TABLE 9	
TRADE-MARK TRIALS IN THE U.S. FEDERAL DISTRICT COURTS FROM 1979 TO 1996 ¹⁶⁹	
NUMBER OF DECISIONS	PLAINTIFF SUCCESS RATE ¹⁷⁰ (%)
937	67

The results of trade-mark infringement actions in Canada reflect the same trend as that found in patent infringement actions, namely that the IPR holder has been successful in the majority of actions instituted since 1971, that is approximately 62 percent of the final judgments. The results from cases heard in the United States show a similar trend, in that the plaintiff in a trade-mark action was successful 67 percent of the time between 1979 and 1996.

Copyright

i) Canada¹⁷¹

TABLE 10		
COPYRIGHT INFRINGEMENT TRIALS SINCE 1971		
NUMBER OF DECISIONS	COPYRIGHT OWNER SUCCESSFUL ¹⁷²	SUCCESS RATE (%)
75	50	67

TABLE 11						
APPEALS FROM COPYRIGHT INFRINGEMENT TRIALS SINCE 1971						
NUMBER OF DECISIONS	COPYRIGHT OWNER APPEAL	APPEAL SUCCESSFUL	SUCCESS RATE (%)	DEFENDANT APPEAL	APPEAL SUCCESSFUL	SUCCESS RATE (%)
18	11	4	36	7	1	14

TABLE 12		
SUCCESS OF COPYRIGHT OWNERS IN FINAL JUDGMENTS SINCE 1971 ¹⁷³		
NUMBER OF DECISIONS ¹⁷⁴	COPYRIGHT OWNER SUCCESSFUL	SUCCESS RATE (%)
78	54	69

ii) United States

TABLE 13	
COPYRIGHT TRIALS IN THE U.S. FEDERAL DISTRICT COURTS FROM 1979 TO 1996 ¹⁷⁵	
NUMBER OF DECISIONS	PLAINTIFF SUCCESS RATE ¹⁷⁶ (%)
622	74

Again, in cases of copyright infringement, the IPR holder has been successful in the majority of cases in Canada. Overall, copyright owners have been successful in 69 percent of the final judgments in actions for infringement since 1971. With respect to appeals, 36 percent of the appeals brought by copyright owners have been allowed by the courts, compared to only 14 percent of the appeals brought by defendants.

CONCLUSIONS

AS DISCUSSED ABOVE, the IP system in Canada is based on the underlying premise that innovation and creativity are positive elements of a strong, competitive Canadian economy and should therefore be fostered and encouraged. Canada has a full range of required statutory and common law provisions for granting various IPRs. However, the exclusive rights provided by the various IP statutes are only as strong as the means by which those rights can be enforced against infringers.

Canada is recognized internationally as a good place to litigate IPRs. As discussed above, this is likely due to a number of substantive and procedural advantages available to IPR holders in this country. In particular, in cases of patent infringement, the fact that the doctrine of *file wrapper estoppel* does not apply in Canada provides a distinct advantage for patentees in this country if the patent is subsequently litigated. In addition, the substantive law applied by enforcement bodies in Canada often favours the IPR holders. In the case of patents, this includes the initial approach taken by the courts toward the construction of a patent, as well as the law relating to the tests for invalidity due to obviousness or anticipation.

The statistics from patent, trade-mark and copyright infringement cases appear to corroborate the proposition that the Canadian system favours the holders of IPRs. In each of the three areas examined, the majority of actions for infringement brought since 1971 have been decided in favour of the IPR holder. The cases brought in the United States demonstrate a similar trend.

Overall, an analysis of the various provisions and enforcement mechanisms in place in Canada and of judicial statistics supports the view that, generally, Canada has a strong IP enforcement system. However, it is apparent that the Canadian system is not as aggressive as that found in other jurisdictions, most notably the United States. For example, the Canadian Patent Office and the Canadian courts do not take as progressive an approach toward patentable subject matter. Furthermore, the courts in this country have rejected a U.S.-style approach to the protection of famous trade-marks against dilution. These are two important examples where the holder of an IPR may be better protected in the United States than in Canada, and two important examples of where the Canadian system could be improved.

ENDNOTES

- 1 Finance Minister Paul Martin, federal government Budget Speech, February 28, 2000.
- 2 Additional IP rights include industrial designs (*Industrial Design Act*, R.S.C. 1985, c. I-9), plant breeders' rights (*Plant Breeders' Rights Act*, R.S.C. 1985, c. P-14.6), integrated circuit topographies (*Integrated Circuit Topography Act*, R.S.C. 1985, c. I-14.6), trade secrets, and Internet domain names.
- 3 See Chrétien, 2001.
- 4 Canada, 1990.
- 5 Canada, *supra*, at p. (i).
- 6 See Industry Canada, 2000.
- 7 See Riordan, 2000. See also *Free World Trust v. Électro Santé Inc.*, [2000] 2 S.C.R. 1024 at p. 1049, where the Court recognizes that the patent system was designed to "advance research and development and encourage broader economic activity".
- 8 Which includes the Patent Office, the Trade-marks Office, the Copyright Office and the Industrial Design Office.
- 9 *Patent Act*, R.S.C. 1985, c. P-4, as amended.
- 10 In Canada, for patents based on applications filed on or after October 1, 1989, the period of monopoly is 20 years from the filing date; see *Patent Act*, s. 44. Until recently, for patents based on applications filed before October 1, 1989, the period of monopoly was 17 years from the date of issue. However, the World Trade Organization ruled that this failed to guarantee a 20-year term of protection in accordance with Canada's obligations under Article 33 of the *Agreement on Trade-Related Aspects of Intellectual Property Rights* (TRIPs). As a result, the Canadian Parliament amended the *Patent Act* so that patents based on applications filed before October 1, 1989 have a term of 17 years from the date of issue or 20 years from the date of filing, whichever is longer; see *Patent Act*, s. 45, as amended.
- 11 *Consolboard Inc. v. MacMillan Bloedel (Saskatchewan) Limited*, [1981] 1 S.C.R. 504 at 517 (S.C.C.). The Court was adopting the observations of Fox, 1969.
- 12 *Free World Trust v. Électro Santé Inc.*, *supra*, at pp. 1049-1050.
- 13 *Patent Act*, s. 27(1). Where the Commissioner is satisfied that an applicant is not entitled by law to be granted a patent, the application will be refused; see *Patent Act*, s. 40.
- 14 *Patent Act*, s. 41. However, leave is required in order to appeal the decision of the Federal Court of Appeal to the Supreme Court of Canada.
- 15 *Patent Rules*, s. 30.
- 16 *Patent Act*, s. 2. It is of note that the definition is essentially the same as that in the U.S. patent statute; see 35 U.S.C. § 101.
- 17 *Harvard College v. Canada (Commissioner of Patents)* (2000), 7 C.P.R. (4th) 1 (F.C.A.).
- 18 Leave granted (June 14, 2001), [2001] S.C.C.A. No. 74 (S.C.C.).
- 19 Canadian Patent Office – *Manual of Patent Office Procedure* (MOPOP), s. 16.05.
- 20 See, for example, *State Street Bank & Trust Co. v. Signature Financial Group Inc.*, 47 U.S.P.Q. 2d 1596 (Fed. Cir. 1998), where the patent related to a system for

implementing an investment structure developed for use as an administrator and accounting agent for mutual funds. In discussing whether the patent was invalid pursuant to the business method exception to statutory subject matter, the U.S. court took the opportunity to “lay this ill-conceived exception to rest” and commented that the business method exception “has merely represented the application of some general, but no longer applicable legal principle ...”. On the other hand, in Canada, MOPOP sets out that a system of doing business is not considered to be patentable subject matter (s.16.04(e)) and that a method of implementing a computer program for doing business is also not patentable subject matter (s. 16.07). It should be noted that such patents are not available in Europe or Japan.

- 21 See, for example, *Diamond v. Diehr*, 209 U.S.P.Q. 1 (U.S.S.C. 1981), where the patent related to a process for curing rubber, which included the use of a mathematical formula and a programmed digital computer, and *State Street Bank & Trust Co. v. Signature Financial Group Inc.*, *supra*, at 1601, where the Court held that “the transformation of data, representing discreet dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, formula, or calculation, because it produces a ‘useful, concrete and tangible result’...”. In contrast, in Canada, the leading decision is *Schlumberger Canada Ltd. v. Commissioner of Patents* (1981), 56 C.P.R. (2d) 204 (F.C.A.), where the Court held that a process that used a computer to convert measurements from seismic testing to human-readable form was not patentable subject matter.
- 22 In Canada, the Supreme Court has held that methods of medical or surgical treatment are not statutory subject matter; see *Tennessee Eastman Co. v. Commissioner of Patents*, [1974] S.C.R. 111 (S.C.C.). On the other hand, in the United States, patents for methods of medical treatment have been allowed; see *Ex Parte Scherer*, 103 U.S.P.Q. 107 (Bd. Pat. App. 1954).
- 23 *Patent Act*, s. 42.
- 24 See, for example, *VISX, Inc. v. Nidek Co.* (1999), 3 C.P.R. (4th) 417 at p. 444 (F.C.T.D.), affirmed [2001] F.C.A. 215 (F.C.A.).
- 25 Known as the “Saccharin doctrine” after the U.K. case of *Saccharin Corp. Ltd. v. Anglo-Continental Chemical Works Ltd.* (1900), 17 R.P.C. 307. In Canada, see, for example, *Farbwerke Hoechst AG v. Halocarbon (Ontario) Ltd.* (1974), 15 C.P.R. (2d) 105 (F.C.T.D.), reversed (1976), 28 C.P.R. (2d) 63 (F.C.A.), reversed (1979), 42 C.P.R. (3d) 145 (S.C.C.).
- 26 *Patent Act*, ss. 54(1) and (2).
- 27 *Whirlpool Corp. v. Camco Inc.*, [2000] 2 S.C.R. 1067, and *Free World Trust v. Électro Santé Inc.*, *supra*.
- 28 *Consolboard Inc. v. MacMillan Bloedel (Saskatchewan) Limited*, *supra*, at pp. 520-521.
- 29 *Free World Trust v. Électro Santé Inc.*, *supra*, at pp. 1043-1044.
- 30 The relevant date depends on the date the application for the patent was filed. If the application was filed before October 1, 1989, the relevant date is the date the patent was granted. If the application was filed after October 1, 1989 but before January 1, 1994, the relevant date is the date the application was laid

open for publication. If the application was filed after January 1, 1994, the relevant date is the earlier of the Canadian filing date or the convention priority date.

- 31 An “interested party” has been defined very liberally by the courts to include, for example, anyone who has been sent a cease and desist letter, or is in competition with the patentee.
- 32 As an alternative to an impeachment action, the *Patent Act* provides that any person who has reasonable cause to believe that they may be alleged to infringe a Canadian patent can bring an action in the Federal Court against the patentee for a declaration of non-infringement; see *Patent Act*, s. 60(2).
- 33 *Sno Jet Ltd. v. Bombardier Limitée* (1975), 22 C.P.R. (2d) 224 at pp. 228-229 (F.C.T.D.).
- 34 *Beloit Canada Ltd. v. Valmet OY* (1986), 8 C.P.R. (3d) 289 at p. 294 (F.C.A.).
- 35 *Ibid*, at p. 297.
- 36 Pursuant to s. 48.2, a re-examination board will undertake a review of the prior art and determine whether or not a substantial new question of patentability has been raised. If the board decides that a new question has been raised, it will notify the patentee, who then has the opportunity to reply to the notice and set out his case. The re-examination board will then consider the matter and render a decision as to the patentability. The Board has the power to cancel any claim it has determined to be unpatentable, which could include the entire patent.
- 37 However, see the recent decision of the Commissioner of Patents in *Torpharm Inc. v. Merck & Co., Inc.* (2000), 9 C.P.R. (4th) 520 (Pat. App. Bd.), where an application for a compulsory licence under Section 65 was refused. The decision of the Commissioner has been appealed to the Federal Court Trial Division, Federal Court matter No. T-1231-00.
- 38 The remaining grounds include:
 - (i) the market demand for the patented product is not being met;
 - (ii) the refusal of a patentee to grant a licence or grant a licence under reasonable terms is prejudicing trade in Canada; or
 - (iii) the patent is for an invention relating to a process involving the use of non-patented materials, and has been utilized by the patentee to unfairly prejudice in Canada the manufacture, use or sale of those non-patented materials.
- 39 *Competition Act*, R.S.C. 1985 c. C-34, as amended.
- 40 On June 11, 1999, the Competition Bureau released guidelines for its policy regarding the interface between IPRs and competition law. On April 25, 2000, the Bureau released a revised set of guidelines. With respect to the general provisions of the *Competition Act*, the revised guidelines set out that the Bureau will only intervene where there is “something more” than the mere exercise of IPRs. With respect to Section 32, the Bureau will only intervene where the requirements of that section are met and where the alleged competitive harm arises directly from the exercise of an IPR and nothing else. For a discussion of the original and revised guidelines, see Garland (1999) and Garland (2000).
- 41 See Horton, 1993.
- 42 This proved to be a significant change as the number of compulsory licences increased from 22 (for the period between 1923 and 1969) to 400 (for the period between 1969 and 1987); see Horton, *supra*, p. 146.

- 43 See *Hoffman-LaRoche Ltd. v. Bell-Craig Pharmaceuticals*, [1966] S.C.R. 313 at p. 319.
- 44 The deferral period was either 7, 8 or 10 years from the date the patentee obtained a Notice of Compliance (NOC), depending on the circumstances.
- 45 S.C. 1993, c. 2, s. 3.
- 46 *Patented Medicines (Notice of Compliance) Regulations*, SOR/93-133, as amended, and *Manufacturing and Storage of Patented Medicines Regulations*, SOR/93-134, subsequently repealed by the *Regulations Repealing the Manufacturing and Storage of Patented Medicines Regulations*, P.C. 2000-1515, discussed *infra*.
- 47 Ruling of the WTO Dispute Settlement Body dated April 7, 2000.
- 48 S.C. 2001, c. 10.
- 49 For a review of the NOC scheme, see *Merck Frosst Canada Inc. v. Canada (Minister of National Health and Welfare)* (1998), 84 C.P.R. (3d) 492 (F.C.T.D.), affirmed (2000), 8 C.P.R. (4th) 48 (F.C.A.).
- 50 *Patented Medicines (Notice of Compliance) Regulations*, s. 7.
- 51 *Patented Medicines (Notice of Compliance) Regulations*, s. 8.
- 52 *Patent Act*, s. 57.
- 53 *RJR-Macdonald Inc. v. Canada (A.G.)*, [1994] 1 S.C.R. 311.
- 54 See, for example, *Cutter Ltd. v. Baxter Travenol Laboratories of Canada, Ltd.* (1980), 47 C.P.R. (3d) 53 at pp. 55-56 (F.C.A.), leave to appeal to the Supreme Court of Canada refused on April 22, 1980 (Laskin, C.J., Estey and Lamer, JJ.).
- 55 An *Anton Piller* order gets its name from the case of *Anton Piller KG v. Manufacturing Processes Ltd.*, [1976] Ch. 55 at p. 61. An *Anton Piller* order would allow a patentee in times of urgency to inspect and seize articles and documents related to the alleged infringement. Such an order is obtained by way of an interlocutory proceeding in which the patentee must establish, *inter alia*, clear evidence that the defendant possesses incriminating articles or documents and that there is a real possibility that such material may be destroyed before an application *inter parties* can be made; see *Nintendo of America Inc. v. Coinex Video Games Inc.*, [1983] F.C. 189 (F.C.A.). The court will typically revisit the order 10 days after the inspection and seizure.
- 56 A *Mareva* injunction is a special interlocutory injunction which will freeze a defendant's assets. Such an injunction is available if there is a clear danger that the assets will be removed from the jurisdiction prior to trial, thus frustrating the potential claim of the plaintiff; see *Marine Atlantic Inc. v. Blyth* (1993), 113 D.L.R. (4th) 501 (F.C.A.).
- 57 35 U.S.C. § 284.
- 58 For example, in *Polaroid Corp. v. Eastman Kodak Co.* (1990), 16 U.S.P.Q. 2d. 1481, *correction for clerical errors* (1991), 17 U.S.P.Q. 2d. 1711 (Dist. Court, D. Massachusetts), the court awarded the patentee \$873,158,971 in damages in an action for patent infringement. Fortunately for the defendant, the court found that the infringement was not wilful or deliberate; otherwise, the tribunal could have tripled this amount.
- 59 See Kokonis, 1993.
- 60 See, for example, *Reckitt & Coleman Products Ltd. v. Borden Inc.*, [1990] R.P.C. 341 (H.L.).

61 The statutory definition of a trade-mark also includes a certification mark, a distinguishing guise and a proposed trade-mark.

62 See Industry Canada, 2000.

63 *Trade-marks Act*, R.S.C. 1985 c. T-13, as amended.

64 *Trade-marks Act*, s. 19. Pursuant to Section 12(1), a trade-mark is registrable if it is not:

- primarily merely a name or surname;
- clearly descriptive or deceptively misdescriptive of the character or quality of the wares or services;
- the name in any language of any of the wares or services;
- confusing with a registered trade-mark;
- a mark which is prohibited by Section 9, 10 or 10.1 of the *Trade-marks Act*; or
- a potential geographical indication, subject to the exceptions listed in Sections 11.16 to 11.19 and 11.2 of the Act.

However, a name or surname or a clearly descriptive or deceptively misdescriptive term might be registrable if it has been used in Canada so as to become distinctive at the time the application is filed.

65 See the discussion on the common law of passing off, *infra*.

66 See Kokonis, *supra*, at pp. 84-85.

67 See the *Trade-marks Act*, s. 30.

68 *Trade-marks Act*, s. 56(1). However, leave is required in order to appeal the decision of the Federal Court of Appeal to the Supreme Court of Canada.

69 Discussed, *infra*.

70 *Trade-marks Act*, ss. 6(1), (2), (3) and (4). It is important to note that registration of a trade-mark will not preclude a person from making *bona fide* use of his personal name as a trade-name, or *bona fide* use, other than as a trade-mark, of the geographical name of his place of business or any accurate description of the character or quality of his wares or services; see Section 20(1).

71 *Ibid.*, s. 6(5).

72 See, for example, *Orkin Exterminating Co. Inc. v. Pestco Company of Canada Ltd.* (1985), 5 C.P.R. (3d) 433 (Ont. C.A.).

73 *Ciba-Geigy Canada Ltd. v. Apotex Inc.* (1992), 44 C.P.R. (3d) 289 at pp. 296-299 (S.C.C.).

74 *Asbjorn Horgard A/S v. Gibbs/Nortac Industries Ltd.* (1987), 14 C.P.R. (3d) 314 at p. 327 (F.C.A.).

75 *Trade-marks Act*, s. 55.

76 *Trade-marks Act*, s. 38(1).

77 Section 30 sets out the various requirements of an application, including, *inter alia*, a statement in ordinary commercial terms of the specific wares or services; if the trade-mark has been used in Canada, the date of first use; if the application is based on proposed use, a statement to the effect that the applicant or a licensee intends to use the mark in Canada; the address of the applicant's principal office or place of business in Canada, or the address of its principal office or place of business abroad and the name and address of an agent in Canada; and a statement that the applicant is satisfied that it is entitled to use the trade-mark in Canada in association with the wares or services described in the application.

- 78 *Trade-marks Act*, s. 38(2).
- 79 See *Trade-marks Act*, s. 38 and *Trade-marks Regulations* (1996), SOR/96-195, ss. 35 to 47.
- 80 *Trade-marks Act*, s. 38(8).
- 81 *Trade-marks Act*, s. 56(1).
- 82 A “person interested” has been defined to include any person who is affected or reasonably apprehends that he or she may be affected by the entry of a registration; see *Burmah-Castrol (Canada) Ltd. v. Nasolco Inc.* (1974), 16 C.P.R. (2d) 193 at pp. 195-196 (F.C.T.D.).
- 83 *Trade-marks Act*, s. 57.
- 84 *Adidas (Canada) Ltd. v. Colins Inc.* (1978), 38 C.P.R. (2d) 145 at p. 160 (F.C.T.D.).
- 85 *Trade-marks Act*, s. 56(1).
- 86 Section 32 prohibits the use of a registered trade-mark so as to:
 - (a) limit unduly the facilities for transporting, producing, manufacturing, supplying, storing or dealing in any article or commodity which may be a subject of trade or commerce;
 - (b) restrain or injure, unduly, trade or commerce in relation to any such article or commodity;
 - (c) prevent, limit or lessen, unduly, the manufacture or production of any such article or commodity or unreasonably to enhance the price thereof; or
 - (d) prevent or lessen, unduly, competition in the production, manufacture, purchase, barter, sale, transportation or supply of any such article or commodity.
- 87 *Trade-marks Act*, s. 53.2.
- 88 *Centre Ice Ltd. v. National Hockey League* (1994), 53 C.P.R. (3d) 34 (F.C.A.).
- 89 See Gilson, 2000.
- 90 (Pub. L. 104-98).
- 91 *United Artists Corp. v. Pink Panther Beauty Corp.* (1998), 80 C.P.R. (3d) 247 (F.C.A.).
- 92 The Supreme Court of Canada granted the trade-mark owner leave to appeal the decision of the Federal Court of Appeal to the Supreme Court. However, the matter was subsequently settled and the appeal was never heard.
- 93 The Pink Panther case has been followed in a number of subsequent decisions, including *Toyota Jidosha Kabushiki Kaisha v. Lexus Foods Inc.* (2000), 194 D.L.R. (4th) 491 (F.C.A.), leave refused [2001] S.C.C.A. No. 32 (Q.L.).
- 94 For an example of such an order, see “Interlocutory Orders in Trade-mark Cases Relating to Counterfeit Goods” (1988), C.P.R. (3d) 514.
- 95 *Criminal Code* R.S.C. 1985, c. C-46, ss. 406-411.
- 96 See Manson and Lo, 1998.
- 97 15 U.S.C. 1125(d).
- 98 *Tele-Direct (Publications) Inc. v. Canadian Business Online Inc.* (1997), 77 C.P.R. (3d) 23 (F.C.T.D.).
- 99 *Ibid.*, at p. 29.
- 100 *Bell ActiMedia Inc. v. Puzo* (1999), 2 C.P.R. (4th) 289 (F.C.T.D.).

- 101 *Innersense International Inc. v. Manegre* (2000), 7 C.P.R. (4th) 107 (Alb. Q.B.),
and *Weight Watchers International, Inc. v. Vale Printing Ltd.* (2000), 7 C.P.R. (4th)
92 (F.C.T.D.).
- 102 See Stangret, 2001.
- 103 *Anticybersquatting Consumer Protection Act*, 15 U.S.C. 1125(d) (2)(A). This provi-
sion enables a trade-mark owner to file an *in rem* action against the infringing do-
main name itself. In order to take advantage of this provision, the trade-mark
must be registered and the trade-mark owner must have been unable to locate the
appropriate defendant.
- 104 See Stangret, 2001.
- 105 *Copyright Act*, R.S.C. 1985 c. C-42, as amended.
- 106 *Copyright Act*, s. 89.
- 107 The *Copyright Act* further defines “literary works” to include tables, computer
programs and compilations of literary works; “dramatic works” to include any
piece for recitation, choreographic work or mime, cinematographic works and any
compilation of dramatic works; “musical works” to include any work of music or
musical composition, with or without words, and any compilation thereof; and
“artistic works” to include paintings, drawings, maps, charts, plans, photographs,
engravings, sculptures, works of artistic craftsmanship, architectural works, and
compilations of artistic works.
- 108 “Neighbouring rights” include performer’s performances, sound recordings and
communication signals (broadcasts).
- 109 See *Copyright Act*, s. 55(2), and *Copyright Regulations*, s. 5 and Schedule.
- 110 *Copyright Act*, s. 53(2).
- 111 *Copyright Act*, ss. 39(1) and (2). As a result, the owner of a copyright can recover
damages in addition to an injunction in an action for infringement.
- 112 *Copyright Act*, s. 14.1.
- 113 *Copyright Act*, s. 14.1(2).
- 114 *Ibid.*
- 115 *Copyright Act*, s. 3(1). This section also sets out a number of particular rights in
detail, specific to the type of work involved.
- 116 *Copyright Act*, s. 27(1).
- 117 *U & R Tax Services Ltd. v. H & R Block Canada Inc.* (1995), 62 C.P.R. (3d) 257 at
pp. 268-269 (F.C.T.D.).
- 118 *Copyright Act*, s. 3(1).
- 119 *Copyright Act*, s. 27(2).
- 120 *Copyright Act*, s. 28.1.
- 121 *Copyright Act*, s. 28.2(1). See, for example, *Snow v. The Eaton Centre Ltd.* (1982),
10 C.P.R. (3d) 105 (Ont. H.C.), where the author of a sculpture of geese was
awarded an injunction to enjoin the defendant from hanging ribbons to the necks
of the geese as this would be prejudicial to the honour or reputation of the author.
- 122 *Copyright Act*, ss. 29, 29.1-29.9, 30, 30.1-30.9, 32 and 32.1-32.2.
- 123 *Copyright Act*, s. 37.
- 124 *Copyright Act*, s. 34(4)(a). Section 34(4) of the *Copyright Act* also allows for sev-
eral other proceedings to be commenced by way of application, including proceed-
ings to prevent importation of certain types of copyrighted works into Canada and

- proceedings taken in respect of a tariff certified by the Copyright Board for the collective administration of copyright.
- 125 *Copyright Act*, s. 57(4).
- 126 *Copyright Act*, s. 57(4)(b).
- 127 *Copyright Act*, s. 34(1).
- 128 *Copyright Act*, s. 34(2).
- 129 *Copyright Act*, s. 35(1).
- 130 See, for example, *Pro Arts, Inc. v. Campus Crafts Holdings Ltd.* (1980), 50 C.P.R. (2d) 230 (Ont. H.C.), where the Court awarded \$35,000 for exemplary damages in view of the actions of the defendant which constituted “a callous disregard of the rights of the plaintiff and showed little more respect for the injunction granted by the Court”.
- 131 *Copyright Act*, s. 39(2).
- 132 *Copyright Act*, s. 40(1).
- 133 *Copyright Act*, s. 38.1(1).
- 134 *Copyright Act*, ss. 38.1(2) and (3).
- 135 A “plate” includes any stereotype or other plate, stone, block, mould, matrix, transfer or negative used or intended to be used for printing or reproducing copies of any work, as well as any matrix or other appliance used or intended to be used for making or reproducing sound recordings, performer’s performances or communication signals; see *Copyright Act*, s. 2.
- 136 *Copyright Act*, s. 38(1)(a). Proceedings under this section are generally referred to as “conversion” proceedings.
- 137 *Copyright Act*, s. 38(1)(b). Note that such a proceeding is only available for copyright infringement and not for the infringement of a moral right: *Théberge v. Galerie d’Art du Petit Champlain inc.*, [2002] S.C.C. 34 at pp. 35-36.
- 138 See, for example, *Diamant Toys v. Jouets Bo-Jeux Toys Inc.*, [2002] FCT 384 at para. 56.
- 139 *Ibid.*, at para. 55.
- 140 *Copyright Act*, s. 42(1). The section lists a number of activities, including making, selling, renting out, distributing for the purpose of trade, exhibiting in public, or importing into Canada for sale or rental, an infringing copy of a work or other subject matter in which copyright subsists.
- 141 *Copyright Act*, s. 42(1).
- 142 For example, s. 327 of the *Criminal Code* makes it a criminal offence to knowingly intercept or provide a device to intercept a telecommunication signal.
- 143 See Nurton, 1996.
- 144 See, for example, Garland and Bochnovic, 1998.
- 145 For example, there are no juries in the Federal Court of Canada so there is none of the related expense to the parties in that regard. In addition, the Federal Court has recently adopted a case management system designed to reduce the time (and thus expense) involved in litigation.
- 146 This can be contrasted with the situation in Japan and the United Kingdom. In Japan, there are no discovery procedures. In the United Kingdom, only documentary discovery is available in the absence of a court order.

- 147 This can be contrasted with the situation in the United States, where such allegations are often raised in patent litigation.
- 148 As discussed above.
- 149 *Free World Trust v. Électro Santé Inc.*, *supra*, at pp. 1059-1062.
- 150 Tables 1, 2 and 3 include data compiled by Dimock (1993). The data from this source was updated to include all decisions reported in the *Canadian Patent Reporter* series (C.P.R.) up to 9 C.P.R. (4th).
- 151 Includes wholly or partly successful actions for patent infringement.
- 152 Includes all decisions where at least one patent claim was found to be valid.
- 153 Includes all appeals by a patentee by way of appeal or cross-appeal of a finding of invalidity or non-infringement.
- 154 Includes all appeals by a defendant by way of appeal or cross-appeal of a finding of validity or infringement.
- 155 Includes all cases that were ultimately decided in favour of the patentee. For example, all cases where at least one claim of a patent was found to be valid and infringed at trial and where no appeal was taken, and all cases where an appeal was taken from a decision at trial but was ultimately decided in favour of the patentee.
- 156 Includes five appeals taken from trial decisions not reported in the C.P.R. or from trial decisions which occurred prior to 1971.
- 157 The information for this table was obtained by submitting a Judicial Statistical Inquiry Form at the web site created by Theodore Eisenberg & Kevin M. Clermont, located at <http://teddy.law.cornell.edu:8090/questata.htm>. The data for the web site was gathered by the Administrative Office of the United States Courts, assembled by the Federal Judicial Centre and disseminated by the Inter-university Consortium for Political and Social Research.
- 158 Includes all patent trials that went to judgment where the plaintiff was successful.
- 159 The data for this table is based on information obtained from Hull, 1994. It includes appeals from District Court cases between January 1, 1985 and July 30, 1993.
- 160 Includes appeals from jury verdicts and bench trials.
- 161 Includes all decisions where the Federal Circuit reversed a finding of a District Court.
- 162 Includes all cases where the Federal Circuit reversed a jury verdict or bench ruling against the patent owner.
- 163 Of the 20 decisions in which a decision of a lower court was overturned, 14 have been in favour of the patentee, including 12 of the past 15 decisions.
- 164 Includes all cases where at least one claim of a patent was found to be valid and infringed and where no appeal was taken, and all cases where an appeal was taken from a decision at trial but was ultimately decided in favour of the patentee.
- 165 This data was compiled from a review of trade-mark infringement actions reported in the C.P.R. from 1 C.P.R. (2d) to 9 C.P.R. (4th).
- 166 Includes wholly or partly successful actions for trade-mark infringement.
- 167 Includes all cases that were ultimately decided in favour of the trade-mark owner. For example, all cases where at least one trade-mark was found to be infringed, and all cases where an appeal was taken from a decision at trial but was ultimately decided in favour of the trade-mark owner.

- 168 Includes one appeal taken from a trial decision not reported in the C.P.R.
- 169 The information for this table was obtained from the web site created by Theodore Eisenberg & Kevin M. Clermont, *supra*.
- 170 Includes all trade-mark trials that went to judgment where the plaintiff was successful.
- 171 This data was compiled from a review of copyright infringement cases reported in the C.P.R. from 1 C.P.R. (2d) to 9 C.P.R. (4th).
- 172 Includes wholly or partly successful actions for copyright infringement.
- 173 Includes all cases that were ultimately decided in favour of the copyright owner. For example, all cases where copyright was found to be infringed at trial and where no appeal was taken, and all cases where an appeal was taken from a decision at trial but was ultimately decided in favour of the copyright owner.
- 174 Includes three appeals taken from trial decisions not reported in the C.P.R.
- 175 The information for this table was obtained from the web site created by Theodore Eisenberg & Kevin M. Clermont, *supra*.
- 176 Includes all copyright trials that went to judgment where the plaintiff was successful.

BIBLIOGRAPHY

- Canada. 1990. *Intellectual Property and Canada's Commercial Interests*. Department of Consumer and Corporate Affairs.
- Chrétien, Jean, Prime Minister of Canada. 2001. *Achieving Excellence – Investing in People, Knowledge and Opportunity*. Canada's Innovation Strategy (January), p. 2.
- Dimock, Ronald E. 1993. "An Introduction to Patent Litigation in Canada." In *Patent Litigation – Effective Management of a Patent Trial from Beginning to End*. Toronto: The Canadian Institute (June 22).
- Fox, Harold G. 1969. *Canadian Patent Law and Practice Relating to Letters Patent for Inventions*. 4th ed. Toronto: Carswell, p. 163.
- Garland, Steven B. 1999. "Canadian Competition Bureau Releases Intellectual Property Enforcement Guidelines." *Copyright World*, vol. 93 (September): 8.
- . 2000. "Canadian Competition Bureau Releases Intellectual Property Enforcement Guidelines Part II." *Copyright World*, vol. 102 (August): 9.
- Garland, Steven B., and John Bochnovic. 1998. "Canada: The Best Jurisdiction for Patentees?" *IP Worldwide* (January/February): 23.
- Gilson, Jerome. 2000. *Trade-mark Protection and Practice*. New York: Matthew Bender & Company, pp. 5-285.
- Horton, J. 1993. "Pharmaceuticals, Patents and Bill C-91: The Historical Perspective." *Canadian Intellectual Property Review*, vol. 10: 145.
- Hull, Michael R. 1994. "Surprising Statistics for Patent Litigants: Jury Verdicts Do Not Fare as Well on Appeals as Bench Trial Decisions." Special June Intellectual Property Law Conference. American Bar Association Section of Intellectual Property Law. Hot Springs, Virginia (June 26-30).

- Industry Canada. 2000. *Making IP Policy a Competitive Asset for Canada in the Global Knowledge-Based Economy – The Policy Setting: Canada's Innovative Challenge*. Corporate Governance Branch (January), p. 5.
- Kokonis, James D. 1993. "The Scheme of the Canadian Trade-marks Act." In *Trade-mark Law of Canada*. Edited by Gordon F. Henderson. Toronto: Carswell, pp. 91-92.
- Manson, Michael D., and Timothy P. Lo. 1998. "Dealing with Counterfeit Goods at the Border and Within Canada – Detention Orders, Anton Piller Orders and Other Remedies." *CLE: Recent Developments in Intellectual Property Litigation*. Vancouver, B.C. (June 16).
- Nurton, James. 1996. "A Dangerous World for Patent Owners." *Managing Intellectual Property* (June).
- Riordan, Barrett, J. 2000. "What's Driving Patent and Trade-mark Application Filings." *European Intellectual Property Review*: 352.
- Stangret, Lesia. 2001. "Listen Up, Here Comes the U.S. Judge." *National Post Online* (January 13).



Jonathan D. Putnam
University of Toronto

17

Policy Options for Canada in the Knowledge-Based Economy

INTRODUCTION: ISSUES IN POLICY ASSESSMENT

WITH THE ADVENT OF THE INTERNET, intellectual property policy has moved to the fore in public debates about new opportunities and threats faced by creators and users of intellectual goods. Clearly, the urgency and volume of the debate have heightened. Yet, in many ways, the abstract problem faced by policy-makers remains much the same as it has been for the last century: how to optimize investment in the creation and exchange of new information so as to maximize productivity growth. The present volume has surveyed a wide range of research addressed, in one way or another, to that question.

Though the Internet and related *technology sector* innovations have transformed global communications — and thus global relationships — and have challenged fundamental legal notions of jurisdiction and sovereignty, the underlying economic principles that define, constrain and predict economic behaviour remain the same. This continuity of economic laws offers stability even as legal and regulatory institutions must adapt to new technological realities. The good news is that Canadian intellectual property (IP) policy-makers can draw on the economic insights of studies such as those published in this volume as they take decisions in the new technological and regulatory environment. The bad news is that the relationship between policy variables and economic outcomes remains unpredictable, particularly as policy linkages among nations tighten and each country adjusts its policy environment to that of others. And though not *news*, it bears repeating that IP policy is not, in itself, the most important policy variable in the productivity growth equation.

In evaluating the policy recommendations below, the reader should keep in mind several underlying trade-offs that inform and constrain the debates over IP, as they do many other debates.

THE TRADE-OFF BETWEEN CONSUMERS AND PRODUCERS

PERHAPS THE MOST IMPORTANT OF THESE is the basic division of the social surplus between consumers and producers. In the IP context, this division is complicated by the fact that many *producers* consume intellectual goods as well as produce them. It is well known that when one monopolist sells to another, the price of the final good is *too high* relative to the price that a single, vertically integrated monopolist would charge. Beyond the additional deadweight loss imposed on consumers of the final good, this pricing pattern also reduces the aggregate profits that the two monopolists earn. As a result, it is impossible *ex ante* to divide the expected profits between the parties in a way that provides each with the optimal incentive to create.

Even without conflicting interests among producers, the division of the social surplus between consumers and producers is difficult to measure or even articulate. Consumers are often said to pay higher prices in the short run in exchange for more rapid technological change in the long run. But this is really a misdescription. Since all technological change necessarily reduces the level of real prices (properly measured), the overall objective is to find the *lowest* real price path (which may well be reflected in *higher* nominal prices, improperly measured). The inability to measure *real* prices and the present value of the incremental investment incentive provided by these incrementally higher prices leads to wasteful public debates, as well as artificial political and legal divides between the alleged interests of consumers and producers.

THE TRADE-OFF BETWEEN PRESENT AND FUTURE CONSUMERS

A PRIME EXAMPLE OF THE INABILITY TO MEASURE productivity growth accurately is found in the current debate over pharmaceutical prices. While there is no question that, as a percentage of national output, expenditures on pharmaceuticals are historically high, and rising, this observation says nothing about whether, *in real terms*, the price of the additional health provided by these pharmaceuticals is *high* or *low*. In addition to the supply-side problem of providing the right investment incentives through patent rights, one must also consider the demand side of market equilibrium. The unabated demand for pharmaceuticals, even in the face of rising nominal prices, indicates that, relative to other consumption and investment decisions, additional expenditures on pharmaceuticals provide large private benefits. In other words, health care is a good characterized by a low price elasticity and a high income elasticity. In a

market economy, it is hard to fault producers for charging high prices for goods on which consumers themselves place a high value, given their alternatives.

When the alternatives for consumers include the public domain (generic) health technology previously induced by the same policies currently under fire, available at a fraction of the cost of the current generation of technology, one can only conclude that the *real* cost of health care is falling over time, albeit at a poorly measured rate. This would mean that productivity is increasing, which is exactly the intended policy outcome.

Moreover, even if the real price of pharmaceuticals could be measured accurately (in terms of their contribution to consumers' health), today's allegedly high nominal prices would presumably attract additional investment that would result in greater competition and/or even greater health improvements in the future, just as yesterday's prices brought today's public domain technology. However, this analytic hypothesis suffers from the inability to measure and test it: there is simply no way to know whether the Canadian economy lies on the optimal price and investment path. Thus, the difficulty of a very real economic trade-off between present and future consumers is exacerbated by the technical deficiency of measurement, which might otherwise inform the current political debate and reassure both present consumers and policy-makers that welfare is maximized over the lifetime of the average consumer.

The Canadian government's recent innovation initiatives have re-oriented Canada's national policy toward investment in new knowledge. In part, this shift implies a re-orientation toward producers of new knowledge. Of course, the ultimate objective is to provide Canadian consumers with a better price path, as described above. But along the transition path, a tilt in IP policy toward Canadian producers over consumers may result in nominal (and even real) price increases. However justifiable and even desirable in the abstract, these two reallocations (from consumers to producers and from present to future consumers) may be difficult to sustain politically, especially when only nominal price levels are calculated and reported.

While the health care sector offers perhaps the most poignant example of both the inability to construct quality-adjusted prices and the political conflict to which that inability contributes, the problem is (so to speak) generic to the basic problem of selecting and sustaining IP policies that raise prices today in the hope of achieving better product quality tomorrow.

THE TRADE-OFFS AMONG CONSUMERS

A THIRD REALLOCATION PROBLEM facing Canadian policy-makers might be termed the trade-off between consumer types. The question may be stated in this fashion: Holding the total division between IP producers and consumers

constant, are there social and/or legal norms regarding the access to and pricing of intellectual goods that favour one set of policies over another?

Many of the difficulties raised by addressing this question are not caused by the presence of knowledge-based goods or intellectual property *per se*. However, as such goods increasingly pervade the economy, and as the ability to produce and to consume these goods determines more and more economic welfare, intellectual property policies increasingly abut other policies that reflect even more fundamental objectives of the Canadian society than economic growth. As in the case of real property, the rights of intellectual property owners are likely to be circumscribed, or *zoned*, in the interests of a (perceived) greater public good. And, as in the case of real property, such restrictions may take the form of reduced contracting and enforcement rights. Alternatively, these restrictions may expand the scope of neighbouring rights.

To make this discussion more concrete: many goods protected by intellectual property are susceptible to price discrimination. Most consumers at most times exhibit a low willingness to pay for most of these goods. In a market economy, sellers use a variety of techniques to identify relatively high-value consumers and charge them higher prices. All of these techniques depend, in one way or another, on restrictions (legal or physical) that prevent one consumer from reselling the good to another, i.e. against pricing arbitrage. Intellectual property policy can facilitate price discrimination indirectly by restricting some circumstances of resale.

Price discrimination has some desirable properties, both privately and socially. In particular, it can extend access to consumers whose willingness (or ability) to pay falls below the (uniform) price charged by a seller who cannot price discriminate. For example, an IP owner might charge less for a pharmaceutical to consumers belonging to a certain age group, or living in a certain region, or having a certain diagnosis, than it does to others. Such a policy takes advantage of the seller's incentive to maximize his profits and his generally superior knowledge of his prospective customers, relative to (say) a centralized bureaucracy set up to establish the *correct* price.

By definition, such pricing is unequal. The question is: Is it unfair? The answer to this question is not purely economic. Moreover, even on its own terms, the success of price discrimination depends on the seller's ability to recognize the consumer's willingness to pay, and to prevent a low-value consumer from reselling to a high-value consumer. That ability depends, in turn, on policies that give sellers access to personal information, both before and after the transaction, which obviously has important implications for the definition of privacy. These considerations extend far beyond the specific context of access to pharmaceuticals, and beyond patents, to software, to copyright in new digital media, and even to the pricing of trademarked goods.

For present purposes, the point is not to resolve this debate. In the context of intellectual property policy trade-offs, two conclusions follow:

1. There are important trade-offs between consumer groups. Policies that enable sellers to extend access to intellectual goods to low-income and low-value consumers, at low prices, generally allow sellers to charge higher prices to high-value consumers. In economic terms, these contracts are relatively efficient. To the extent that they raise the sellers' profits, they also increase the incentive to create new intellectual goods. However, uniform pricing usually restricts inefficiently access for low-income consumers. Policy-makers who seek to satisfy oversimplified political demands for *equal access* must recognize the basic trade-off between *equality* and *access*.
2. Policies that promote price discrimination also favour increased seller access to, and control over, consumer purchase and resale decisions. This access-and-control implicates diverse social norms such as consumer privacy and freedom to contract. Depending on the nature of the good, some consumers may favour or oppose restrictions on privacy and contracting, while others will take the opposite stance.

INTERNATIONAL POLITICAL ECONOMY

THE TRADE-OFFS DESCRIBED ABOVE also manifest themselves in Canada's international trade policy. Rich in physical resources, Canada has lagged in public and private research investments that are thought to provide comparative advantage in a technology-based economy. As a consequence, Canada is a net importer in many technology sectors. For example, — again taking the pharmaceutical sector — Canada has historically focused on acquiring foreign-origin pharmaceuticals at low cost by adopting IP policies (such as compulsory licensing) that favour generic pharmaceutical firms over research-based firms. This policy orientation conforms to basic notions of comparative advantage in international trade, and benefits Canadian consumers. However, it lies at odds with the view that Canada should be able to compete with other nations at the highest technological levels of the new global economy. The reform of Canadian policies dealing with compulsory patent licensing evidences not only the intent to harmonize Canadian laws internationally, but also the intent to choose a new price and investment path, characterized both by higher consumer prices and (one must infer) a faster rate of technological change in Canadian health care. But in spite of this clear regime shift, the mechanics of developing coherent intellectual property policy in the context of other deeply felt domestic and international political concerns remain complex at best.

A second substantial trade-off for Canadian policy-makers lies in the decision to harmonize (or not) Canada's IP laws with that of its major trading partner, the United States. In part, the decision to harmonize is driven by political, economic and strategic security considerations that transcend even such fundamental national objectives as economic growth. Despite (and partly because of) the norms established under the North American Free Trade Agreement (NAFTA), frictions between the world's two largest trading partners continue to embroil various sectors. Just as it should be emphasized that harmonization does not intrinsically favour the interests of Canada's trading partners over its own, it must be recognized that the same transitional considerations that complicate domestic reform may surface in an international trade setting, inextricably linked to other political and economic objectives. The international political calculations that determine the true cost of pursuing a given domestic IP reform go beyond the policy horizon addressed by the authors of studies published in this volume.¹

For convenience, the remaining discussion of policy recommendations follows the structure of the volume, beginning with an overview of the scope of Canadian intellectual property protection.

OVERVIEW: HARMONIZATION OF SUBJECT MATTER AND OTHER ISSUES

IN VARIOUS CONTEXTS, beginning with David Vaver's study, the present volume asks whether IP protection should be extended to historically unprotected technologies, such as software, living organisms, business and surgical methods, and databases. The justification for extending protection in these areas lies not so much in a deliberate policy response as in the evolving legal distinction between an *invention* (something made by humans) and a *discovery* (pre-existing in nature). Following its declaration that "anything under the sun made by man" is patentable subject matter, the U.S. Supreme Court has markedly reduced or eliminated most of the traditional subject-matter exemptions.

While the owners of newly created intellectual property rights have welcomed most of the resulting expansion, academics, for various reasons (including their dependence on intellectual property created by the private sector for their own research), have regarded it with some skepticism. Like their colleagues, academic participants at the Conference who are represented in this volume were not especially sanguine about these extensions. Although the reasons expressed vary, and not all of them are economic, the economic grounds may be divided into four general efficiency concerns:²

1. When the Patent Office interprets the *Patent Act* and rules in a manner that broadens the existing patentable subject matter, the quality

of its examination may initially be quite limited because it lacks prior examining expertise and a database of prior art against which to judge applications [e.g. the United States Patent and Trademark Office (USPTO) and business methods]. In turn, this may open the door to numerous patent challenges based on invalidity.

2. There is already substantial innovation in a new field, hence no obvious need to induce still more rapid innovation (software, databases). Overinvestment in research and development (R&D) is difficult to measure but not difficult to imagine, and it carries with it its own social costs.
3. For many complex technologies, the rights created overlap to such an extent that the proliferation of patents may eventually hinder rather than promote innovation (high technology). This argument is most often framed in terms of transaction costs, but it also raises a coordination problem: there may be no solution to the problem of how to provide optimal incentives to the owners of all the IP that must enter into a given output.
4. The amorphous and (it is sometimes alleged) shrinking role of *fair use* or *fair dealing* eliminates many IP transactions that increase social welfare without markedly improving investment incentives (copyright). Again, this argument is presented most often as a transaction costs problem, although certain institutions (such as copyright clearance centres) have developed to mitigate the problem by facilitating small payments for using parts of copyrighted works.

Conference participants sounded cautionary notes along each of these lines in considering whether Canada ought to expand its subject-matter protection. As in many other areas, the *realpolitik* question regarding the broadening of protectable subject matter is whether Canada would be better off harmonizing with an allegedly *bad* policy, or attempting to pursue alone a *good* policy. In the absence of trade pressures from the United States, there appears to be no immediate imperative to expand protectable subject matter or otherwise follow the general U.S. trend toward stronger intellectual property rights (IPRs).

At the same time, Canada's dependence on trade with the United States requires that it monitor the effects of its singular path. These effects were thought to have at least three manifestations. First, there may be sectors of innovative activity that grow more rapidly in the United States than in Canada (particularly in the financial services sector, where business methods were first given patent protection). Second, Canada may end up offering patent protection *de facto* if not *de jure*, as clever patent application drafters learn to embody software or business methods claims in ubiquitous and essential computer

hardware patent claims. Since Canada's copyright law has already recognized the essential equivalence between software and its implementation in hardware,³ the presumption that such a bright line exists cannot be maintained. Third, the technology itself may force recognition of the choice of subject matter made in the United States. In a networked world, many new business methods must create products and services that are available for sale in any jurisdiction. If, as would be expected, the product of a patented business method could not be imported into the United States, nor (under U.S. law) offered for sale there, the costs of avoiding an infringement claim in the United States for business methods made available over the Internet may render certain inventions substantially less profitable, even if they were otherwise *free* for use in Canada.

In several areas investigated in the present volume — software and biotechnology (at least for multi-cellular inventions), as well as business and medical treatment methods — Canada may deny patent protection while the United States offers it. From a policy perspective, the current difference between Canadian and U.S. patentable subject matter offers a rare opportunity to conduct a valuable experiment. Given the proximity and similarity of the two economies, and their substantial interdependence, Canada and the United States both stand to gain from a comparison of the incremental effects of U.S. patent protection with respect to new knowledge investment and diffusion. While it is possible that policy differences will exacerbate the flow of research and human capital going from Canada to the United States, it is also conceivable that the absence of patent *thickets*⁴ in Canada will stimulate invention here and lead to higher rates of growth.⁵ In the end, this is an empirical question that demands an empirical answer.

Recommendation 1 – For the time being, Canada should wait before following the United States in expanding patentable subject matter to new areas such as software and business methods. At the same time,

- a) the Canadian Intellectual Property Office (CIPO) should monitor efforts to obtain patent protection for excluded subject matter by, for example, comparing the claims allowed in Canada with those allowed for parallel U.S. patents;
- b) Industry Canada should undertake specific case studies to determine whether and to what extent the absence of patent protection has facilitated or inhibited the use of an invention in Canada; and
- c) it should determine firm-level R&D responses to differences in patentable subject matter between Canada and the United States.

THE ROLE OF INTELLECTUAL PROPERTY INDUSTRIES IN THE CANADIAN ECONOMY

AS THE STUDY BY CHARLES, MCDOUGALL AND TRAN from Industry Canada makes clear, industries that depend on the creation of new intellectual property constitute a large and growing share of the Canadian economy. The study establishes an important new benchmark for tracking changes in the economic health of these industries. However, it does not quantify the share of total value added that arises specifically from intellectual property in the firm's production function, nor does it attempt to distinguish Canadian-origin from foreign-origin intellectual property. As a next step, it will be important to determine the form and extent of linkages between these industries and Canada's international trade pattern, both in goods and in their underlying intellectual property rights.

Canada's proximity to, and close trading relationship with, the United States afford the opportunity to study easily and in detail the incentives offered to Canadian inventors, who, according to Petr Hanel's innovation survey, routinely seek patents in the United States. In fact, larger and more frequent patenting firms may patent more in the United States than in Canada. If Canadian inventors are increasing their patenting activity in areas where the United States offers protection but Canada does not, the latter should re-assess its position with respect to new technologies and should be prepared to expand its patentable subject matter. In particular, if the availability of IP protection in the United States, but not in Canada, exacerbates the emigration of skilled inventors from Canada to the United States, the loss of human capital alone should be grounds for reconsidering the existing policy.

Recommendation 2 – Canada should review retrospectively and monitor future investment by Canadians in the production of goods subject to intellectual property rights in the United States, but not in Canada. These reviews should include cross-sectional comparisons with technologies for which Canada offers similar protection, and temporal measurements of changes in goods and services trade and in the international movement of skilled labour.

FIRMS, INDUSTRIES AND OTHER TECHNOLOGY-SPECIFIC INITIATIVES

SEVERAL ECONOMIC STUDIES, such as that by Manuel Trajtenberg,⁶ have underlined the key role played by new information technology in fostering

productivity growth. While evidence presented in this volume (by Rafiquz-zaman and Mahmud) shows that Canada is catching up in this area, its productivity growth has not increased to the same extent.

As Canada implements its new research initiatives, it is important that it actively innovates in its policy approach toward intellectual property, and toward productivity growth more generally. Thus, Canada's uniform stance should not be to await the outcome of U.S. policy experiments and to adopt those that succeed. As part of a conscious decision not to adhere to U.S. standards and to tailor its intellectual property protection to its own strengths, Canada must seriously consider alternative arguments for not offering protection, determine whether this approach would, in fact, lead to greater innovation in the Canadian context, and adopt (and, if necessary, develop) related policies to facilitate *growth by diffusion* in addition to (or, in some cases, instead of) *growth by creation*.

For example, if it is true that software patents actually inhibit innovation in the aggregate, then Canada should offer an ideal platform for software development: close to the United States and tightly integrated with that country, but comparatively free of development restrictions. Canada also offers an ideal environment where unprotected inventions, such as business methods, can be transferred for use and adaptation.⁷

Recommendation 3 – Industry Canada should extend policy-related research to selective, active study and promotion of technology fields where substantial innovation exists and where Canada does not offer patent protection. The purpose of this research would be to determine empirically whether Canadian economic objectives are better served by the presence or absence of patent protection in these fields. Particular attention should be paid to ancillary institutions (such as the availability of private financing) and market responses (such as the movement of human capital to and from the United States).

Recent studies have shown that intellectual property rights differentially affect small- and medium-size enterprises as compared to large firms. For example, a patent-free environment may be better suited to start-up firms than to established firms that already have large patent portfolios. Hanel's study suggests that small- and medium-size firms are systematically less likely to use intellectual property rights to protect innovations, and that the enforcement of these rights may be more costly in their case. At the same time, these firms can be the source of the most innovative products and services: Hanel's survey shows that firms that introduce a higher fraction of *Canada-first* innovations are more likely to receive R&D grants than less innovative firms. Of course, there may be a sample selection bias and firm-specific scale economies at work

that could also explain the data. Nevertheless, there is sufficiently strong evidence of underemployment of IPRs by small firms to anticipate possible gains from policies directed specifically toward increasing small firms' experience in creating and relying on IPRs (especially patents) to appropriate the returns to their R&D.⁸

As with all programs that subsidize economic activity (like R&D) with a high option component, the overall objective is not to create more IPRs as such, but to encourage the successful development of private research and licensing programs that foster economic growth. Thus, a concomitant component of a program aimed at encouraging the use of IPRs by small firms should be an ongoing preference for IPRs that have demonstrated a positive economic impact, particularly those that generate licence income from abroad.

In addition to cross-sectional comparisons with similarly situated firms in the United States, time-series comparisons may also offer significant insights into the stage of a firm's or industry's growth cycle at which IPRs assume greater importance. Just as economies (like the United States in the 19th century, and Japan and South Korea in the 20th century) mature and shift from a weak to a stronger IP regime, so may sectors of the domestic Canadian economy. In this context, there is a wealth of economic and organizational research available on the successful selection and financing of start-up firms, and the role played by IP in that process. It would be a mistake to think that strengthening or weakening IP policy, in the absence of complementary shifts in patent policy, will fundamentally shift the production and diffusion of new knowledge in the Canadian economy.

Recommendation 4

- a) Canada's patent regime should recognize that the fixed cost of learning about and effectively using patents falls disproportionately on small- and medium-sized firms. Policies should aim to reduce the costs to these firms through a combination of (but not limited to) tax credits, training programs and differential pricing of government services, such as for patent prosecution. The regime should reward investments that generate licence income or otherwise demonstrate positive economic impact;
- b) simultaneously, Statistics Canada's innovation survey should be expanded to determine whether the relatively low use of patent rights by small Canadian firms represents an actual source of economic inefficiency in these firms' research and financing activities; and

- c) Statistics Canada's innovation survey should also seek to determine whether the expanded use of patent rights by Canadian firms would generally increase barriers to entry for small firms.

In addition to Hanel's general innovation survey, three studies examine the role of IPRs in three high-technology industries: pharmaceuticals, biotechnology and software. While these industries are characterized by substantial R&D investments, they differ in market structure, regulatory oversight, barriers to entry and international trade patterns. Accordingly, the scope for policy intervention differs as well. Balancing the desirable goal of tailoring policies to particular industry contexts are the constraints imposed by Canada's international trade obligations under NAFTA and the trade-related aspects of intellectual property rights (TRIPs), which generally require that a country's patent protection regime not discriminate by field of technology. For that reason, intellectual property policy innovations targeted at particular sectors may have to use instruments that are, strictly speaking, outside the scope of intellectual property laws.

PHARMACEUTICALS

AS PAZDERKA AND STEGEMANN POINT OUT, Canada's share of the world pharmaceutical market is small, measured either by its consumption or its production. That fact and the great importance placed on pharmaceutical patent protection by the research-based pharmaceutical industry and Canada's international obligations under NAFTA and TRIPs constrain Canada's ability to influence the economic research environment through IPR policy intervention.

Pazderka and Stegemann argue that none of the proposed policy interventions they examined — fuller and earlier disclosure of Canadian pharmaceutical patent applications; change in the patent examination deferment period; new grounds for pre- and post-granting patent opposition; and patent term restoration for new drugs to compensate for regulatory delay — would generally serve Canada's interests, given the relative size of its research-based pharmaceutical industry and the fact that most Canadian pharmaceutical inventors patent first in the United States. While Canada must honour its international commitments, the authors see no point in going beyond them, given the country's comparative advantage. Indeed, the presence of pharmaceutical price regulation in Canada means that broadening or lengthening patent protection may have even less effect on research incentives than if prices were determined in a purely competitive market.⁹

In the pharmaceutical industry, the analytical trade-off between the dynamic gains from innovation and the static loss from higher short-term prices is played out every day — with very high stakes — in the ongoing legal battles

between research-based pharmaceutical firms and their generic competitors. Both in Canada and the United States, the laws that regulate generic entry are complex. Research-based firms have developed creative mechanisms for delaying generic entry, such as obtaining multiple sequential patents on a single product, thereby benefiting from mandatory statutory stays after successive allegations of infringement. Generic firms have responded, in part, by either inventing around patents or by successfully challenging them. Under U.S. law, the existence of a 180-day generic marketing exclusivity provision has occasionally resulted in litigation settlements that had the effect of delaying the generic firm's entry into the market in exchange for a payment from the patentee. This kind of settlement has drawn fire from U.S. competition authorities as a form of restraint of trade.¹⁰

Since there is no apparent danger of patent duration becoming systematically longer in Canada than in the United States, and since generic firms enter the market at least as effectively in this country, the potential gains from trying to develop innovative policy toward generic entry appear to be limited. This is one area where Canada seems well-positioned to benefit from observing the U.S. struggle to balance the interests of research-based firms, generic firms and consumers.

Recommendation 5 – At present, there do not appear to be grounds to favour additional protection of pharmaceutical inventions, beyond those required by current domestic and international law.

BIOTECHNOLOGY

THERE ARE FEW LARGE BIOTECHNOLOGY FIRMS: most are early-stage ventures spun off from or staffed by current employees of university laboratories. A viable business model, at least in the early stages of the industry, has been to use a single promising scientific discovery to raise private capital, then hope to iterate on the discovery-followed-by-new-capital scenario until being bought out by a larger firm with a significant revenue stream from existing products. Unlike major pharmaceutical firms, most biotechnology firms are not capable of bringing a product to market on their own (lacking resources and expertise in clinical trials, marketing and distribution), and many are not even capable of exploiting their initial discovery without significant human capital and IP inputs from firms with complementary assets. Hence, joint ventures and alliances among firms in the same industry are ubiquitous.

A second important difference between IP policy toward biotechnology and toward pharmaceuticals is that the ethical concerns that once restricted the patenting of medicines have been replaced by ethical concerns that restrict the patenting of *life*. Harkening back to its pre-reform period, Canada has

adopted a relatively restrictive policy on biotechnology patents by denying patent protection on higher life forms.

A third important difference between traditional pharmaceuticals and biotechnology has been that, while the canonical pharmaceutical product derives from a single patent on an active ingredient, biotechnology inventions potentially require many overlapping IPRs held by others, regardless of the scale of the firm. At the same time, it must be acknowledged that the pharmaceutical landscape is changing as manufacturers increasingly patent, for example, various formulations or polymorphs of the same active ingredients in a drug as well as multiple uses for it. In addition, firms have been known to copyright portions of their drug product monographs.

Similarly, large computer hardware manufacturers obtain annually hundreds of potentially overlapping patents. They have evolved a system of blanket cross-licences to their past and (for up to five years) future patents (accompanied by lump-sum balancing payments based on the relative strength of each firm's patent portfolio and the size of its royalty base, proxied by current sales), with periodic renegotiation of licence terms.¹¹ Again, the biotechnology sector, with many small start-up firms, few repeat negotiations, and a highly uncertain future revenue stream, does not offer conditions that are favourable to the evolution of such licensing practices.

Despite these obstacles, Lazarus's study shows that Canadian firms have proved adept at negotiating bilateral alliances and joint ventures. Whether the actual level of such cooperation is optimal, however, is difficult to determine and, in any event, may not be known until the industry moves closer to large scale introduction of final products. At present, most firms are so small, and the impact of their current investments on future product markets is so speculative, that the Competition Bureau would not be justified to restrict horizontal cooperation among them. Moreover, the author sampled firms that have common interests beyond that of overlapping IP rights. There may still be significant resource misallocations whose only manifestation is the current absence of licensing or other form of cooperation. Such vacuums are inherently difficult to identify. Therefore, the absence of challenge from competition authorities and the apparent abundance of deals between firms should not be taken as proof that these firms are not hindered, by licensing- and competition-related concerns, in their efforts to combine IP assets.

An important component of negotiating access to overlapping property rights is to ensure that firms only expend resources to negotiate access to asserted rights that will survive judicial scrutiny. Canada's *Patent Act* permits anyone to ask for the re-examination of a patent based, for example, on prior art that was not before the examiner during the examination process.

SOFTWARE

SINCE 1981, PATENTING OF COMPUTER SOFTWARE in the United States has increased substantially as a result of the growth of the information technology (IT) sector and changes in patent policy. In response, U.S. and Japanese IT multinationals embarked on a practice of *patent farming* — consciously increasing their patent holdings to further strategic corporate goals, such as gaining leverage in cross-licensing negotiations. What have been the effects on competition and entry conditions for new entrepreneurs and firms? Is the large-scale acquisition of software patents by IT multinationals truly for defensive rather than offensive purposes? If it is primarily for cross-licensing among peers, what is the consequence for smaller players who are increasingly vulnerable to infringement claims? What is the impact on software innovation in the United States and other countries? These questions have not been addressed satisfactorily in existing studies, mainly because the counterfactual hypothesis — that innovation would occur more rapidly if software patenting were limited — cannot be tested.

In their most recent study of U.S. software patenting, Graham and Mowery (2003)¹² focus on the role of *continuations* — procedural revisions of patent applications that remain out of the public view for long periods and then emerge as *submarines* when the use of the target technology has been established in the market.¹³ This strategy rewards the inventor disproportionately, relative to his degree of technical advance, because it induces rivals to sink costs in an infringing technology and then face the burden of switching when the patent surfaces. The authors' analysis of software patent practices offers evidence of significant costs associated with the use of software patents. Given that U.S. software firms derive a significant fraction of their total profits from sales abroad, software patents may indeed represent a net benefit to the U.S. economy. However, the empirical evidence on the net benefit for software importers is weaker.

Japan's software patent policy and practices are the most closely aligned with those of the United States. In the European Union, where assessment of a technological innovation has been more rigorous in awarding software patents, there has been much debate over the last year about the desirability of aligning European software patent policy with that of the United States to improve Europe's competitiveness. Recent news reports indicate that the trans-Atlantic policy rift is closing toward the U.S. approach.

So far, Canada has resisted suggestions to revisit its software patent policy. Several observers of the U.S. patent scene have recommended to Industry Canada not to take that route.¹⁴ Furthermore, there is no explicit demand on the part of the Canadian software industry to change the policy. The general view in the country's IT sector is that Canada has nothing to gain from emulating

the U.S. software patent regime. Major holders of software patents will often concede publicly that there is no economic justification for the 20-year term of software patents. On the other hand, important societal benefits could be realized in Canada if the federal and provincial governments were to raise awareness about open-source software options for public administration, education, health services and the voluntary sector. For their part, Canadian software entrepreneurs can externalize much of their development costs to open-source software communities to which their employees participate; they can also bundle open-source software in their product offerings, or establish themselves as value-added distributors and integrators of open-source solutions.

Recommendation 6 – Industry Canada should seek from the Organisation for Economic Co-operation and Development (OECD) a global assessment of the economic rationale for national software patent protection regimes, their duration and their impact on innovation. There should be a comparative study of the positive externalities associated with open software development and protection models and their impact on innovation.

PRODUCTIVITY, GROWTH AND TRADE

ECONOMIC GROWTH ARISES FROM INVESTMENT in new knowledge, which produces gains through productivity increases and comparative advantage in international trade. These gains enter the national income accounts as an increase in gross domestic product (GDP) per capita. Economic growth is, literally, the bottom line of intellectual property policy.

As the bottom line, however, economic growth is difficult to manipulate directly without focusing on the *intermediate* lines — the detailed policies that induce individual actors to behave in an efficient fashion. A mandate to *increase* economic growth begs the question: What causes it? Much of the present volume has been dedicated, directly or indirectly, to precisely that question.

Therefore, studies published in this volume that focus on trade and economic growth are more descriptive or diagnostic in nature — they tell us whether the bottom line, and proxies for it, are improving. They do not, by themselves, generate direct policy prescriptions.

Fortunately, each study published in this section offers some cause for optimism that Canada is heading down the right track. For example, the evidence indicates that strengthening patent protection increases the propensity to patent, and that Canadian patent quality is improving; moreover, increasing the level and quality of patent protection is associated with improvements in productivity growth. With an intermediate level of patent protection relative to its trading partners, Canada has the potential to improve its productivity ranking by tightening its patent laws (particularly through improved enforcement).

These productivity improvements can translate into significant gains in GDP per worker, at least in manufacturing.

However, there are many things about the bottom line that the present collection of studies do not tell us. They do not reveal, for example, whether and by how much programs like the government's current research initiative (which increases direct government research spending rather than changing policies to induce greater private spending) raise the rate of economic growth, a question that may not be answerable for ten years or more. They do not tell us if any such increase will be permanent or temporary. Perhaps most importantly from a policy perspective, they cannot tell us whether the benefits are worth the costs, i.e. what is the return on the investment?

In the increasingly globalized world of the knowledge-based economy, the implications for international trade of changes in domestic innovation policy are also difficult to determine. The handwriting on the wall is there for all to see: many countries seek answers to the same questions examined in the present volume from Canada's vantage point. Given stronger institutional and market linkages among countries, the response (particularly in the form of increased research investment) of many countries to these questions will determine the *future* efficacy of Canadian policy, in a way that extrapolations from *past* investments cannot. Such competition may potentially result in an inefficient overinvestment in public R&D, or in granting too much IP protection to the private sector. However, given the substantial competing demands on Canada's public treasury, it is unlikely that Canada's resource commitment to public and private research will be deemed excessive in the foreseeable future. At the same time, the upside potential from such investments, for both Canadian consumers and producers, remains high.

As the opening discussion of nominal price indexes made clear, the chief policy problem facing those who seek confirmation in the bottom line is that the bottom line is not measured accurately. The data are weak; as Sherlock Holmes observed, analysts cannot make bricks without straw. The cost of inadequate price indexes shows up not only in the GDP, but also in productivity and trade statistics, where the failure to incorporate quality adjustments may understate growth and overstate the trade deficit. At the micro-economic level, forecasts for future industrial and institutional reforms are clouded by the inability to measure the effects of past policy changes. For better or for worse, innovation in the *real* economy demands innovation in the *government* economy, here taking the form of improved information for government policy analysts and private sector agents alike.

Recommendation 7 – In cooperation with Statistics Canada, Industry Canada should develop accurate, quality-adjusted, sector-specific price

indexes to improve the reliability of intertemporal policy decisions, as well as the quality of the policy debate surrounding those decisions.

Some of the best economic work on quality-adjusted prices has been directed at the pharmaceutical sector — a good starting point.¹⁵ Canada, which by some measures leads the world in the aggregate welfare of its citizens, could lead the world in the accurate measurement of changes in that welfare induced by innovation.

In an international trade context, one of the thorniest economic and political problems related to intellectual property is the role played by the so-called *grey market*, which comprises *parallel* imports of products that are sold by an intellectual property holder at a relatively low price in one country, then re-exported to another country (where the IP holder may also enjoy protection) to be sold at a higher price, usually in competition with the IP holder or one of its licensees. As the earlier discussion of Canadian resale of pharmaceuticals to the United States suggests, such exports can lead to private retaliation as well as to charges of unfair trading. While international price discrimination is a boon to lower-income countries, its efficacy depends on the ability of the price-discriminating IP holder to prevent resale. To the extent that Canada benefits from international price discrimination, it must be prepared to prevent re-importation from countries where IP holders charge even lower prices. This inconsistency of pricing across countries is not the only difficult policy issue: the legal tolerance of parallel imports varies by type of intellectual property and the degree to which the IP holder's rights are *exhausted* by the first sale of the product. Canada must adopt a consistent legal and economic position with respect to parallel imports of knowledge-based products.

Recommendation 8 – In cooperation with the Department of Foreign Affairs and International Trade, Industry Canada should articulate international trade guidelines in respect of parallel imports that

- a) meet Canada's treaty obligations;
- b) advance the economic interests of Canadian consumers;
- c) demonstrate consistency between standards of import and standards of export; and
- d) protect the interests of Canadian producers from trade retaliation.

COPYRIGHT AND INNOVATION

DIGITAL COPYRIGHT

WITH THE EXCEPTION OF PROTECTION FOR DATABASES (discussed below), copyright protection in the last quarter of the 20th century expanded steadily in length, breadth and subject-matter coverage. This *de jure* expansion has been systematically countered by a *de facto* increase in the ease of illegal copying. By and large, the expansion of rights did not stem from a coherent policy framework but from fortuitous interaction between new technologies that were themselves copyrightable (or facilitated the creation and reproduction of copyrighted works), and lobbying by copyright holders, content providers and distributors (in part, to control copyright in new technologies and the evolving use of copyrighted works). The tension between new technologies and uses, on one hand, and the efforts to control them, on the other, has produced sharp divisions among interest groups in the knowledge-based economy. Much of the impact of the resulting legal scramble has yet to be seen.

On the supply side, claims about the costs of software and content piracy run in the tens of billions of dollars. While no software or content provider is immune, on the political front most of the organized opposition to piracy exists in the United States.¹⁶ However, the claims made by the victims are suspect, at least if one defines cost as foregone revenue. However illegal it may be, much piracy comprises uses that would not have occurred if the seller had been able to insist on a take-it-or-leave-it offer at the uniform price. Therefore, it is hard to gauge the incremental effect that a reduction in piracy would have on producer incentives. As the political debate makes clear, the social costs of reducing piracy may rival the social benefits in magnitude.

If we divide copyright in the knowledge-based economy into software and content, then Canada appears to be in the following position. First, as a net importer from the United States over the foreseeable future, Canada's economic interests are unlikely to coincide with those of major U.S. copyright holders. Even if they did, there does not seem to be a political consensus that would permit Canada to tilt the balance in favour of software and content copyright holders. In addition, software requires standards, which create network externalities, and these externalities are at least as important as copyright protection in the incentive calculations of software providers. Those standards — whether based in law, market behaviour or in the technology itself — are likely to be set outside of Canada.

Given the uncertain effects of piracy on supply, and the certain economic and political pressures from its trading partners, Canada would appear to gain nothing, economically, from unilaterally strengthening copyright protection.

However, Canada may gain from investments in the infrastructure with which the existing copyright incentives are implemented. When transaction costs are high, small payments to copyright holders are inefficient. High transaction costs lead to much *de minimis* piracy, which promote a culture of disrespect for the property rights of copyright holders. In an economy where intellectual property rights are supposed to play an increasingly important role, such a culture ought to be counterproductive.

Canada has implemented some interesting policy innovations to mitigate these effects. For example, it adopted a levy on blank recording media in anticipation of their being used for illegal copying. The proceeds of this levy are transferred to copyright holders as compensation. In exchange for the levy, people may copy music for private use.

There are many contexts (e.g. rides at an amusement park) where the private sector provides perfectly legal *all you can eat* consumption at a marginal cost of zero, in exchange for a fixed payment up front.

On the demand side, potential efficiency gains to consumers from enhanced price discrimination might be offset (at least in some social welfare calculations¹⁷) by a potential transfer of consumer surplus to producers. Moreover, enhanced price discrimination is made possible through improved producer access to consumer buying patterns, which may be politically unacceptable or otherwise require regulation under privacy laws. Finally, the increasingly common monitoring of post-purchase consumption behaviour has, aside from obvious privacy implications, an element of converting copyright users from final consumers to intermediate links in the copyright holder's production and distribution chain. This phenomenon could redefine the meaning of *consumption* of copyrighted goods in the knowledge-based economy.

Given the potential efficiency gains from price discrimination, Canada may benefit from investing in both the market infrastructure and the social norms that draw into the economy transactions heretofore excluded by uniform pricing or conducted illegally at a price of zero (piracy). As matters stand, consumers fall into one of two groups: those against whom property rights may be asserted (and who are charged the uniform price), and those who are exempt under the fair-trading exemption (who pay a price of zero). A more nuanced approach to property rights and consumer segmentation would permit broader price discrimination than the current binary form.

DATABASES¹⁸

THE EVIDENCE AND ANALYSIS MARSHALLED in this volume suggest that the same arguments against rushing to expand the scope of patent protection apply to the enactment of *sui generis* protection for databases. As in other IP areas, the incremental worldwide effect of the stimulus is likely to be small.

However, some market niches have been dominated by Canadian database producers, either because of Canada's comparative advantage in the supply of certain information or because of Canadian demand for Canadian content. The competitive advantage of these firms should be monitored closely for evidence that systematic protection might strengthen their competitiveness and encourage similar investments by other Canadian firms. On balance, however, Canada is likely to remain a net importer of database services; as such, database protection is likely to raise costs for Canadian consumers more than it would benefit Canada's database producers.

With respect to copyright, most works achieve the threshold level of originality, so there are fewer issues here. The one great exception, of course, is the protection of databases. We know that alphabetical telephone listings do not qualify.¹⁹ But since it is a trivial matter for a computer to sort a database by one or more fields, it is hard to argue that any other useful ordering of the data is *original* to the author, either. Even if it were, this ordering would not protect the database in its electronic form against misappropriation.

Traditional copyright criteria, which do not protect facts but the *judgment* and *skill* applied to the selection and arrangement of facts, are perversely unhelpful in the context of databases, which often strive to be both comprehensive (*selecting* everything in some universe, such as telephone subscribers in a geographic area, and allowing users to exercise judgment in selecting a subset) and intuitive (*arranged* to conform to user expectations, such as alphabetical ordering, rather than according to an original scheme of the author).²⁰

A quasi-intellectual property right — the tort of unfair competition — has been sometimes used in the United States to deal with the misappropriation of another's investment in factual information.²¹ Yet, even then, there is a crucial ambiguity in the exact nature of the tort: does the misappropriator take the fruits of another's investment, or merely misrepresent those fruits as his own?²²

Despite the lack of any overarching theory of protection, Canadian and foreign database creators have managed to use a variety of means — technological, contractual and legal — to guard against the kind of wholesale misappropriation and cut-rate imitation that would undermine their investment. As a net importer of database products, Canada seems to have established a workable database protection regime, at least on the supply side.

On the demand side, access to database products sometimes suffers from the inability of database providers to price-discriminate between different types of users and different types of uses. For example, the commercial value of a database may lie largely in its up-to-date provision of information; for many purposes, yesterday's stock prices are absolutely useless, and command a market price of zero. But for research purposes, access to broad swaths of historical or cross-sectional data may be critical to understanding a phenomenon.

Obviously, the broader the extraction from the database, the more likely it is to substitute for the database as a whole, a fact that makes database owners particularly unwilling to encourage large extractions by reducing per-unit data prices. The result is that there may be considerable deadweight loss from the uniform pricing of database services for all classes of customers.

In keeping with Canada's broader knowledge dissemination goals, fruitful research remains to be done on the social losses resulting from uniform database pricing. Depending on the outcome of such research, some policy interventions may assist *both* researchers and database providers in negotiating access to databases on terms that facilitate large-scale research while protecting the creator's legitimate interest in preventing wholesale duplication.

Finally, many databases possess the attribute that their very existence discourages or eliminates the prospect of substantial competition: there is, for instance, only one multiple listing service for real property in most cities. As in other knowledge-based ventures, the fixed cost of setting up and marketing these databases is paid for by some form of monopoly pricing over time. Unlike intellectual property, however, this monopoly pricing is not temporary. On the contrary, the monopoly power of the database is likely to increase over time, as its very history and comprehensiveness become a barrier to entry. Moreover, because facts are not copyrightable, two databases with the same set of facts are perfect substitutes for one another. In that case, a second entrant faces the prospect of an unprofitable price war and the loss of his fixed investment in duplicating the incumbent's database. As a result, no entry occurs. Since competition is unlikely, and price regulation is inefficient, other mechanisms may induce entry while reducing long-term pricing distortion.

Recommendation 9

- a) At the present time, Industry Canada should not create a *sui generis* right to database protection;
- b) Industry Canada should study means of ensuring access to commercial databases for research purposes by, for example, acting on behalf of all educational institutions to negotiate rates for non-commercial uses; and
- c) when the market for a database is likely to support only one supplier, Canada should consider subsidizing the fixed costs of creating the database. Where it contributes substantial public funds, the Government of Canada should secure royalty-free licences to databases, and use these licences to facilitate access by researchers and others, both to increase the social value of the database and to discipline the seller's pricing practices.

INSTITUTIONS

SCOPE OF SERVICES

AS PAQUET AND ROY MAKE CLEAR in their comprehensive discussion of the role of the Canadian Intellectual Property Office (CIPO), there are a number of initiatives that CIPO could examine or undertake immediately. Perhaps most important and sweeping is their recommendation that CIPO rethink its role in the Canadian economy, transforming itself from a passive gatekeeper into an active manager, coordinator and intermediary.

With respect to the specific services that CIPO offers, two concrete recommendations stand out:

Recommendation 10 – CIPO should:

- a) as a bilingual national authority, undertake a detailed study of the costs and benefits of becoming an international search authority; and
- b) expand from administrative gatekeeper to a partner, leader in demonstrating knowledge management techniques, and intermediary in the dissemination of new knowledge.

IPR ENFORCEMENT

ONE OF THE GREAT DIFFICULTIES with investing in intellectual property rights is the inability to predict whether and in what circumstances the rights obtained are enforceable. Since the government does not guarantee these rights, they may be successfully challenged by a third party. Moreover, the interval between the time a right is asserted and the time it is adjudicated is so long relative to standard product cycles that vindicating the right is often commercially infeasible.

Intellectual property cases, particularly those involving complex technology, often demand much deeper knowledge of the technology than of the law. Partly for this reason, they are the bane of trial judges. Litigating parties, for their part, are understandably reluctant to place the decision regarding an interlocutory injunction (often the most important part of the case) in the hands of a technically unsophisticated judge. IP trials are usually expensive, time-consuming and tedious. They turn on the irreconcilable opinions of competing experts, which are offered in support of what the notional “person of ordinary skill in the art” would have believed about the state of the art, often at some point in the technologically remote past. Even copyright trials may depend on musical and other experts educating the tribunal as to how one work differs from another.

The difficulty in reaching a quick and just solution leads to still other undesirable behaviour. For example, the prospective challenger of a patent right may accumulate such great liability while waiting for judicial resolution that it risks bankruptcy. This situation does not favour the patentee, however, because securing a judgment against a bankrupt infringer is a pyrrhic victory at best. Both parties face an incentive to settle the litigation on terms that permit the patentee to enforce a potentially invalid patent right, thereby preserving its market position. While the settlement of litigation is generally considered efficient, in this case it can lead to anti-competitive outcomes.

The root cause of these problems is the use of federal trial courts to adjudicate intellectual property disputes. While there are good jurisprudential reasons for allocating IP litigations to federal tribunals, this practice bypasses the wealth of specialized technical and administrative expertise embodied in CIPO.

But the most important reason for reforming the present system is that it takes too long to get from start to finish. Justice delayed truly is justice denied, when the context of the dispute is the technological development of a rapidly changing industry.

In response to decades of calls for improvements in speed and consistency, and more recently to charges of patent infringement as a form of unfair trade, the United States has created two new institutions in an effort to provide additional speed and certainty in intellectual property litigations. On balance, it seems to have taken two steps forward and one back. In the case of U.S. patentees facing allegedly infringing competition from foreign importers, the International Trade Commission (ITC) has been empowered to hear and decide claims of patent infringement, and to issue injunctions that prevent further imports of the accused product if an infringement is found. By law, this process is required to take no more than one year from the time a complaint is filed. Unfortunately, it achieves that laudable objective by placing the accused foreign firm at a distinct tactical disadvantage. Moreover, the ITC does not possess technical expertise and its hearings are conducted before administrative law judges. For that reason, either party to an ITC decision may seek relief in federal trial courts, which are not bound by the ITC's decision. It can and does happen that the ITC and the federal court reach opposite conclusions as to patent validity and infringement. Needless to say, this state of affairs does not reduce litigation uncertainty — but it does illustrate the perceived need for speed in (some types of) patent litigations.

The U.S. Court of Appeals for the Federal Circuit (CAFC) is a specialized tribunal that hears appeals of all patent cases. Its judges are not technically trained, but they do specialize in intellectual property. The CAFC has had the salutary effect of unifying appellate judicial opinion across the eleven Circuit Courts of Appeals, thereby markedly reducing forum shopping and (arguably)

strengthening the rights of patentees. However, as in Canada, U.S. IP cases are still heard in federal trial courts, which, with a few exceptions, do not provide anything like swift justice by technically-minded judges. Moreover, an appeal to the CAFC (which takes about a year after the trial court has rendered its verdict) results in the trial court's decision reversal at a disturbingly high rate. Clearly, the United States has not solved the problem of how to provide quick and predictable resolution to intellectual property disputes.

There appears to be no immediate crisis in the enforcement of IP rights in Canada. Indeed, Garland and Want report that, in one survey, Canada was selected as the best country in the world in which to litigate a patent. Nonetheless, Canada has a real opportunity to create a North American trial court to adjudicate intellectual property cases. While located in the judicial branch, this tribunal could draw on the expertise resident in CIPO, with respect to both the technology and the administrative procedures involved in the creation of an IP right. By using streamlined discovery procedures and regulating the use of experts, the court could guarantee a decision within a predetermined interval, giving litigants an important landmark in their planning process. As an ancillary service, the CIPO might offer mediation or arbitration programs, having well-defined templates for predicting the court's handling of issues like patentability, infringement and damages. Such an expansion of services is consistent with Paquet and Roy's call for transformation of CIPO into an active intermediary in the knowledge-based economy.

ADDITIONAL REMARKS

THE PRESENT VOLUME SURVEYS A WIDE RANGE of theoretical and empirical issues that will inform Canadian policy toward intellectual property and innovation over the coming decade. However, it should be stated explicitly that there are at least five areas linked to Canada's policies toward intellectual property rights and enforcement that have not been covered. The reader is cautioned to investigate these areas before reaching additional inferences about the role of Canadian policy in the knowledge-based economy.

These five areas are: competition policy; university technology transfer; public funding of private sector research; higher education; and taxes. While it is clearly impossible to draw all the links between the research topics investigated in this volume and these five broad areas, the following remarks are designed to point the reader in the right direction.

COMPETITION POLICY

THE IMPORTANT ROLE OF COMPETITION POLICY in balancing the property rights granted to IP owners cannot be overstated, especially as the right to

exclude others approaches a market monopoly. Fortunately, Industry Canada had the foresight to commission a study of the relationship between intellectual property and competition policy even before sponsoring the research presented in this volume. *Competition Policy and Intellectual Property Rights in the Knowledge-Based Economy*²³ surveys such important IP-related competition issues as tying, patent acquisitions, R&D joint ventures, network industries, and international and domestic antitrust enforcement. These issues remain fresh and, indeed, more in need of innovative policy management now than at the volume's initial launch. The reader of the present volume would do well to consult the earlier research volume as an essential complement.

UNIVERSITY TECHNOLOGY TRANSFER

BECAUSE A LARGE PART of the Canadian government's research initiative is aimed at university research, no discussion of intellectual property policy toward universities and its impact on productivity would be complete without comprehensive reference to the processes by which university research results in commercial applications. In the United States, a wholesale regime change occurred in 1984 with the *Bayh-Dole Act*, which assigned to performing universities the patent rights to inventions resulting from federally funded research.

For their part, universities have awakened to the large and growing opportunities for private sector funding that arise from licensing their inventions.²⁴ The ability of universities to privately license their research findings obviously presupposes their ownership of inventions developed with federal funds, an intellectual property issue that also implicates other policies toward universities and toward public access to publicly funded inventions.²⁵ Public universities have also been called to account for their unusual practice of allowing their employees to profit from the creation and sale of their own intellectual property (e.g. textbooks and, with the advent of the Internet, distance-learning curricula), contrary to private-sector practices of requiring an assignment of rights.

While nearly everyone agrees that facilitating the efficient transfer of technology out of university laboratories is a good thing, some researchers are less sanguine about the incentive effects that the prospect of private-sector funding has on the choice of university research projects. To the extent that university researchers respond to market incentives, they may both improve productivity growth in the short term by generating marketable inventions, and reduce it in the long term by shrinking the pool of fundamental knowledge from which future inventors must draw their commercial applications.²⁶ The net effect of these two offsetting trends may not be known for years or even decades.²⁷ Encouragingly, Statistics Canada has begun a series of annual or bi-annual surveys to measure intellectual property commercialization in the Canadian higher education sector, and it has recently entered into a partnership

with the Association of University Technology Managers (AUTM) in an effort to harmonize the measurement of university technology transfers across Canada and the United States.²⁸ Data from these surveys should prove valuable to policy-makers working on intellectual property and innovation policy toward universities in Canada over the coming years.

PUBLIC FUNDING OF PRIVATE SECTOR RESEARCH

GIVEN THE OBSERVATION that much innovative research comes from small firms (which are more likely to engage in revolutionary innovation that leaps entry barriers than are large incumbent firms), and the claim that small firms holding new knowledge as their main asset may lack access to efficient capital markets, the U.S. National Science Foundation has, for years, targeted small firms with its Small Business Innovation Research (SBIR) Program. Though SBIR has funded a number of successful firms, critics have charged that the rate of return on the government's investment is low and that the public subsidy crowds out R&D expenditures that the firm would have made anyway.²⁹ Nevertheless, policy-makers continue to search for funding mechanisms to prime the private sector pump, in the process using a form of subsidy that does not violate international trade laws while giving national firms a competitive advantage. Canada may have to confront this form of aid to small businesses as a political reality, even if it does not pass rigorous economic scrutiny.

EDUCATION AND TAXES

EDUCATION AND TAX POLICIES raise so many other social and legal issues that one cannot meaningfully discuss their relationship to intellectual property policy just in passing. From a strict economic perspective, it must be emphasized that these fundamental and pervasive policies influence, and sometimes determine, the outcome of investments in research and intellectual property, both by individuals and by large R&D-performing organizations. For better or for worse, these policies may have far greater implications for macro-economic patterns of productivity growth and trade than do micro-economic policies related to innovation — even in the context of the *new* economy.

ENDNOTES

- 1 As an example of how Canada's intellectual property policies intersect with its health care, competition, international trade and human rights policies in allocating benefits among groups of consumers, consider the following scenario: Canadian pharmaceutical distributors resell pharmaceuticals to U.S. consumers over

the Internet at the substantially lower Canadian price. This practice may infringe a pharmaceutical manufacturer's U.S. patent, which prohibits importation without consent. The response of the pharmaceutical manufacturer (typically not a Canadian firm, but not necessarily a U.S. firm either) is to refuse to sell to the Canadian distributor. (The manufacturer may cite concerns over the *quality* of the infringing imports, but because the pharmaceuticals in question are produced either directly by, or under licence from, the manufacturer, these concerns appear to be specious.) Both Canadian consumers and producers are made worse off by the refusal to deal, which may in turn subject the manufacturer to penalties under the *Competition Act*. Normally, the manufacturer's second-best alternative would be *not* to price-discriminate, i.e. to charge the same price in Canada as in the United States, thereby removing the incentive for arbitrage. This response would, of course, make Canadians even worse off. But in this case, Canada's Patented Medicine Prices Review Board (authorized under the *Patent Act*) may restrict the prices that can be charged in Canada. While distributors do not appear to violate any Canadian laws by reselling to Americans, the wholesale infringement of U.S. patents runs counter to the spirit, if not the letter, of the intellectual property provisions of NAFTA and of the TRIPs section of the World Trade Organization.

This scenario has been played out recently in Canada, as Canadian consumers attempted to organize a boycott of the U.K. pharmaceutical firm GlaxoSmith-Kline, which refused to sell pharmaceuticals to Internet distributors that resell to the U.S. market. See, for example, "Canadian drug vendor calls for Glaxo boycott," *Reuters*, February 4, 2003.

- 2 To these may be added another — albeit legal — objection, the status of which has at least been temporarily clarified under Canadian law: According to the Supreme Court of Canada, the *Patent Act* does not contemplate the patenting of higher life forms. For the present, this decision places Canada at odds with the large majority of OECD member nations.
- 3 See *Apple Computer v. Mackintosh Computers* (1990), 71 D.L.R. (4th) 95 (S.C.C.).
- 4 See Shapiro (2001), Walsh, Arora and Cohen (2002), and Heller and Eisenberg (1998).
- 5 One should not understate the empirical difficulties involved in discriminating between these hypotheses. Among other factors, Canada's dependence on trade with the United States might permit it to *free-ride* for an extended period of time on U.S. R&D investments. Conversely, a slowdown in U.S. R&D in response to bad patent policy might shift R&D to Canada only slowly and with uncertainty.
- 6 See Trajtenberg, 1990.
- 7 Obviously, re-exports of patented technology to the U.S. market remain prohibited. Whether the offer for sale in the United States of a service produced with the assistance of a patented business method infringes the patent remains untested in U.S. courts.
- 8 See Lanjouw and Schankerman (2001), and Lerner (1995).
- 9 For an exposition of the view that relatively low Canadian pharmaceutical prices are based on Canada's relatively lower per capita income, rather than on constraints imposed by the Patented Medicine Prices Review Board, see Graham, 2000.
- 10 See Balto, 2000.

- 11 See Grindley and Teece, 1997.
- 12 See Graham and Mowery, 2003.
- 13 The benefits of this strategy have recently been restricted by U.S. policy reforms, which (like elsewhere in the world) limit the term of a patent to 20 years from application, and require automatic publication of patent applications 18 months after the date of filing (unless the inventor promises not to file counterpart applications outside the United States and specifically requests secrecy).
- 14 For example, Russell McOrmond has made several recommendations to Industry Canada related to the overall negative impact of software patents, suggesting that more economic studies on the topic are required. See <http://www.flora.ca/patent2003/software-patent2003.shtml>.
- 15 See, for example, Berndt, Bir, Busch, Frank and Normand (2000), Berndt, Cutler, Frank, Griliches and Newhouse (1998), and Berndt, Cockburn, Cocks, Epstein and Griliches (1997).
- 16 Trade groups such as the Business Software Alliance, the Recording Industry Association of America, and the Motion Picture Association of America each produce calculations of the alleged losses to their members from copyright infringements.
- 17 The Competition Bureau calculates total welfare as the sum of consumer surplus and producer surplus, which implies that a transfer from consumers to producers should be welfare-neutral. However, for obvious reasons, the Competition Bureau's guidelines do not universally reflect political calculations of welfare.
- 18 An excellent survey of current Canadian law and policy toward databases may be found in a study commissioned by the Department of Canadian Heritage; see Robert Howell, 2002.
- 19 See *Feist Publications, Inc. v. Rural Telephone Service Company, Inc.*, 449 U.S. 340 (1991); in Canada, a comparable result was reached for the Yellow Pages in *Tele-Direct (Publication) Inc. v. American Business Information Inc.* (1996), 74 C.P.R. (3d) 72 (F.C.T.D.) *aff'd* (1997), 76 C.P.R. (3d) 296 (F.C.A.). These decisions expressly rejected the so-called "sweat of the brow" doctrine, which justified copyright protection based on the investment required to produce the compilation, rather than the "labour, judgment or skill" exercised in its "selection or arrangement." Since the utility of most databases rests not in their selection but in their comprehensiveness, many do not qualify under this standard. Recently, the Court of Appeal appears to have opened the door to "sweat of the brow" arguments in *CCH Canadian Ltd. v. Law Society of Upper Canada*, 2002 F.C.A. 187 (2002) by upholding the *copyrightability* of header notes for reported legal decisions.
- 20 Perhaps ironically, databases that are, on some original or creative dimension, *incomplete* or *selected* are more likely to qualify for copyright protection than those that strive for comprehensiveness. Thus, a simple telephone directory (which selects the subset of all Canadian citizens who reside in a certain geographic area) is not copyrightable, but other specialized directories (such as a directory that selects the subset of all Canadian citizens who reside in a certain geographic area and have Italian surnames) have been held to exhibit sufficient creativity to merit protection; see *Ital-Press Ltd. v. Sicoli*, 86 C.P.R. (4th) 129 (F.C.T.D.).

- 21 The classic case is *International News Service (INS) v. The Associated Press (AP)*, 248 U.S. 215 (1918), which enjoined (for a short period after initial transmission of the news) INS from copying the AP's so-called "hot news" directly off the news wire, despite its essentially factual nature.
- 22 In *INS v. AP*, the majority opinion found that INS had engaged in unfair competition by copying facts initially reported by AP. In a concurring opinion, Justice Holmes held that the source of the wrong lay in INS's representation that its reporting was based on its own efforts, rather than AP's. His remedy merely would have required that INS attribute the source accurately: "The Associated Press reports that...".
- In the context of databases, the question is whether a database owner should be able to exclude others from transmitting facts contained in, or analyses derived from, the database without attribution, or whether the prohibition extends to the facts and analyses themselves.
- 23 See Anderson and Gallini, 1998.
- 24 According to the Association of University Technology Managers (AUTM), a trade group that includes both Canadian and U.S. research universities, university licences generated US\$1.26 billion in revenues in 2000. See AUTM, 2001.
- 25 According to the Association of Universities and Colleges of Canada, individuals "who are familiar with both the Canadian and U.S. systems believe that institutions in the United States give a higher priority to IP exploitation than their Canadian counterparts. This is partly because of U.S. legislation requiring that U.S. universities exploit IP resulting from federally funded research...". See ARA Consulting Group Inc., 1998.
- 26 See Jensen and Thursby, 2001.
- 27 For a recent study of university technology transfers and public-private joint ventures, see Darby, Zucker and Wang (2003). See also Zucker, Darby and Armstrong (2001).
- 28 AUTM press release, January 26, 2003.
- 29 See Lerner, 2000.

BIBLIOGRAPHY

- Anderson, Robert D., and Nancy T. Gallini (eds.). 1998. *Competition Policy and Intellectual Property Rights in the Knowledge-Based Economy*. Calgary: University of Calgary Press. Industry Canada Research Series, Volume No. 9.
- ARA Consulting Group Inc. 1998. *Approaches of Canadian Universities to the Management and Commercialization of Intellectual Property Diversity and Challenges*. Discussion Paper. Vancouver.
- AUTM. 2001. *AUTM Licensing Survey: FY 2000*, Northbrook (IL): Association of University Technology Managers, p. 1.
- Balto, David. 2000. "Pharmaceutical Patent Settlements: The Antitrust Risks." *Food and Drug Law Journal*, pp. 321-342.

- Berndt, Ernst R., Anupa Bir, Susan H. Busch, Richard G. Frank and Sharon-Lise T. Normand. 2000. *The Medical Treatment of Depression, 1991-1996: Productive Inefficiency, Expected Outcome Variations, and Price Indexes*. NBER Working Paper No. 7816 (July).
- Berndt, Ernst R., Iain Cockburn, Douglas L. Cocks, Arnold Epstein and Zvi Griliches. 1997. *Is Price Inflation Different for the Elderly? An Empirical Analysis of Prescription Drugs*. NBER Working Paper No. 6182 (September).
- Berndt, Ernst R., David M. Cutler, Richard G. Frank, Zvi Griliches and Joseph P. Newhouse. 1998. *Price Indexes for Medical Care Goods and Services: An Overview of Measurement Issues*. NBER Working Paper No. 6817 (November).
- Darby, Michael R., Lynne G. Zucker and Andrew Wang. 2003. *Universities, Joint Ventures, and Success in the Advanced Technology Program*. NBER Working Paper No. 9463 (January).
- Graham, John R. 2000. *Prescription Drug Prices in Canada and the United States – Part 2: Why the Difference?* Vancouver: The Fraser Institute. Working Paper (September).
- Graham, Stuart J.H., and David C. Mowery. 2003. "Submarines in Software? Continuation Patenting in Software in the 1980s and 1990s and its Implication for Open Source." (May). See <http://opensource.mit.edu/confpapers.html>.
- Grindley, Peter, and David J. Teece. 1997. "Managing Intellectual Capital: Licensing and Cross-Licensing in Electronics." *California Management Review* 38, 2 (Winter): 8-41.
- Heller, Michael A., and Rebecca S. Eisenberg. 1998. "Can Patents Deter Innovation? The Anti-Commons in Biomedical Research." *Science* (May 1st).
- Howell, Robert G. 2002. *Database Protection and Canadian Laws – Second Edition: State of Law as of March 31, 2002*. Ottawa: Canadian Heritage.
- Jensen, Richard, and Marie Thursby. 2001. "Proofs and Prototypes for Sale: The Licensing of University Inventions." *American Economic Review* (March): 240-259.
- Lanjouw, Jean Olson, and Mark Schankerman. 2001. *Enforcing Intellectual Property Rights*. NBER Working Paper No. 8656 (December).
- Lerner, Josh. 1995. "Patenting in the Shadow of Competitors." *Journal of Law and Economics* 38, 2 (October): 463-495.
- . 2000. "Evaluating the Small Business Innovation Research Program: A Literature Review." In *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*. Washington (D.C.): National Academy Press.
- Shapiro, Carl. 2001. "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting." In *Innovation Policy and the Economy*. Edited by A. Jaffe, J. Lerner and S. Stern. Cambridge (Mass.): National Bureau of Economic Research.
- Trajtenberg, Manuel. 1990. "A Penny for Your Quotes: Patent Citations and the Value of Innovations." *Rand Journal of Economics* 21, 1 (Spring): 172-187.
- Walsh, John P., Ashish Arora and Wesley M. Cohen. 2002. *The Patenting and Licensing of Research Tools and Biomedical Innovation*. National Academies of Science. Working Paper (May).
- Zucker, Lynne G., Michael R. Darby and Jeff S. Armstrong. 2001. *Commercializing Knowledge: University Science, Knowledge Capture, and Firm Performance in Biotechnology*. NBER Working Paper No. 8499 (October).



Discussants' Comments

Session I

Intellectual Property in Canada: The Context

Canadian IP Law: Our Choice to Make?

Michael Geist
University of Ottawa and Goodmans LLP

GILLES MACDOUGALL AND PROFESSOR DAVID VAVER have delivered two excellent studies that raise many interesting issues. I draw two main points from both. First, notwithstanding the presence of several international treaties on the protection of intellectual property (IP), IP laws differ at the national level. Second, there are frequently good reasons for these differences.

Professor Vaver's starting point is to ask first whether Canada and the United States are truly far apart on their respective IP laws, and second, whether the differences can be bridged. Vaver responds to his own questions with a yes and no, respectively. Yes, Canadian and U.S. IP laws really are far apart, and no, it is unlikely that the differences can be bridged. Although the author is unquestionably correct in his assessment, I would like to suggest that these are actually the wrong questions to ask. Instead, I believe that the question about whether we can bridge our differences in pursuit of a global harmonized standard has been rendered moot. What is occurring now in the field of IP law is not the harmonization of IP law to which Vaver refers, but rather the americanization of IP law.

Unlike harmonization initiatives, the americanization of IP law is not achieved at the negotiating table but instead through the aggressive assertion of jurisdiction. To put a new spin on an old phrase, much like 'if Mohamed does not come to the mountain, the mountain will come to Mohamed,' in today's

world of IP law, if the U.S. approach to IP law is not adopted by foreign jurisdictions, then the United States will bring its laws to those jurisdictions.

Please note that this is not to be viewed as U.S. bashing. In fact, quite to the contrary. The Industry Canada study provides a compelling case for the United States to act in a very rational manner by pursuing a policy that affords maximum IP protection. If Canada enjoyed a \$3 billion trade surplus in the copyright industries, I'm sure it too would pursue a policy of extending highly protective IP laws around the globe.

However, as a net importer of copyright, the aggressive U.S. IP policies raise two questions from Canada's perspective. First, is the U.S. approach well-suited to Canada and thus deserving of adoption as Canadian law? Second, is the current vision of an open Canadian policy discussion, itself premised on our ability to make our own choices in IP law, an outdated vision of IP policy-making in this new digital century?

I would argue that today, we increasingly find that IP policy around the world does indeed emanate from the United States, coming from U.S. courts, from the U.S. Congress and from national legal codes.

Let us begin with the courts and the iCraveTV case, a decision that is likely familiar to a Canadian audience. iCraveTV was a Toronto-based web-caster with no physical presence in the United States. Much like the cable television operators of yesteryear, iCraveTV took freely available television signals and, rather than retransmitting them over a cable system, retransmitted them over the Internet. Within days of launching its service in December 1999, iCraveTV faced lawsuits in both Canada and the United States. While the Canadian lawsuit was slow to develop, a U.S. court issued an injunction prohibiting iCraveTV's webcasting activities and the service disappeared almost as quickly as it appeared.

In considering the iCraveTV case, the U.S. judge had the following to say about the applicability of Canadian copyright law to the issue:

Defendants have submitted a declaration of a Canadian law professor...which argues that defendants' activities are permissible under Canadian law. However, because plaintiffs seek relief under U.S. law for infringements of the U.S. Copyright Act, there is no need for this Court to address any issue of Canadian law.¹

The court was telling iCraveTV that while it might have been a Canadian entity operating in Canada seeking to avail itself of Canadian law, for the purposes of a U.S. court, the Canadian connection is irrelevant. It is U.S. law that is applicable. It is U.S. law that would reach up into Canada and find itself applied to a Canadian-based entity.

A similar approach is unfolding in the U.S. Congress with regard to trade-marks and domain names. Consider, for example, the *Anticybersquatting Consumer Protection Act* (ACPA).² The ACPA features an *in rem* jurisdiction provision that has raised considerably controversy. The provision is designed to address those instances where traditional personal jurisdiction cannot be asserted since the foreign party has no ties to the jurisdiction. Rather, the statute grants trade-mark holders the right to sue the domain name, which is seen as *based* in the United States since the domain name root server resides there.

The application of the ACPA *in rem* jurisdiction provision arose in the Canadian context in the case *Heathmount A.E. Corp. v. Technodome.com*, a dispute over the Technodome.com domain name.³ Technodome was a Montreal-based company seeking to develop theme parks in both Canada and the United States. It owned trade-marks over the name Technodome in both countries. The owner of the technodome.com domain was a small Toronto-based theatre company. Although there was nothing stopping the trade-mark holder from launching an infringement action in Canada, or a traditional ICANN/UDRP (Internet Corporation for Assigned Names and Numbers/Uniform Domain Name Dispute Resolution) action, it chose instead to launch an ACPA action in Virginia. Since the Toronto theatre company had absolutely no connection to the State of Virginia, the trade-mark owner was able to invoke the *in rem* jurisdiction clause by suing the domain name, rather than its owner.

The court considered the propriety of a U.S. court addressing a suit between two Canadian litigants and concluded:

Plaintiff may not be able to assert the same rights in Canada, which lacks a body of law equivalent to the ACPA and whose enforcement of its trademark laws cannot extend into the United States. Defendants suggest that Canadian intellectual property law, drawing upon recent English case law, might view the registration of a trademark-infringing domain name as an actionable trademark violation. This outcome is particularly likely, Defendants argue, in a case like the one at bar, involving both registration and use of the mark. However, Defendants' prediction of what the Canadian courts will do when presented with this issue is necessarily speculative and provides little support for the argument that Canada is a satisfactory alternative forum for this lawsuit.⁴

Once again, we have a U.S. court determining that it is better suited to address a Canadian dispute by applying U.S. law since it is unsure whether Canadian law will provide an effective legal remedy. The supposed inability of Canadian courts to address cybersquatting cases will come as news to litigants in recent cases involving domains such as *iTravel.ca*⁵ or *Saskatoonstar.com*.⁶ In both of these cases, Canadian courts had little trouble applying Canadian trade-mark law to alleged instances of cybersquatting.

Much like the courts and Congress, the export of U.S. law also comes in codes such as the *Uniform Computer Information Transactions Act* (UCITA), the controversial model code referred to by Professor Vaver in the context of its alteration of traditional copyright protection through the use of contracts. My interest in UCITA is jurisdictional in nature. In particular, its export to other jurisdictions in the form of a provision granting parties the right to choose UCITA law without any tie to a particular jurisdiction. Maryland became the first U.S. state to implement the UCITA provisions into state law.⁷ By invoking the UCITA provisions, an Ontario-based software company could conceivably choose the State of Maryland as its governing law and, by doing so, import the UCITA into Canada.

As we consider reforms to the Canadian IP law framework, we must remain mindful of the helpful review of Canada's place in the global IP law system that Professor Vaver provides, but also acknowledge that IP laws are no longer ours alone to make. Instead, IP laws co-exist in a complex global environment where the applicable law for those residing in Canada may not be Canadian law but rather the law of another jurisdiction, typically the United States. That reality presents us with a double challenge — first, identifying an appropriate IP policy framework for Canada, and second, ensuring that Canadian law and policy are the ones applied in Canada.

ENDNOTES

- 1 *Twentieth Century Fox Film Corp. v. iCraveTV*, No. 00-121, 2000 U.S. Dist. LEXIS 1013 (W.D. Pa. Jan. 28, 2000).
- 2 15 U.S.C. § 1125(d)(2)(C).
- 3 60 U.S.P.Q.2D 2018 (E.D. Va. 2000).
- 4 *Ibid.* at p. 2024.
- 5 [2001] O.J. No. 943 (Ont. Sup. Ct. 2001).
- 6 12 C.P.R. (4th) 4 (Sask. Q.B. 2001).
- 7 *Maryland Uniform Computer Information Transactions Act — Implied Warranty Exemption*, S. Bill 398.

Session II

The Global Nature of Intellectual Property

Bronwyn H. Hall
University of California at Berkeley and Oxford University

INTRODUCTION

IN HIS VERY INTERESTING STUDY written for this conference, Keith Maskus reviews Canadian patent policy in the light of changes in the treatment of IP in the United States and the rest of the world and he makes a series of recommendations concerning its future evolution. In general, I find myself in complete agreement with his suggestions. In this discussion, I will provide some additional context for two of his suggestions, specifically the recommendations against shifting to the recognition of broader claims and toward the U.S. standard on *burden of proof* in re-examination and litigation. I will also present evidence on the operation of the post-grant challenge system drawn from the U.S. and European experiences. I begin with a brief review of the *political economy* of IP protection before giving a more detailed comparison of the U.S. and European legal and administrative systems for patent enforcement.

THE POLITICAL ECONOMY OF IP PROTECTION

THE CENTRAL IP PROBLEM FOR MOST COUNTRIES TODAY is that IP laws are largely country-based, whereas competition and innovation is global. The implication is that regulation is carried out one level below where it ought to be. In this respect, IP policy is similar to antitrust or competition policy. The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs) pertaining to patent harmonization is an attempt to deal with the fact that competition in IP policies has something of a prisoner's dilemma: strengthening IP protection for its own inventors may benefit a single country (because it will attract innovative activity), but if all countries do it, there could be lower social welfare overall (if the strength of protection is greater than what is needed to achieve the *optimal* level of invention).

At the national level, the benefits and costs of stronger IP protection are conceptually simple: stronger IP rights provide stronger incentives for innovators and increase the potential for local (within country) R&D (research and development) spillovers. Costs take the form of higher prices due to the monopoly power created and the increase in the cost of follow-on innovation, which may reduce local R&D because of increasing transaction and other costs of acquiring prior technology.¹ Choosing an optimal national policy rests on weighing these costs and benefits.

The more difficult problem arises because the very externalities that lead a country to adopt an IP protection policy mean that the effects of the policy do not stop at the national border, nor are countries immune from the repercussions of other countries' policies. A country with a strong IP policy has increased the *global* incentive for innovation and the potential for spillovers, while at the same time reducing the *relative* incentive for innovative activity elsewhere, both by inducing R&D to move within its borders and by raising the cost of follow-on inventions elsewhere.²

Of course, the actual size of these cross-border effects varies enormously with a country's size, capacity for innovation and R&D, education levels, trade position, and even commercial language, with countries conducting business in English being privileged due to the prominence of that language in international patenting and scientific publications. Such factors mean that countries like the United States will be less impacted by developments elsewhere than smaller economies like Canada. The optimal national policy that takes account of international considerations may thus be quite different in various countries. Nevertheless, the collective view expressed in the TRIPs Agreement is that the harmonization of IP protection is desirable.

Although desirable in general, the harmonization of patent laws has proved difficult, mostly for political reasons, and it can sometimes be costly in terms of social welfare, both because of extreme differences among countries in the costs and benefits of IP protection and because harmonization generally proceeds by raising all countries up to the level of the country that has the strongest IP laws.

As an illustration of the difficulty of achieving harmonization, consider the European patent system: for approximately 20 years (since 1978), the European Patent Office (EPO) has offered a one-stop patent application for up to 20 European countries.³ This provides considerable harmonization across European countries up to the point where a patent holder wishes to enforce his patent. At this point he or she must turn to one of the 20 national court systems for enforcement; there is little harmonization in the litigation process, which varies substantially across countries.

An effort to create a true European Union (EU) patent that could be enforced at the European level failed in March 2002 at the Stockholm Congress,

in spite of near-universal demand for such an instrument on the part of European businesses. The problems appear to lie in the very different national court systems of European countries: creating such a patent requires harmonization of enforcement, which effectively requires extensive changes to national systems of litigation. This type of change is more difficult to achieve than patent harmonization itself. Specifically, negotiations were reported to have broken down because Spain and Portugal, who have very different legal systems, felt that their languages and national traditions were being overlooked.⁴

The tendency for harmonization to raise the level of protection is often observed: once a property right has been granted to a group of voters, it is extremely difficult to take it away, which means that it is far easier politically to strengthen that right in countries where it is weak than to weaken it in countries where it is strong. One example is the European database directive, an extremely strong piece of legislation that the U.S. federal government has been under some pressure to imitate.⁵ We have also seen the negative welfare effects that this levelling can have in its consequences for the marketing and sale of generic (lower cost) pharmaceuticals in developing countries when stronger patent protection is introduced.⁶

POST-GRANT CHALLENGES IN THE U.S. AND EUROPEAN PATENT SYSTEMS⁷

VARIOUS AUTHORS HAVE CRITIQUED several recent developments in the operation of the U.S. patent system, mostly on the grounds that these developments have increased the number of patents granted without a commensurate increase in social welfare.⁸ Controversies center on the following issues: 1) the expansion of patentable subject matter to include software, business methods, and gene fragments; 2) an apparent shrinking of the size of the inventive step required (especially in some new subject matter areas); 3) inadequate prior art search, again especially in new subject matter areas where there are no prior patents; 4) excessive claims breadth, and failure to supply enough information for someone skilled in the art to reproduce the patentable product or process.

Merges (1999) has argued that an improved post-grant opposition system in the United States, one that would look more like the EPO opposition system, could address some of these concerns. There is no doubt that competitors are often the best placed to supply prior art, especially in areas where there is little available in prior patents. In this section, I review the two systems and present some facts about their operation and outcomes.

Both the U.S. Patent and Trademark Office (USPTO) re-examination system and the EPO opposition system are designed to allow third parties to question the validity of a patent after it has been granted. In the United States, re-examination can be requested at any time during the life of the patent, whereas in the EPO system, the opposition must take place within 9 months of

the patent grant. The actual mean (median) lag between the date of the patent application and the date of the re-examination/opposition request is about 6(3.5) years in the United States and 5.9 (5.5) years in Europe; in the EPO's case, most of the delay is due to the lag in granting the patent so the distribution is much tighter. The U.S. system is an *ex parte* administrative proceeding, whereas the EPO system is an adversarial administrative proceeding. This difference probably accounts for most of the real differences between the two systems in take-up and outcomes.

As mentioned, the current U.S. process is initiated by a third party, but the resultant administrative proceeding is *ex parte*. The requestor's role is limited to an application for re-examination, as well as the right to receive a notice of the decision, a copy of the patentee's response, and the right to file a rejoinder to that response. The only admissible evidence is prior patents and publications, and the burden of proof rests on the applicant. A claim or patent can only be overturned if there is a substantial question of patentability. Any questions raised (or *which could have been raised*) during re-examination cannot be used again in litigation, which is a substantial discouragement to third parties who truly believe a patent is invalid. There are thus significant limitations to the U.S. re-examination system, and as a result it is rarely used, with a total take-up rate roughly equal to 0.3 percent of patents granted.

In contrast, the European opposition system is adversarial, initiated by any third party, usually a competitor. A patent may be challenged on any patentability grounds: novelty, inventive step or industrial application, and there is no limit on the nature of admissible evidence. Patent examiners hear the challenge, and if there is an appeal, it is heard by a panel of administrative judges. The process can be very slow, and occasionally litigation is delayed in order to wait for the outcome of the opposition proceeding. The average length of time until a case is closed is around 2-3 years, compared to 1.6 years for re-examination. The take-up rate is between 4 and 8 percent, with the higher rate characteristic of patents in the biotechnology/pharmaceutical area.

Table 1 summarizes the differences in outcomes between the U.S. re-examination system and the EPO opposition system. A priori, if the systems were the same, we might expect the EPO system to have more favourable outcomes for the patent holder because it is used more often, while the initiator is the firm that does not hold the patent (and presumably, only the most obvious cases are brought in the United States). In spite of this, the outcomes of the two systems are fairly similar. The main difference seems to be that more patents are revoked than are amended in Europe, whereas in the United States, patents are more likely to be confirmed, and least likely to be revoked. Further exploration of the effectiveness of these systems awaits the completion of the Graham, Hall, Harhoff and Mowery (GHHM) 2001 study.

TABLE 1

OUTCOMES OF EPO AND USPTO POST-GRANT CHALLENGES⁹

	EPO OPPOSITION – PHARMACEUTICAL/ BIOTECHNOLOGY	USPTO RE-EXAMINATION (STACY, 1997)	USPTO RE-EXAMINATION (GHHM, 2001)
	(%)		
Confirmed in Full	25	28	33
Amended	40	59	46
Revoked in Full	34	13	<22

CONCLUSION

IT WOULD BE VERY USEFUL to have a model of the interactions of different IP regimes in different jurisdictions, incorporating the costs and benefits of an IP system and allowing for the migration of R&D in response to the rights offered by a jurisdiction. This would allow us to better assess the global optimality of the array of IP systems currently in use around the world and their interplay.

In setting Canadian patent policy, it is important to consider related events in the United States. There is considerable backlash in various quarters to the apparent subject matter expansion of the past 10-15 years and its consequences on the ability to search prior art. The U.S. Patent Office has responded by requiring an extra layer of examination for business method patents and the U.S. Congress has responded by legislating a specific prior use exception for these patents. It is likely that things will continue to evolve in this area.

A final thought: because it is sometimes difficult to get the genie back into the bottle, it may be advisable to move slowly in expanding and strengthening IP rights.

ENDNOTES

- 1 See Heller and Eisenberg (1998) on this topic in biotechnology, and Hall and Ziedonis (2001) on semiconductors.
- 2 For evidence that this factor matters, see Bloom, Griffith and Van Reenen (1998), who show that changes in the relative tax-adjusted prices of R&D across countries induce cross-border movements in R&D spending. On this point, see also Hall and Van Reenen, 2000.
- 3 Countries currently covered are the 15 EU members plus Cyprus, Liechtenstein, Monaco, Switzerland and Turkey. The protection conferred by European patent applications and patents can also be extended to a number of central and eastern European states.

- 4 See James, 2001. Currently, EPO applications may be submitted in one of three languages, English, French or German, and presumably there is also substantial resistance to changing that requirement to be more inclusive.
- 5 See Maurer and Scotchmer, 1999, for more information on this question.
- 6 See Lanjouw, 1998, for a discussion of this issue.
- 7 This section draws extensively on joint work with Stuart Graham, Dietmar Harhoff and David Mowery (see Graham, Hall, Harhoff and Mowery, 2001).
- 8 See Merges (1999), Hunt (2001), and Heller and Eisenberg (1998), among others. Some of these developments can be traced to recent and not-so-recent court decisions that have been incorporated into patent office practice. See Quillen, 2001.
- 9 See Graham, Hall, Harhoff and Mowery, 2001, for more information.

BIBLIOGRAPHY

- Bloom, Nicholas, Rachel Griffith, and John Van Reenen. 1998. *Do R&D Tax Credits Work? Evidence from an International Panel of Countries 1979-1994*, Institute for Fiscal Studies, Working Paper No. W99/08.
- Graham, Stuart J.H., Bronwyn H. Hall, Dietmar Harhoff and David Mowery. 2001. University of California at Berkeley, Oxford University, and Ludwig-Maximilians Universitaet Muenich. Work in progress.
- Hall, Bronwyn H., and Rosemarie Ham Ziedonis. 2001. "The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-1995," *Rand Journal of Economics* 32: 101-128.
- Hall, Bronwyn H., and John Van Reenen. 2000. "How Effective are Fiscal Incentives for R&D? A New Review of the Evidence," *Research Policy* 29: 449-469.
- Heller, Michael A., and Rebecca S. Eisenberg. 1998. "Can Patents Deter Innovation? The Anticommons in Biomedical Research," *Science* 698, May 1.
- Hunt, Robert M. 2001. "You Can Patent That? Are Patents on Computer Programs and Business Methods Good for the New Economy?" *Philadelphia Federal Reserve Bank Business Review*, Spring.
- James, Barry. 2001. "Agreeing on Little, EU Leaders Muddle Ahead," *International Herald Tribune*, March 26.
- Lanjouw, Jean O. 1998. *The Introduction of Pharmaceutical Product Patents in India: 'Heartless Exploitation of the Poor and Suffering'?*, National Bureau of Economic Research, Working Paper No. 6366.
- Maurer, Stephen M., and Suzanne Scotchmer. 1999. "Database Protection: Is It Broken and Should We Fix It?," *Science*, 284: 1129.
- Merges, Robert P. 1999. "As Many as Six Impossible Patents Before Breakfast: Property Rights for Business Concepts and Patent System Reform," *Berkeley High Technology Law Journal* 14: 577-615.
- Quillen, Cecil D., Jr. 2001. *The Patent System: Is it Broke? And Who Can Fix It, If It Is?*, Presentation to the Spring Meeting of the U.S. Association of General Counsels, May 12.
- <http://www.european-patent-office.org>
- <http://www.uspto.gov>

Session III

Intellectual Property Rights and Economic Performance

Donald G. McFetridge
Carleton University

MY TASK IS TO COMMENT on two econometric studies, by Park and by Gallini, Putnam and Tepperman (GPT), respectively, and on a survey study by Raffiquzzaman and Ghosh (RG). The first part of the survey study covers recent empirical studies of IP and it links quite well with the two econometric studies. My discussion focuses on the empirical component of the survey study and the two econometric studies.

The RG study sets the tone for the session. In the view of these authors, there is a need among policy-makers for much more empirical work on the effects of IP rights on innovative and creative activity. It is apparent from these studies, however, that while empirical work on IP rights has come a long way since the early days of regressing patents on things, and things on patents, there are still formidable challenges to overcome in obtaining empirical results that are sufficiently precise and robust for policy purposes.

There are a number of common themes in the three studies on which I am commenting. One is the recognition that empirical work should be grounded in a formal optimizing model. A second is the recognition that disaggregation is essential. A third theme is the recognition of the potential interdependence between decisions to seek various forms of IP protection in various countries and decisions regarding R&D, exports, foreign direct investment and licensing.

IP RIGHTS IN OPTIMIZATION MODELS

RECENT EMPIRICAL WORK proceeds on the premise that the innovation and diffusion decisions and the decision regarding which IP rights, if any, to rely on are made on the basis of economic self-interest and are conditioned by the strength of IP rights.

As for the role of underlying optimizing models, the RG study cites insights on the relationship between various characteristics of IP rights (especially patents) and innovative behaviour derived from game theory models.

In Professor Park's study, the profit-maximizing domestic R&D investment decision depends on the stock of R&D and the strength of domestic IP rights. Domestic R&D investment, together with investment in physical capital and the strength of national IP rights, then determines the national rate of growth in labour productivity. The implication of this formulation is that the strength of domestic IP rights influences national productivity both *directly* and *indirectly* by influencing domestic R&D investment. The channel of direct influence is not specified. It could be that stronger national IP rights encourage the diffusion of foreign innovations via imports, foreign direct investment or licensing.¹

The GPT study begins with an optimizing model where the number and quality of domestic R&D projects depends on the strength of domestic and foreign IP protection. The study does not test the model. Instead, it tests and accepts the hypothesis that the probability that an invention originating in country *i* will be patented in country *j* depends on the strength of IP protection in destination country *j*. The study leaves the nature of the resulting benefits to the patentee and the nature of the benefits, if any, to the destination country.

DISAGGREGATION

IT HAS LONG BEEN UNDERSTOOD that meaningful empirical work on IP rights requires disaggregation. The studies emphasize the number of dimensions over which disaggregation may be appropriate.

Of course, there are different forms of IP. While innovators sometimes have the choice of IP right or combination of IP rights to use, individual IP rights normally apply to different creative or innovative activities. What constitutes a stronger right and the response it evokes vary from right to right.

As both RG and Park emphasize, an IP right is itself a bundle of characteristics. Some characteristics such as the duration or term of the right are readily measurable and the consequences of changing them have been much studied. Other characteristics such as patent breadth are, as RG note, open to a variety of interpretations. The consequences of increased breadth depend on the other characteristics of the right (priority rule, disclosure requirement) and we are less sure about the behavioural consequences of changing them. While there appears to be a rough consensus on the directional effect on the strength of an IP right of changes in most of the characteristics of the right, there is much less agreement on the weights of these characteristics. As a consequence, when a reform package weakens an IP right in some respects and strengthens it in others, there may be some dispute as to its net effect. GPT provide an example of this (repeal of compulsory licensing with a reduction in the novelty requirement).

Indeed, the Park, RG and GPT studies disagree about the net effect of the 1989 patent reforms in Canada, with Park and RG saying that they were *pro-patent* and GPT remaining agnostic.

While the construction of summary indexes of the strength of national IP protection is problematic, the exercise is nevertheless instructive. It forces us to think about the many possible dimensions of an IP right. The discussion of the construction of such indexes is one of the most useful features of Park's study.

The strength of national IP rights may depend on the quality of national legal institutions as well as on the characteristics of the rights themselves. It is well understood that the marginal effects of stronger IP rights can differ from country to country. The implication is that the characteristics of the ideal IP right or set of IP rights, viewed either from a national or a global perspective, can differ from country to country as well.

As RG note, innovation takes many forms and IP is used for different purposes in different industries. For example, in some industries there would be little innovation without IP protection. In others, the IP right is merely an added bonus. In still others, it may be completely irrelevant. It has been understood at least since the work of Nordhaus (1969) that the characteristics of the ideal IP right, or indeed the ideal set of IP rights, vary from industry to industry.

Both econometric studies recognize the need to disaggregate. Professor Park disaggregates both by type of IP right and by industry. GPT disaggregate by industry. GPT find that the propensity of foreigner patentees to patent in Canada is highest in the two-digit manufacturing industries where, in their view, Canada is strongest. This may imply either that Canada poses a greater threat of imitation or offers greater potential for ongoing collaboration, or both, in these industries. Their disaggregated analysis also leads them to recognize that the observed relationship between the propensity of foreigners to patent in a country and the strength of its patent right may be at least partly spurious. For example, the patent-intensive industries of a destination country with a stronger patent right may be larger and/or more successful or be more closely matched with source-country industries.

The aggregate analysis of IP rights can be misleading. The Park and GPT studies illustrate the potential pitfalls of using countries or two-digit industries as sample observations. RG find that the results of a theoretical analysis of IP rights are highly contextual. Empirical analysts should take heed. There is much to be said for the analysis of specific characteristics of individual IP rights within the context of a specific national legal and economic environment. While there is always a place for statistical analysis of big databases, inter-country or inter-industry cross-section data are unlikely to yield parameter estimates that are stable when disaggregated into smaller cross-sections.

JOINT DEPENDENCE

THE STRENGTH OF IP RIGHTS may both determine and be determined by economic conditions. Park notes that countries in the earlier stages of economic development tend to have weaker IP rights. Countries with strong and enforceable property rights in general may also have stronger IP rights. The strength of national IP rights may also depend on a country's industrial composition. International differences in productivity growth may, in turn, be a function of the stage of economic development, the general strength of property rights and industry mix. The implication is that there is a danger in attributing productivity growth to strong IP rights when it is due, at least in part, to other national characteristics.

The decision by an innovating firm to seek IP protection may be made jointly with other investment and marketing decisions. GPT note that the decision to seek patent protection in a foreign country may both determine and be determined by the value of exports to that country. This joint dependence could extend to other decisions. The decision to seek IP protection in a foreign country could determine and be determined by the extent of foreign direct investment or licensing in that country. GPT reject the hypothesis of joint dependence between the propensity to patent and trade in the context of their model but the conceptual possibility remains.

CONCLUSION

PARK'S STUDY EXPLORES TWO LINKS between the strength of national IP protection and national productivity growth. The first link is through domestic R&D. Park finds that countries with stronger IP rights are more R&D-intensive. This finding is not supported by the time-series results surveyed by RG. These authors conclude that, within individual countries, increases in the strength of IP rights are not accompanied by increases in R&D or, more broadly, innovative activity.

The second link explored by Park is said to be direct. The nature of the direct link is not specified but it may involve increased access to foreign technology. Whatever the channel through which the direct linkage operates, Park finds that it has no effect on aggregate productivity growth. It does have an effect on industry-level productivity growth, but it is not clear what this means. It could mean that countries with strong IP protection have more of the industries with the fastest productivity growth, or that productivity growth in a given industry is faster in countries with stronger IP rights.

The GPT study explores the effect of stronger patent rights in destination countries on the propensity of foreigners to patent in those countries. The study finds that stronger patent rights in destination countries do attract more foreign patentees. The consequences of this are not explored. The study hints that this might result in increased international technology transfer but it could conceivably result in less.

The RG study surveys existing empirical work on IP and calls for more. My impression after reading these studies and some of the studies they cite is that more insight might be gained from case studies properly grounded in theory than from cross-sectional econometric studies.

ENDNOTE

- 1 The *direct* effect of the strength of domestic IP rights could also be negative, implying that while stronger national IP protection stimulates domestic R&D, it also restricts diffusion.

BIBLIOGRAPHY

Nordhaus, W.D. 1969. *Invention, Growth and Welfare*. Cambridge (Mass.): MIT Press.

Session IV

Emerging Intellectual Property Issues

Wesley M. Cohen
Duke University

I WILL CONSIDER THE THREE STUDIES presented in this session in turn. Graham and Mowery's (GM) *Intellectual Property Protection in the U.S. Software Industry* provides a crisp history of the development of the U.S. software industry and the evolution of IP rights for software since 1945. In this study, the authors make the important point that the evolution of the industry can itself affect IP policy, suggesting that the latter is endogenous. An implication of this point is that studies such as Walter Park's *Do Intellectual Property Rights Stimulate R&D and Productivity Growth?*, presented at this conference, that show a relationship between the *strength* of IP protection and productivity growth cannot be interpreted as showing causality running from the former to the

latter if innovation-led growth might actually induce nations to strengthen their IP policies (or if some other variable drives productivity growth and IP policy).

GM's study also quantitatively documents, for the first time, a shift among software producers from the use of copyright to the use of patents to protect software. While GM suggest that such a shift may strengthen markets for software technology, I think that is not apparent. Although it is true that patents are better at preventing 'inventing around' than copyright, and thus may offer better protection for licensing, patenting may also give rise to transaction costs that can act as a break on market exchange.

GM show rapid growth in software patenting as a percentage of all U.S. patents through 1997 in the 11 software-related IPC (International Patent Classification) classes that they examine. The patenting activity in these classes grew from 1.55 percent of all U.S. patents in 1984 to 3.85 percent in 1997 — which is impressive in light of the fact that annual patents issued almost doubled during the same period. They also find that large software firms' *patent propensity* (patents divided by R&D) and share of software patents has grown through the same period. While posing the question of why this may be the case, the study does not provide an explanation for this growing prominence in large-firm software patenting.

Despite the rapid growth in patenting by software firms, large software firms in particular, we need to recognize a point that the study does not underscore sufficiently. The share of software patents represented by the 100 largest packaged software firms is small — 3.25 percent of software patents in 1997, and only 0.7 percent in 1996 if Microsoft is dropped. It is actually electronics firms, and particularly IBM, who are patenting the most in the 11 IPC categories examined by GM. And these 11 categories do not even include embedded software where one would expect electronics firms to dominate all the more. IBM alone accounted for 25 percent of software patents in these 11 categories, and major electronics firms together accounted for almost 50 percent. The study shows that while specialized packaged software firms have grown the fastest, they were late to the game, especially compared to IBM. These figures suggest an explanation for the growing prominence of large software firm patenting noted above, namely that it may reflect a defence against the attempts of large electronics firms to garner a greater share of rents from software.

GM also address the issue of the quality of software patents. One of the most vexing issues linked to software patents is the location of prior art. The problem is that prior art in software is often not documented in any publicly accessible form, either in earlier patents or in the literature. The question is whether the issue of the location of prior art — and its impact on patent quality — will be an enduring problem or a transitional one that will diminish once the U.S. Patent and Trademark Office gains more experience with software patents, and the cumulative record of previously patented software innovations grows. In the absence of an

explicit attempt to build a library of software *art* extending well beyond patented software, I suspect the problem will endure, and could perhaps be best remedied, as suggested in Mowery's presentation of the study, by the creation of a post-grant opposition process. I suspect that software patents will yield an insufficient record of past innovation once one recognizes that not even half of all product innovations in the manufacturing sector are patented — and not even 40 percent of innovations in the computer industry, and far fewer process innovations (Cohen, Nelson and Walsh, 2000).

GM try to assess trends in the quality of software patents by examining the two-year forward citations to the patents of the top 100 software firms relative to the citations to all software patents in the 11 categories examined. They claim that this measure reflects, if anything, a slight uptrend. The trouble with such a measure, however (as noted by the authors), is that it does not reflect the quality of software patents as a whole. It only looks at the citations to the top firms' patents relative to the citations to all software patents in the categories examined. However, there is a more fundamental problem with a citation-based measure of quality for a newly patentable subject matter such as software. During an adjustment period when firms are just learning how to patent, one would normally expect citations to increase as applicants become more adept at searching for prior art. Nonetheless, how could we explain the modest uptrend observed by the authors? One possibility is that firms may simply pay more attention to the past patents of larger firms — especially in light of the greater ability of these firms to sue.

As highlighted in GM's study, the patentability of software has been controversial and the logical question is whether software poses unique challenges as patentable subject matter. Software features include dispersed development and use, modularity, cumulativeness, rapid change, the difficulty of locating prior art and the availability of other legal protection, namely copyright. While all these features have social welfare implications for the application of patent policy to software, it is not clear that software is different in kind from other patentable subject matter, though it may be different in the degree to which some of these features apply. In the end, the controversy surrounding the patenting of software, particularly the recent court affirmations of the patentability of software-enabled business methods, is that it comes closest to the patenting of disembodied ideas rather than either things or the way things might work.

Maurer's study, entitled *Across Two Worlds: Database Protection in the United States and Europe*, considers the recent European Union (EU) directive to provide *sui generis* protection to database owners. The study provides useful taxonomies for different types of databases and providers (e.g. portals, gatherers and refiners). It also constructs the first systematic dataset on the subject, organizing databases by type and provider. A key question posed by the study is why is such *sui generis* protection needed, particularly in light of the numerous

existing alternative legal, technical and strategic mechanisms offering protection to databases? The impetus behind the directive is not clear. One rationale reported by the study is that government database budgets are politically unsupportable in the long run. However, this premise is tenuous and applies differentially across the OECD (Organisation for Economic Co-operation and Development). The key question posed by the study is: How will the directive impact the development and use of databases?

The study considers whether the directive has affected incentives to create new databases, which presumably is a key policy rationale for IP protection. The anecdotal evidence apparently suggests little or no effect — only the addition of an *extra layer of protection*. The study shows that the number of new European providers experienced only a one-year spike. The data marshalled by the study surely makes one wonder why we do not see more of an effect. One also wonders if there is a parallel with patents here, particularly in the light of findings by others that patents effectively protect inventions in only a small number of industries, while firms apparently rely more heavily on other mechanisms such as lead-time advantage, complementary manufacturing or marketing capabilities and secrecy. Perhaps in the numerous industries where patents are not central to the appropriability strategies of firms, they too may only represent an extra layer of protection.

Maurer considers the case against database protection, focusing especially on the prospects for distortions due to *excessive monopolization* (excessive charges leading to underuse) and interference with data aggregation, which affects a broad range of uses that are of particular interest to the scientific research community. While some evidence is offered to support both charges, it remains incomplete (which is unsurprising given the recent advent of database protection), though no more so than the evidence offered on behalf of such protection to begin with. The author has provided a wealth of well organized information on databases and their providers. To consider the welfare implications of database protection more fully, we also need a systematic evaluation of the impact of the directive on the use of databases in Europe. However, such data will be difficult to collect.

Maurer suggests that there is little reason for Canada and the United States to follow the European lead on database protection. I would agree. Rather, with little apparent cost, they can exploit the current European experiment in *sui generis* database protection by monitoring its impact on the generation and use of databases.

Lazarus' study, entitled *On the Role of Patenting in Innovation for the Biotechnology Industry in Canada*, considers the straightforward though challenging question of whether patents stimulate innovation in biotechnology. In the empirical economics literature, there is no answer to this question for any industry, no less for the manufacturing sector as a whole. Indeed, the prior work of Scherer, Herzstein, Dreyfoos, Whitney, Bachmann, Pesek, Scott, Kelly and Galvin (1959),

Mansfield (1986) and Levin, Klevorick, Nelson and Winter (1987), along with recent findings of Cohen, Nelson and Walsh (2000), certainly provides a basis for skepticism. This work has found that in a preponderance of manufacturing industries, patents are not very effective for protecting inventions. Rather, firms tend to use other means to protect their inventions, including secrecy, lead-time advantage, and the exploitation of complementary marketing and manufacturing capabilities. However, the drug industry is a notable and robust exception to this finding. Patents are apparently effective in protecting the licensing and commercialization of innovations in the drug industry. While these prior findings suggest that patents are *relatively* ineffective, they do not show that patents do not stimulate innovation.

Lazarus' selection of biotechnology for examining the impact of patents on innovation offers both a disadvantage and an advantage. As noted above, the drug industry, including biotechnology, is unique because patents work relatively well in that industry. As a consequence, any results from biotechnology cannot be generalized. On the other hand, if patents do not stimulate innovation there, then where? Thus, biotechnology can provide a possible 'existence statement' for the impact of patents on innovation.

Lazarus' basic argument is that R&D and patenting are mutually determined, contrary to other models. It is simple to see that R&D generates inventions that are patented. Lazarus argues that, at least in biotechnology, patents allow firms, particularly small ones, to raise the capital necessary to finance their R&D. Thus, R&D and patents should be conceived as mutually determined. While I would agree with that broad suggestion, I would generalize Lazarus' argument on the basis of the literature. As for the causal link running from patents to R&D, if patents increase the appropriability of profits from invention, they should indeed stimulate R&D. In circumstances where patents increase such appropriability, they can also be used to secure capital, but that is not the key to the story. The important question is whether patents effectively increase the appropriability of rents from protected inventions. Thus, I am suggesting a simultaneous system where R&D and patenting are jointly determined, and the key is the contribution of patents to appropriability.

Lazarus' empirical results are rather mixed. Some are also subject to alternative interpretations. For example, in one specification, he finds that patent applications increase with R&D per employee. Rather than reflecting an effect of patenting on R&D, a modest reformulation of the result suggests that it is equivalent to the stylized fact of Scherer and others about decreasing average patent productivity (patents per R&D dollar) with firm size (employees). While some have interpreted this result as suggesting that smaller firms are more innovative than larger ones, it more likely reflects an appropriability advantage of large size in most industries (Cohen and Klepper, 1996). Some of Lazarus' results are also interesting and sensible. For example, he finds that alliances substitute

for R&D, at least among large, publicly traded firms. I believe this. However, does Lazarus answer the main question, namely whether patents stimulate innovation in biotechnology? Alas, not. But, I would encourage a continuation of these efforts. They are on the right track.

BIBLIOGRAPHY

- Cohen, W.M., and S. Klepper. 1996. "A Reprise of Size and R&D." *Economic Journal* (July).
- Cohen, W.M., R.R. Nelson and J. Walsh. 2000. *Protecting their Intellectual Assets: Appropriability Conditions and Why Firms Patent (or not) in the U.S. Manufacturing Sector*. National Bureau of Economic Research, Working Paper No. 7552.
- Levin, R.C., A.K. Klevorick, R.R. Nelson and S.G. Winter. 1987. "Appropriating the Returns from Industrial R&D." *Brookings Papers on Economic Activity*, 783-820.
- Mansfield, E. 1986. "Patents and Innovation: An Empirical Study." *Management Science* 32: 173-181.
- Scherer, F.M., S. Herzstein, Jr., A. Dreyfoss, W. Whitney, O. Bachmann, C. Pesek, C. Scott, T. Kelly and J. Galvin. 1959. *Patents and the Corporation: A Report of Industrial Technology Under Changing Public Policy*. 2nd ed. Boston (Mass.): Harvard University, Graduate School of Business Administration.

Session V

Intellectual Property in Practice

Ajay Agrawal
University of Toronto

THE FOLLOWING REMARKS WERE PREPARED for the *International Conference on Intellectual Property and Innovation in the Knowledge-Based Economy*, held May 23-24, 2001 in Toronto, Canada. A version of the remarks was presented as part of a panel discussion entitled *Intellectual Property in Practice*, chaired by Maureen Dougan, Chief Operating Officer of the Canadian Intellectual Property Office (CIPO). The author of these remarks was the discussant of two studies: *Current Intellectual Property Protection Practices of Manufacturing Firms in Canada* by

Petr Hanel, of the University of Sherbrooke, and *Managing Intellectual Property Rights from Public Research* by Bénédicte Callan and Mario Cervantes, of the OECD.

These studies are both interesting and provoke serious thought on a variety of issues concerning the use of IP. At the same time, they differ in terms of the questions they consider and the style of research they present. The objective of the former study is to test a series of hypotheses about the relationship between the characteristics of firms and their propensity to innovate and to use IP. The objective of the latter is to describe variations in IP policy at the institutional and national level and discuss ways in which these may result in variations in the propensity to commercialize. The first study focuses on Canadian manufacturing firms while the second focuses on OECD countries.

The authors use quite different sources of information and analytical techniques to address their respective objectives. Hanel uses data from Statistics Canada's Survey of Innovation (1999) to test two sets of models. First, he tests an innovation model which uses a logit specification to predict whether a firm innovates as a function of its size, competitive conditions, reputation, R&D, government support, sector, and home province. The sample size (weighted N) is 8,509 firms. He finds no relationship between the likelihood that a firm will innovate and its size. However, he does find statistically significant relationships for the other dimensions. In summary, he reports that firms are more likely to innovate if: 1) they are in the *core* sector (technology-oriented), 2) they conduct R&D, 3) they use government assistance (e.g. R&D grants, R&D tax credits, etc.), 4) they develop new markets for their products (inside Canada and outside), and 5) they protect their IP through patents, trade-marks or trade secrets.

Next, Hanel tests an IP model based on a series of logit specifications to predict the use of IP rights. With data from the same sample, he shows that firms are more likely to use IP rights if: 1) they are large (more than 500 employees), 2) they perform R&D, 3) they have introduced *world-first* innovations, and 4) they are the beneficiaries of government financial assistance. In addition, the author reports that firms are more likely to use patents if they introduce product innovations, but to use secrecy, confidentiality and trade-marks if they introduce a combination of product and process innovations.

Callan and Cervantes' study takes the form of a descriptive essay that does not include an empirical analysis, and thus does not utilize quantitative data. Rather, the authors present a general overview of important issues concerning IP rights across OECD countries that specifically affect public research organizations (PROs) and may influence their incentive or ability to commercialize their research. In particular, they review the following: 1) significant changes in IP rights over the past three decades, 2) challenges faced by PROs as they move toward more aggressive commercialization strategies, 3) emerging best practices at both the national and institutional level for commercializing public IP, and 4) evaluation methods for measuring the success of IP commercialization strategies.

The authors identify several interesting trends in IP rights across OECD countries and draw some conclusions regarding the role of public policy in this area. Perhaps the most striking observation is the degree to which IP rights have harmonized and continue to do so. However, the authors note a significant variance across countries in national guidelines about title to publicly funded research results. They believe that central governments have a very important role to play in setting clear guidelines in this area. They suggest that central governments can provide incentives (and assistance) for the formation of technology licensing and transfer offices associated with PROs, since this is a long-term investment that may generate local spillovers.

At the institutional level, Callan and Cervantes argue that PROs must move from passive IP administration to strategic IP management in order to fully exploit the output of public research, but they are cautious to include caveats regarding the respect for the open scientific process and sensitivity toward potential conflicts of interests. Finally, the authors suggest that there may be a role for central governments to assist with the collection of data and the dissemination of best practices in parallel with organizations such as the Association of University Technology Managers.

It is clear from the brief summaries above that these are two very different studies, although they address issues related to the same general topic: intellectual property. Given this commonality at a very general level, the remainder of these remarks addresses common threads that run through both studies. Commonalities are found on five conceptual fronts: 1) performance optimization, 2) learning/bounded rationality issues, 3) efficiency impediments, 4) assumption caveats, and 5) policy implications.

Performance optimization issues ultimately motivate both studies. Hanel's study examines manufacturing firms that are assumed to be profit maximizers. Callan and Cervantes' study examines OECD countries and PROs. Countries are assumed to be welfare maximizers. PROs are, theoretically, more complex since their objective functions include multiple optimization parameters—research productivity, education, and arguably revenue in some cases. How is innovation specified in these objective functions? How are IP rights specified in these objective functions? Both studies offer valuable contributions to improve our understanding of these issues at the levels of the firm, the PRO and the central government.

In much of the economics literature, optimization refers to efficiency gains from sophisticated *fine tuning*. However, both studies suggest that this is not true in the case of IP rights. Instead, they indicate that firms, PROs, and governments are still very much learning how to effectively use IP rights such that, in most cases, first-order gains are possible simply by learning how to use IP. Hanel states that to innovate successfully, firms must not only learn how to conduct R&D, they also have to learn to use IP rights efficiently and combine them with other appropriation strategies. Similarly, Callan and

Cervantes state that the Association of University Technology Managers and the Association of European Science and Technology Transfer Professionals offer platforms for public research institutions to share best practices. The studies suggest that firms and governments may be greatly rewarded from strategies and policies that simply increase the rate of learning about mechanisms, costs and benefits associated with IP rights.

In addition to learning, both studies discuss efficiency impediments that limit the optimization potential. At the government level, the trend toward harmonization increases potential gains due to lower transaction costs associated with international trade, especially in some industries and countries. However, countries have different initial endowments and thus common policies benefit them to varying degrees such that the trend may, in some cases, reduce the overall optimization potential. At the PRO level, organizations face the difficult task of optimizing multiple objective functions that often conflict with each other. The temporary monopoly awarded to patent holders that is the basis of IP economics is in direct conflict with the notion of open communication that is the cornerstone of the scientific community.

At the firm level, some types of firms use IP rights more than others. This may be partly due to the limited nature of IP protection mechanisms. For example, patents are considered a rather blunt IP protection mechanism due to its *one size fits all* nature. Also, the product lifecycle of software is very short relative to the time required for patent examination and many software innovations are long obsolete before the 20-year patent protection period expires. Thus, very substantial efficiency gains remain possible from policy development in this area.

A few basic assumptions implied in these studies may be overlooked by the reader, but may have a significant impact on the analysis of central questions. Foremost is the assumption regarding incentives to innovate. The primary reasoning behind patents is that they offer a temporary monopoly to inventors that gives them with the incentive necessary to innovate. At the same time, it is recognized that such monopolies may have negative effects on overall welfare by stifling further innovation. This is why those monopolies are only temporary. However, is it true that inventors need the incentives from monopoly protection in order to innovate? Certainly, in the case of PROs studied by Callan and Cervantes, there is a long history of productive scientific research without such incentives. Of course, they focus on the commercialization of publicly funded inventions. While previous work has suggested that IP rights increased the propensity of PROs to patent in the United States, no conclusive evidence that IP rights increase the likelihood of successful commercialization has been published. So, this assumption must be viewed with caution.

The second assumption is that there is indeed a conflict between commercialization objectives (patenting) and scientific objectives (publishing), especially in the context of PROs. To the contrary, Agrawal and Henderson

(2002) examine a group of engineering professors at MIT over a 15-year period and find no evidence of a *trade-off* between patenting and publishing. This study does not present conclusive evidence, but does raise uncertainty regarding this controversial trade-off. Third, the assumption that stronger IP regimes stifle diffusion must be tempered by the consideration that a common alternative, particularly for private sector science, is secrecy. Although patented inventions receive a temporary monopoly, they are published such that their ideas are made available in the public domain. Policy debates will benefit from a questioning of these assumptions.

Finally, both of these studies inspire a number of policy questions regarding IP rights. Hanel examines the variation across firms in their propensity to innovate and their propensity to use various IP instruments, and he studies this variation as a function of characteristics of the firm and its environment. Important policy questions that are motivated by this work include: Why do some Canadian firms have a higher propensity to use IP than others? How do policy instruments influence this variation? Is the current distribution of IP use optimal from the perspective of the firm? Is it optimal from the perspective of society?

Callan and Cervantes report on variations in IP policies across OECD countries that affect PROs. This work motivates a number of interesting questions such as: Why might we observe variance in IP policies for publicly funded research across OECD countries? Why might we observe harmonization (lack of variation)? In what ways might countries benefit from a comparative advantage due to variations in their IP rights?

Finally, it is worthwhile to consider implications for Canadian IP policy. In general, the objective of IP policy is to optimize: 1) the incentive to innovate and 2) the diffusion of knowledge. However, the incentives for Canadian inventors to innovate are far greater from U.S. IP rights than from their Canadian counterparts, since the United States offers a much larger market. As a result, Canadian IP policy could afford to focus more on optimizing the diffusion of knowledge. If this is true, how might it result in conceptual differences between policies adopted by the two countries? Specifically, how might Canadian policy take advantage of this asymmetry?

The studies by Hanel and by Callan and Cervantes are interesting and important, especially since IP is an increasingly critical asset for firms and nations that compete in the knowledge-based economy.

BIBLIOGRAPHY

- Agrawal, Ajay, and Rebecca Henderson. 2002. "Putting Patents in Context: Exploring Knowledge Transfer from MIT." *Management Science* 48:1 (January) 44-60.

Michael Erdle,
Deeth Williams Wall LLP, Toronto

THE DEGREE OF PROTECTION AFFORDED IP has a direct effect on the value of innovation. Therefore, the policy decisions made by government and the enforcement decisions made by the courts act as an incentive or disincentive to innovation.

The studies reviewed illuminate some of the key factors that will determine Canada's success in the global innovation economy.

Garland and Want cite several reports on the commercial importance of IP. Additional support can be obtained from financial publications, which regularly report on mergers and acquisitions driven largely by innovation and IP. But the direct value of IP rights simply scratches the surface. The IP system is a cornerstone of the innovation infrastructure that includes academic research and the manufacturing and services sectors. All sectors of the economy are affected. For example, Canada's agriculture and natural resources industries — perhaps regarded by many as *low-technology* sectors of our economy — are world leaders in innovation and IP.

The usual justification of IP rights is that it is a social contract between the state and innovators intended to encourage innovation. Paquet and Roy state that IP rights represent a balancing of interests (society's interest in innovation vs. the innovator's interest in obtaining a monopoly on her or his work). The author would agree, but would add that the interests to be balanced are primarily commercial in nature. It is no coincidence that the Canadian Intellectual Property Office is part of Industry Canada and that the United States Patent and Trademark Office is part of the Commerce Department. When IP rights are treated as a tool of social or cultural policy, the results are rarely beneficial, from either a social or an economic perspective. IP rights are, and should remain, primarily a tool of commercial and competition policy.

Therefore, these comments will consider some points raised in the two studies primarily from a commercial perspective, and from the author's personal perspective as a business lawyer.

PUBLIC AWARENESS

PAQUET AND ROY NOTE A LACK OF UNDERSTANDING of the different forms of IP rights in Canada and other countries. A recent example may help illustrate the problem. The author happened to hear a broadcast of *As It Happens* on

CBC Radio on May 15, 2002 in which the presenter managed to demonstrate a hopeless confusion among patents, trade-marks and copyright in the course of a 30-second introduction. To those who know anything about IP, it may seem comical to hear someone talk about copyrighting human gene sequences or obtaining a trade-mark on an animal, when the issue under discussion was the patentability of higher life forms. But the resulting muddle completely undermined the credibility of the interview. Members of the public who heard the program would have left no wiser about the serious issues being discussed. In the author's view, it is essential that innovators, researchers, the public, the media, and government all become more knowledgeable about all forms of IP in order to make meaningful policy decisions.

The author heartily agrees with Paquet and Roy's recommendation that CIPO take a pro-active role in developing an environment and framework in which strategic relationships can flourish among government, business and research institutions. One would also encourage the involvement of industry and professional associations in that process. In addition to the groups referred to in the study, we would mention the Information Technology Association of Canada, representing the IT industry, and the Intellectual Property Institute of Canada (IPIC), representing the IP profession.

IP professionals and service providers also have a vested interest in fostering awareness of IP and an innovation environment. As Paquet and Roy correctly point out, this will increase the need for their specialized services. But beyond that, such an environment will foster a greater appreciation for these services. It will encourage academic institutions to devote more resources to training service providers. It will help to create a robust infrastructure, which, in turn, will generate more intellectual and financial resources to foster and encourage innovation.

IPIC has established partnerships with McGill University to deliver training programs to IP professionals. It works in co-operation with CIPO to train and qualify patent and trade-mark agents. More of such co-operative ventures are needed among government, academic institutions and the private sector to develop the innovation infrastructure in a knowledge-based economy.

In many ways, the development of a knowledge-based economy is like the introduction of a new technology. There must be a critical mass of innovators and users and a supporting infrastructure before real change can occur. One might consider the introduction of the fax machine as an example. At first, these machines were expensive, slow and without common standards, so very few people had one and their use was limited to specific point-to-point transmissions. As costs fell and performance improved, fax machines became more common, but they were still limited to business use. But the increase in number generated a *network effect* which quickly increased the utility of the technology at the same time as it continued to drive down prices. Fax machines have now

become ubiquitous and essential at the same time. In other words, when only a few people have a technology, there is little reason for others to invest in it, either as innovator or as user. But once everyone has the technology, then everyone needs it and (virtually) everyone can afford it.

ADMINISTRATION OF IP RIGHTS

Patents

WHILE THE SPEED OF EXAMINATION and the timely issuance of patents are important, we would argue that the quality of the issued patent is even more important. Innovators are asked to make a considerable investment to obtain a patent. They are willing to do so only if that investment is likely to produce long-term commercial benefits.

According to Paquet and Roy, patent portfolios are a key source of market credibility for emerging firms. This is true, but only if investors and business partners can rely on those patents. This means that there must be a consistently high level of examination.

The authors identify four related sets of forces that are driving the governance challenges faced by CIPO: globalization, commercialization, diffraction and e-linkage. These are explained in the study, but we would argue that globalization and competition are the two most persistent challenges affecting IP rights, in Canada and elsewhere. Other countries seem to be ahead of us in responding to these challenges.

Garland and Want state that Canada has lagged behind other countries, particularly the United States, in issuing patents for higher life forms, software and business methods. Many have argued that the USPTO has gone too far in the other direction by issuing patents of dubious validity and value. (For example, see U.S. Patent No. 6,368,227 issued April 9, 2002, for a 'Method of swinging on a swing.' The patent claims a method of swinging on a child's swing in a side-to-side or elliptical motion. It is available on-line at the USPTO website at www.uspto.gov.) Nevertheless, this represents a clear policy choice by the United States in favour of innovation. The USPTO approach has been to give the benefit of the doubt to the inventor, issue the patent and leave it to the patent owner to enforce it. Canada, typically, has taken a much more conservative approach. This may mean that the patent owner can have greater confidence in the validity and enforceability of a patent issued in Canada. But it may also mean that many innovators are missing out on commercial opportunities or that their innovations have less commercial potential here. In turn, this may mean that more Canadian innovators turn to the United States or other external markets to Canada's detriment.

Paquet and Roy recommend that CIPPO follow the experience of patent offices in other countries. While Denmark and Australia are offered as models, there are significant differences to consider. Canada's most important trading partner and largest competitor is obviously the United States, which is 10 times its size. In the Australia example, Canada's position is closer to New Zealand, the junior partner in the relationship with Australia. In Europe, countries are much closer in size and economic importance. While Denmark may be quite small relative to the largest European countries, it is part of a group which recognizes that the smaller member countries have a role to play. The United States is often blind to any interests other than its own. It is thus difficult to see how Canada could play a meaningful role in the U.S. patent system. Nevertheless, it must avoid simply becoming a rubber stamp for U.S. IP rights.

Therefore, it is essential that Canada establish and maintain a meaningful international role for CIPPO. The emergence of regional patents may provide an opportunity to do so. The United States may seek to balance strong European and Asian patents with a North American patent, as Paquet and Roy suggest. Canada may seek to temper U.S. dominance of such a system through the establishment of a hemispheric patent which would include Central and South America. Since such a system would require administration in four languages, and since CIPPO has experience administering a bilingual system, our expertise would be very useful. This would be consistent with Canada's traditional support of multilateral trade relations. This approach may also have some appeal for the United States if it greatly increases the market for U.S. innovations and reduces the costs of obtaining and enforcing IP rights throughout the region.

Paquet and Roy also recommend that Canada consider implementing a form of *partial* patent with a more limited scope of protection. They point to the *innovation patent* recently introduced in Australia. The innovation patent is issued for a period of up to eight years without examination. It requires only an innovative step, not an inventive step. However, the patent cannot be enforced unless it has been examined. One must question the value of such a patent. As discussed below, the main impediment for small and medium-sized enterprises in Canada is not the cost of obtaining a patent. It is the perceived cost and uncertainty of enforcing it. Introducing some lesser bundle of rights — and calling them a 'patent' in whatever guise — simply gives innovators a false sense of value. Similar criticisms have been made about the provisional patent system in the United States. However, the provisional application at least gives inventors the benefit of an early filing date and a year to raise money to commercialize the invention before incurring the full cost of a patent application. If Canada is to consider any means to make the patent system more welcoming to individual inventors and small businesses, the provisional application is one to consider.

Trade-marks

Trade-marks are perhaps the most valuable forms of IP in today's global consumer society. Garland and Want cite the enormous value of the COCA-COLA and MICROSOFT marks as examples. While it is difficult to accurately quantify these values, it is certainly true that they depend in large part on their international fame and recognition, and thus on their international protection. Due to its proximity to the U.S. market, Canada is bombarded with U.S. marketing. Many U.S. trade-marks are as familiar to Canadians as they are to Americans. As a result, there is greater pressure to harmonize Canadian trade-mark laws and policies with the United States than with other trading partners.

The Canadian Trade Marks Office has resisted the registration of innovative marks, such as sound marks, movements and three-dimensional marks. There may be practical problems in registering such marks — for example, it may be difficult to index sound marks under the current system — but these are not insurmountable. There does not seem to be any policy reason why any mark that serves to identify a product or service should not be registered. From a commercial perspective, there are many reasons why unconventional marks should be protected, including the increasing difficulty of finding word marks for global products. Even coined words are becoming difficult to find; those that are available may have a negative meaning or connotation in another country or may otherwise not be appropriate.

Garland and Want also note that Canada has lagged behind the United States with respect to the protection afforded trade-mark owners against *dilution* — the gradual whittling away of the distinctiveness of famous or well-known marks. They cite the Pink Panther case as an example of a situation where the Federal Court of Appeal has ruled that the use of a mark in one line of business (hair care and beauty products) does not diminish the value of the mark in another business (movies, audio and video recordings and entertainment). The court held that there should not be an automatic presumption of confusion just because the plaintiff's mark is famous. This runs directly counter to the U.S. dilution theory. However, one must also observe that dilution cases in the United States seem to have gone far beyond the original logic of the doctrine. Virtually every trade-mark owner in that country considers its mark to be *famous* no matter how obscure it may be. And virtually every new mark is challenged on the basis that it dilutes similar marks in other businesses or channels of trade. The result has been a proliferation of trade-mark litigation in the United States. The dilution theory has become even more strained when it comes to actions taken by trade-mark owners against domain name holders.

Copyright

Paquet and Roy point out that digital property and *informational goods* have challenged the basic assumptions of existing IP rights regimes based on protection against the reproduction of IP, such as copyright. Since copying in a digital world does not depend on location, traditional territory-based IP rights are much less effective. The authors advocate a redefinition of the *moral contracts* among producers, distributors and users. They recommend that CIPO shift its focus from administration and implementation of existing IP rights to active renegotiation of the nature of the respective rights of all stakeholders.

In our view, it seems much more likely that new technology will marginalize traditional notions of copyright. Recent examples illustrate the complex dynamics of digital copyright. Although existing commercial interests, led by the recording industry, were successful in shutting down the Napster peer-to-peer file sharing service, at least a dozen similar services (many with superior technology) have emerged to replace it. Recording artists and record companies must, therefore, protect their work with encryption technology or take other steps to protect their existing business model. This has proven to be ineffective, as every encryption method is quickly defeated. Therefore, creators must develop an entirely new business model where commercial success does not depend on copyright.

Creators have always had to adapt to changes in technology. In many cases, the new technology has had entirely unpredictable results. When the movie industry in the United States tried to block the initial commercial deployment of videocassette recorders in the Sony Betamax case, they argued that these machines would be used to record movies and television programs in violation of the producers' copyright. Fortunately for the movie industry, it lost the case. The U.S. Supreme Court ruled that home copying for private use was a fair use under U.S. copyright law. In the event, the home video recorder vastly increased the value of the IP in question. In the years since the Sony case was decided, home video sales and rentals have become one of the most important sources of revenue for Hollywood studios and have rescued many films from financial disaster. This outcome was entirely unexpected — and quite possibly could not have been predicted — at the time the technology was first introduced and the legal case was decided.

ENFORCEMENT

GARLAND AND WANT STATE that Canada has strong IP rights enforcement regimes and has been cited in at least one survey as the best country in the world in which to litigate a patent. The statistics presented in their study seem to bear this out. Generally speaking, the majority of IP owners are at least partially successful in enforcing their patents, trade-marks or copyright in Canada.

Most strikingly, patent owners have been successful in almost 2/3 of reported cases in Canada over the last 30 years while the success rate in the United States is closer to 1/2 (Garland and Want, 2005). These are surprising statistics in view of the common perception that the United States is more patent-friendly; however, they may support the thesis that, while the number and scope of patents issued in Canada may be smaller, the general quality of the patents issued is stronger.

Nevertheless, there are ways in which the current enforcement system could be improved.

It has often been suggested that Canada follow the lead of other countries that have recognized the utility of a specialized patent or IP tribunal. Specialized courts can offer speed, predictability and consistency of decisions. The Northern District of Virginia and Federal Circuit Court of Appeals in the United States are often cited as models. The Federal Court of Canada has the potential to be such a specialized court, but one cannot view it as such today. It is true that some judges in the Trial Division and the Federal Court of Appeal are very knowledgeable about IP matters. However, they must also deal with a large number of immigration, tax and other matters, which precludes a truly specialized court. In addition, many IP matters are heard in the provinces' superior courts, which have no expertise in such matters.

Steps could be taken to enhance the role and to improve the level of expertise of the Federal Court. Administrators might consider whether it is possible to designate certain judges exclusively for IP matters, and whether such an approach would be advantageous both for the litigants and for the administration of the court. CIPO and IPIC could offer Federal Court judges more training in IP matters. New judges with IP experience could be appointed. This might encourage litigants to bring more cases before the Federal Court rather than the provincial court system. This approach has been adopted by the High Court in the United Kingdom with some success.

One of the more striking statistics cited in the Garland and Want study is the relatively small number of IP cases that have gone to trial in Canada in the last 30 years relative to the United States. For example, there were 105 patent infringement trials in Canada over the period. In the United States, there were 1,210 patent trial decisions during the 15-year period from 1979 to 1996. If these numbers are extrapolated so the time periods are the same, this would mean that the number of patent cases tried annually in the United States is about 23 times the number of cases in Canada. The number of patent appeal cases is similarly disproportionate. The statistics show a 40:1 ratio in the number of trade-mark trials. For copyright cases the ratio is about 17:1.

These numbers seems greatly disproportionate to the relative size of the two economies. Of course, they may simply reflect the greater propensity toward litigation in the United States. However, they may also demonstrate a

lack of awareness on the part of Canadian IP owners about the relative risks and rewards of enforcing their IP rights. If Canadian innovators are not fully aware of the advantages of enforcing IP rights in Canada, this is a serious impediment to the development of a knowledge-based economy. Negative perceptions about enforcement have a direct impact on the willingness of innovators to devote scarce resources to obtain IP protection in the first place. It is thus imperative that CIPO, IP practitioners and others involved in fostering innovation actively inform innovators of the advantages offered by the Canadian enforcement regime. It is also imperative that all stakeholders do what they can to make the system more efficient and effective than it already is.

CONCLUSION

ALL OF THE STUDIES AND SPEAKERS at this conference recognize that innovation is the driving force of the knowledge-based economy. All of the participants in the system have crucial interlocking roles to play. None will succeed without the others. CIPO can be an important catalyst by improving the efficiency and effectiveness of its administration of IP rights and by conducting broad-based public awareness campaigns. Steps can also be taken to make the court system move effective. Academic researchers, entrepreneurs and professional IP advisors can also continue to press for the government policies, funding and training required in support of a robust innovation infrastructure.



About the Contributors

Ajay Agrawal is the Peter Munk Professor of Entrepreneurship at the University of Toronto's Rotman School of Management. His research interests include the strategic use of intellectual property rights, international labour mobility and knowledge flows, and private-sector competition over public-sector science. His research focuses on the economics of innovation, the economics of creative industries, the market for ideas, technology management, corporate strategy, and entrepreneurship. His work has appeared in various publications, including *Management Science*, the *International Journal of Industrial Organization*, and the *National Bureau of Economic Research Working Paper Series*. Dr. Agrawal received his Ph.D. in Business Economics from the University of British Columbia. He also studied at the London Business School, and at the Sloan School of Management of the Massachusetts Institute of Technology as a visiting scholar.

Bénédicte Callan is an Administrator in the Directorate for Science and Technology at the Organisation for Economic Co-operation and Development (OECD). Her work focuses on measuring the economic impact of new technologies and on evaluating the tools available for governments to improve public benefits from investments in science and technology. She is presently responsible for several projects, including a cross-country survey of patenting and licensing practices at public research organizations, and a study of high technology spin-off firms from public research organizations. Prior to joining the OECD, Dr. Callan was Fellow in Political Economy at the Council on Foreign Relations in New York. She was also a research associate for the Berkeley Roundtable on the International Economy, and a visiting scholar at Saitama University and Tokyo University. She obtained her Ph.D. in Political Science from the University of California at Berkeley.

Mario Cervantes is an Economist in the Directorate for Science, Technology and Industry at the OECD since 1995. In this position, he is responsible for managing various projects mandated by the OECD's Committee for Scientific and Technological Policy, whose goal is to provide empirically-based policy advice to the OECD's 30 member countries, as well as China, Israel, Russia and South Africa. Current projects in his portfolio include academic patenting and licensing in OECD countries, the interface between industry and public research, and the globalization of the research workforce. He has authored numerous articles and reports in the area of science and technology policy and recently co-authored an OECD report, entitled *Turning Science into Business: Patenting and Licensing at Public Research Organisations*. Mr. Cervantes has also been an advisor to the World Bank's *Knowledge for Development Project* in Chile. He received his M.A. from Columbia University, and holds a Diploma from the Institut d'études politiques in Paris.

Sandra Charles is a Senior Policy Advisor for e-business development in the Electronic Commerce Branch at Industry Canada. She received a Bachelor's degree in Economics from the University of Montreal in 1993, and a Master's degree in Economics from the University of Montreal in 1995.

Wesley M. Cohen is the Frederick C. Joerg Professor of Business Administration and Professor of Economics and Management in the Fuqua School of Business at Duke University. His research interests include strategy, technology and knowledge management, industrial organization economics and the economics of technological change. He is also a research associate of the National Bureau of Economic Research, and was a member of the National Academies' Committee on Intellectual Property Rights in the Knowledge-Based Economy. Professor Cohen is the associate editor of *Research Policy*, and was main editor of this journal from 1995 to 1999. He is a widely published author and his research has appeared in scholarly periodicals such as the *American Economic Review*, the *Economic Journal*, the *Review of Economics and Statistics*, and *Management Science*. He is also co-editor of the recently published *Patents in the Knowledge-Based Economy*. Dr. Cohen received his Ph.D. from Yale University.

Michael Erdle is a founding member of the law firm Deeth Williams Wall, LLP. He practises primarily in the area of information technology law, with an emphasis on outsourcing, business transactions and licensing. He is a qualified mediator and arbitrator, specializing in technology and intellectual property matters. Mr. Erdle is an active member of many legal and technology industry associations, including the Canadian Bar Association, the Canadian IT Law Association and the Computer Law Association. He is a member of the Executive

of the Intellectual Property Institute of Canada (IPIC) and past chair of its Trademarks and Domain Names on the Internet Committee. He is a founding member of the Ontario Bar Association's Information Technology and E-commerce Section, and a past chair of the Toronto Computer Lawyers Group. Mr. Erdle has written and spoken on many current issues in information technology and intellectual property law, including dispute resolution, outsourcing, the development and distribution of Internet and multimedia products and services, electronic commerce and software licensing. He is the author of several texts on electronic commerce and privacy law in Canada.

Nancy T. Gallini is a Professor of Economics and the chair of the Department of Economics at the University of Toronto. She currently serves on the editorial board of the *Journal of Economic Literature*. She has written numerous articles on resource economics, technology licensing, competition policy and the economics of intellectual property and has served on the editorial boards of the *American Economic Review*, the *International Journal of Industrial Organization* and the *Journal of Industrial Economics*. Dr. Gallini has co-edited an Industry Canada Research Series volume with Robert Anderson, entitled *Competition Policy and Intellectual Property Rights in the Knowledge-Based Economy*, and has served as academic advisor to the Competition Bureau in Ottawa on a variety of projects. She received her Ph.D. from the University of California at Berkeley.

Steven B. Garland is a lawyer whose practice focuses on intellectual property litigation in the areas of patents, trade-marks, copyright, industrial designs, trade secrets and competition law. He is also an adjunct professor at the University of Ottawa Law School where he teaches the patent law course. Mr. Garland has appeared as trial and appellate counsel before the Ontario Supreme Court and Court of Appeal, the Federal Court of Canada and the Supreme Court of Canada. He is a registered patent and trade-mark agent, and a licensed professional engineer in Ontario. He is also a member and Vice-President of the Intellectual Property Institute of Canada (IPIC), and a member of the International Association for the Protection of Intellectual Property. Mr. Garland obtained a B.Eng. (chemical and biochemical engineering) in 1985, and a law degree in 1990.

Michael Geist is a Professor of Law and the Canada Research Chair of Internet and E-commerce Law at the University of Ottawa. He has written numerous academic articles and government reports on the Internet and the law, and is a columnist on technology law issues for the *Toronto Star*. Professor Geist is the creator and consulting editor of BNA's Internet Law News, a daily Internet law news service. He is also the founder of the Ontario Research Network for

E-commerce, and serves on the advisory boards of several leading Internet law publications, including *Electronic Commerce & Law Report*, the *Journal of Internet Law* and *Internet Law and Business*. Dr. Geist obtained a Bachelor of Law (LL.B.) degree from Osgoode Hall Law School in Toronto, Master of Law (LL.M.) degrees from Cambridge University in the United Kingdom and Columbia Law School in New York, and a Doctorate in Law (J.S.D.) from Columbia Law School.

Shubha Ghosh is a Professor of Law at the University of Buffalo Law School and the State University of New York (SUNY), and a Visiting Professor at the SMU Dedman School of Law. His research focuses on understanding markets as social, political, and economic institutions, understanding the connections between legal methods and policy and science, especially social science, and understanding doctrinal and theoretical issues in intellectual property, anti-trust, and business torts. Professor Ghosh is a member of the Executive Committee of the Canadian Law and Economics Association, and is past Treasurer of the Section on Law and Economics of the American Association of Law Schools. He received a Ph.D. in Economics from the University of Michigan, and a J.D. from Stanford Law School. Dr. Ghosh is a widely published author and his research has appeared in academic periodicals such as the *Journal of the Copyright Society of the USA*, the *Harvard Journal of Law and Technology* and the *Florida Law Review*.

Stuart J.H. Graham is an Assistant Professor of Strategic Management in the College of Management at the Georgia Institute of Technology. Professor Graham teaches and conducts research on firm strategy, the management of innovation and technology, intellectual property strategies, and the legal environment of business. He received his Ph.D. in Business Administration from the University of California at Berkeley and he holds advanced degrees in Law (J.D.), Management (M.B.A., M.S.) and Geographical Information Systems (M.A.). Dr. Graham is an attorney licensed to practice in New York State and a member of the American Bar Association and of the American Intellectual Property Law Association. He has written on intellectual property and litigation strategies in the software and biotechnology industries, comparative studies of the U.S. and European patent systems, and the use by companies of patenting and secrecy in their innovation strategies.

Bronwyn H. Hall is a Professor of Economics at the University of California at Berkeley and a Research Associate of the National Bureau of Economic Research, and the Institute for Fiscal Studies in London. She is also the founder and a partner of TSP International, an econometric software firm. She has published numerous articles on the economics and econometrics of technical change in such journals as *Econometrica*, the *American Economic Review*, the *Rand Journal of Economics* and *Research Policy*. Professor Hall is currently a member of the Science, Technology and Economic Policy (STEP) Board of the U.S. National Research Council, the International Advisory Board of the New Economic School, in Moscow, the editorial board of *International Finance*, and she is an associate editor of *Economics of Innovation and New Technology*. Dr. Hall received her Ph.D. in Economics from Stanford University.

Petr Hanel is a Professor of Economics at the University of Sherbrooke and a member of the Centre interuniversitaire de recherche sur la science et la technologie (CIRST), in Montreal. His previous work includes two books and numerous articles and studies on industrial and commercial policies and, more recently, studies of the economic aspects of technological change, innovation and technological policies. He is the co-author with John Baldwin of a book entitled *Innovation and Knowledge Creation in an Open Economy – Canadian Industry and International Implications*, published by Cambridge University Press in July 2003.

Gary Lazarus is an Economist in the Marketplace Policy Planning Group of Industry Canada. He has worked on policy issues related to copyright, patents, trade-marks and integrated circuit topographies. He holds a Master of Statistics degree from North Carolina State University and a Ph.D. in Economics from Carleton University.

Arif Mahmud is an Economist in the Micro-Economic Policy Analysis Branch of Industry Canada. His current duties include participation in the Skills Research Partnership, a joint venture between Industry Canada, Human Resources and Skills Development Canada, and the Social Sciences and Humanities Research Council. He is also the author of *Think Canada*, a presentation deck prepared monthly for the Department of International Trade and used extensively by Canadian embassies and consulates around the world. Prior to joining Industry Canada, he was a Pricing Analyst in the Insurance Risk and Actuarial Analysis Division of the Canada Mortgage and Housing Corporation (1999-2000) and a Professor of Economics and Finance at Algonquin College (1994-97), where he was awarded a Certificate of Teaching Excellence in 1996. Mr. Mahmud holds an M.A. in Economics from Carleton University.

Keith E. Maskus is a Professor of Economics at the University of Colorado at Boulder. He is also a Research Fellow at the Institute for International Economics. In 2001-02 he was a Lead Economist in the Development Research Group at the World Bank. He has been a Visiting Scholar at the Federal Reserve Bank of Kansas City, a Visiting Senior Economist at the U.S. Department of State and a Visiting Professor at the University of Adelaide. He serves as a consultant for the World Intellectual Property Organization and the United Nations Conference on Trade and Development. He was associate editor of the *Review of International Economics* and is currently the editor of *The World Economy: the Americas*. Dr. Maskus received his Ph.D. in Economics from the University of Michigan in 1981. He has written extensively on various aspects of international trade, including the empirical testing of trade models, the determinants of foreign direct investment and the political economy of trade. His current research focuses on the international economic aspects of protecting intellectual property rights. His latest book, entitled *Intellectual Property Rights in the Global Economy*, was published by the Institute for International Economics.

Stephen M. Maurer is a Lecturer at the University of California at Berkeley, where he presents graduate-level courses on Internet law and economics and technology. He is also an attorney specialized in intellectual property and high technology litigation. Mr. Maurer has published research on database policy, patent law, and academic/industry transactions. He recently completed an assignment with a U.S. National Academy of Sciences Committee studying licensing of geographic data and services. He has also performed sponsored research for the U.S. National Academy of Sciences on industrial research agreements and database protection legislation, and for Industry Canada on U.S. and European database policies. His research has been published in journals such as *Nature*, *Economica*, *Research Policy* and *Science*.

Gilles Mcdougall is the Director of Research at the Copyright Board of Canada. He holds a Master's degree and an ABD in Economics from the University of Montreal. He has worked for Industry Canada as a researcher and published two Industry Canada Working Papers dealing with the impact of mergers in Canada, and the business strategies of small and medium-size firms and of large firms in Canada. Mr. Mcdougall has managed the Industry Canada Research Publications Program, which publishes internal as well as external economic studies. He has also been Chief of the Economic Team in the Intellectual Property Directorate of Industry Canada.

Donald G. McFetridge is a Professor in the Department of Economics at Carleton University. He is a former chair of the Department of Economics, and held the T.D. MacDonald Chair in Industrial Economics of the Competition Bureau in Ottawa. He has also served as Research Coordinator, Economics of Industrial Structure, for the Royal Commission on the Economic Union and Development Prospects for Canada. Professor McFetridge has been teaching and writing in the fields of industrial economics, regulatory economics and competition policy for nearly 30 years. His research has been published in *The Canadian Business Law Journal*, the *Canadian Journal of Economics* and the *Review of Economics and Statistics*, as well as many other economic and business journals. He is a member of the editorial board of the *Canadian Competition Record*. Dr. McFetridge has advised both the Competition Bureau and numerous Canadian and international firms on such competition matters as horizontal restraints, predatory pricing, abuse of dominance, and mergers. He received his Ph.D. in Economics from the University of Toronto.

David C. Mowery is the William A. and Betty H. Hasler Professor of New Enterprise Development in the Walter A. Haas School of Business at the University of California, Berkeley, and a Research Associate of the National Bureau of Economic Research. During 2003-2004, he was the Marvin Bower Research Fellow at the Harvard Business School. His research deals with the economics of technological innovation and the effects of public policies on innovation. He has testified before Congressional committees and has served as an advisor to the OECD, various federal agencies and industrial firms. Dr. Mowery has published numerous academic papers and has written or edited a number of books, including *Ivory Tower and Industrial Innovation: University-Industry Technology Transfer Before and After the Bayh-Dole Act*, *Paths of Innovation: Technological Change in 20th-Century America*, *The International Computer Software Industry: A Comparative Study of Industry Evolution and Structure*, *U.S. Industry in 2000*, *The Sources of Industrial Leadership* and the *Oxford Handbook of Innovation*.

Gilles Paquet is Emeritus Professor and Senior Research Fellow at the University of Ottawa's School of Political Studies. His research focuses on industrial economics, knowledge management, governance, and public policy and management. Professor Paquet is a member of the Order of Canada, Fellow of the Royal Society of Canada and of the Royal Society of Arts in London. He has authored or edited 35 books on such subjects as urban studies, multinational firms and governance. He has written more than 175 chapters in books and some 130 papers published in various academic periodicals such as the *Journal of Cultural Economics*, the *Canadian Journal of Economics*, *La Revue d'économie politique*, *Science*, *Public Policy* and *La Revue générale de droit*.

Walter G. Park is an Associate Professor in the Department of Economics at the American University in Washington, D.C. He has been a faculty member at the American University since 1991, where he specializes in the economics of patent systems. His research work has focused on international R&D and patenting activities and their impact on international trade, technology diffusion, and productivity growth. Professor Park has developed measures of patent strength and patenting cost. He also studied the phenomenon of international research spillovers (i.e. the influence national research and patenting activities have on other countries' economic performance). He has conducted projects for the World Bank, the World Intellectual Property Organization, Industry Canada, the American Intellectual Property Law Association, the OECD and the U.S. Department of Energy. Dr. Park received his Ph.D. from Yale University.

Bohumir Pazderka is an Associate Professor in the School of Business at Queen's University. He received his Ph.D. in Economics from Queen's University. His current research focuses on research and development (R&D) and patent protection in the pharmaceutical industry, the analysis of the determinants of R&D expenditures, and the financing and valuation of knowledge-based high-technology firms. He has held visiting appointments at the École supérieure de commerce in Toulouse, France, at the University of Queensland in Brisbane, Australia, and at the Science Policy Research Unit, University of Sussex in Brighton, England. Dr. Pazderka is the author or co-author of numerous publications including a book on the economic and social benefits of the stock market, a textbook on micro-economics, and monographs on professional licensing, and on international comparisons of R&D expenditures. He has published research on professional licensing, the effectiveness of advertising, the economics of R&D, pharmaceutical industry R&D, the financial systems of the transition economies of Central and Eastern Europe, the evaluation of technology companies, and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and the pharmaceutical industry.

Jonathan D. Putnam is the Ontario Research and Development Challenge Fund Professor of the Law and Economics of Intellectual Property at the University of Toronto's Centre for Innovation Law and Policy, where he teaches intellectual property law and the regulation of high-technology industries. He is also a Vice President at Charles River Associates, a litigation and management consulting firm headquartered in Boston. Professor Putnam is an expert in intellectual property, industrial organization, and technological change. He has authored several articles on the use of patent data and the valuation of patents.

He has provided intellectual property-related expert testimony before the Supreme Court of Canada, federal, state and bankruptcy courts in the United States, and the Federal Trade Commission. He has also provided econometric analyses of differentiated products mergers approved by U.S. antitrust authorities. His dissertation received a National Science Foundation Small Business Innovation Research Grant for methods of valuing the patent portfolios of firms. He attended Yale Law School on a Mellon Foundation Fellowship, and Columbia Law School on a Julius Silver Foundation Fellowship, and obtained his Ph.D. in Economics from Yale University.

Mohammed Rafiquzzaman is a Senior Economist and Coordinator of Innovation Analysis in the Micro-Economic Policy Analysis Branch of Industry Canada. During the 2001-2002 winter term, he was a visiting fellow in the Department of Economics and the Centre for Innovation Law and Policy at the University of Toronto. He also taught at Concordia University and York University. His research interests focus on law and economics, intellectual property, innovation and technology diffusion, and economic growth. His research has been published in journals such as the *International Journal of Industrial Organization*, *Research in Law and Economics*, the *Canadian Journal of Economics*, and *Canadian Business Economics*. Dr. Rafiquzzaman received an M.A. in Economics and an M.A. in Mathematics from the University of Western Ontario, and a Ph.D. in Economics from Carleton University.

Jeffrey Roy is an Associate Professor in the School of Management at the University of Ottawa, and is currently a visiting faculty member of the School of Public Administration at the University of Victoria. He specializes in models of democratic and multi-stakeholder governance within the realms of electronic government reforms, community and citizen engagement, and economic development. In addition to delivering graduate and undergraduate courses, he has designed a variety of professional development seminars for officials at the local, provincial and federal levels. Professor Roy served as Managing Director of the Centre on Governance at the University of Ottawa in 2001-2002. In 2002, he was a Canadian consultant to the OECD for an international study of e-government. In 2003, he was a visiting scholar in the School of Public Administration and Urban Planning at San Diego State University and at the World Foundation for Smart Communities. He is an associate editor of the *International Journal of E-Government Research* and a regular contributor to *CIO Government Review*, a Canadian publication devoted to a better understanding of the nexus between technology and government.

Klaus Stegemann is Professor Emeritus of Economics at Queen's University. Educated in Germany, with two years of post-doctoral studies at the Massachusetts Institute of Technology, he came to Canada in 1967. He has published work in the areas of European economic integration, the theory of international trade, trade policy and industrial economics. He has written several books as well as numerous articles published in academic journals such as the *Canadian Journal of Economics*, *Canadian Public Policy*, the *Cornell International Law Journal*, the *Journal of World Trade Law*, *International Organization*, the *World Economy* and the *Journal of World Intellectual Property*.

Andrew Tepperman is a Senior Associate at Charles River Associates (CRA), a consulting company specializing in economics, finance and business strategy. His expertise is in industrial organization, intellectual property, and applied micro-economics. While at CRA, he has analyzed intellectual property, anti-trust, regulatory, and contractual issues. In the intellectual property area, he has assisted in cases involving damages for patent infringement, trade secret misappropriation, and disputes related to licensing contracts. Before joining CRA, Dr. Tepperman lectured on managerial economics in the Faculty of Commerce at the University of Toronto. Dr. Tepperman obtained his Ph.D. in Economics from the University of Toronto.

Julie Tran is an Economist working in the area of trade policy at the Department of Fisheries and Oceans. Previously, she worked at Industry Canada in the Industrial Trade Policy Directorate and in the Intellectual Property Policy Directorate. In 1998, she received her Bachelor's degree in Business Administration, and in 2000 she received her Master's degree in Applied Economics from the École des hautes études commerciales in Montreal.

David Vaver is Professor of Intellectual Property and Information Technology Law at the University of Oxford, United Kingdom. He is also a Fellow and the Director of the Oxford Intellectual Property Research Centre at St. Peter's College. Professor Vaver previously taught at Osgoode Hall Law School and at the University of British Columbia. He was the Editor of the *Intellectual Property Journal* from 1984 to 1998, and remains a consultant editor of this journal. He is currently a member of the U.K. Intellectual Property Advisory Committee. Professor Vaver's published works include *Intellectual Property Law: Copyright, Patents, Trademarks* (Toronto: Irwin Law, 1997), *Copyright Law* (Toronto: Irwin Law, 2000), and he co-edited a volume, entitled *Intellectual Property in the New Millennium: Essays in Honour of William R. Cornish* (Cambridge: Cambridge University Press, 2004).

Jeremy E. Want is an Associate in the Ottawa law office of Smart & Biggar / Fetherstonhaugh, where his practice involves patent prosecution and litigation. Mr. Want holds an Honours B.Sc. in Chemistry from the University of Western Ontario and a law degree from the University of Manitoba. He was admitted to the Ontario Bar in 2000 and is a registered patent and trade-mark agent. Mr. Want is a member of the Canadian Bar Association, and of the Litigation Committee of the Intellectual Property Institute of Canada.



Industry
Canada Industrie
Canada

Canada

Intellectual Property Policy

Conference on Intellectual Property and Innovation - Program

Conference Program

Intellectual Property and Innovation in the Knowledge-Based Economy

A conference organized by the Centre for Innovation Law and Policy and Industry Canada
May 23-24, 2001
Metro Toronto Convention Centre
Toronto, Ontario
Canada

Wednesday, May 23, 2001

7:30 - 8:30: Registration and Breakfast

8:30 - 9:00: Introductory Remarks

Richard Owens, Executive Director, Centre for Innovation Law and Policy
Andreï Sulzenko, Assistant Deputy Minister, Industry and Science Policy, Industry Canada

9:00 - 10:30: Intellectual Property in Canada: The Context

Chair: Jonathan Putnam, University of Toronto

Canada's Intellectual Property Framework

David Vaver, Oxford IP Research Centre
Oxford University

This paper examines the current state of IP laws in Canada, and highlights some of the main differences with those of the U.S.

Economic Profile of Intellectual Property Industries

Sandra Charles, Gilles McDougall, Julie Tran,
Industry Canada

This paper examines the importance to the Canadian economy of industries that are intensive users of different types of IP rights, namely patents, copyright, and trademarks.

Discussant: *Michael Geist, University of Ottawa*

10:30 - 11:00: Break

11:00 - 12:30: The Global Nature of Intellectual Property

Chair: Robert Main, Acting Director General, Corporate Governance Branch, Industry Canada

Canada's Patent Policy in a North American Context

Keith Maskus, University of Colorado

This paper examines the Canadian and U.S. patents system, and assesses Canada's policy options, from closer harmonization with the U.S. to distinct policies adapted to Canada's economic structure.

The Economics of Copyright

Jonathan Putnam, University of Toronto

This paper assesses the relevance of the copyright regime with respect to the digital economy and discusses how the Internet and new technologies affect the dynamics of copyright-related industries.

Discussant: *Bronwyn Hall, University of California, Berkeley*

12:30 - 14:00: Lunch

14:00 - 15:15: Intellectual Property Rights and Economic Performance

Chair: Renée St-Jacques, Director General, Micro-Economic Policy Analysis Branch, Industry Canada

The Impact of Intellectual Property Rights on Economic Performance: A Literature Survey

Mohammed Rafiquzzaman, Industry Canada

Shubha Ghosh, University at Buffalo, New York State University

This paper reviews the current economic literature, from both a theoretical and an empirical point of view, on the impact of IP rights on economic performance. It discusses patents, copyrights and trademarks.

The Determinants of Patenting in Canada

Nancy Gallini, Andrew Tepperman and Jonathan Putnam, University of Toronto

This research reviews the theory on determinants of patents and develops an empirical model of patenting activity.

Intellectual Property Rights and Economic Growth

Walter Park, American University

This research defines a quantitative measure of the strength of different types of IP rights and examines whether such a measure helps in assessing the impact of IP protection on economic growth in Canada.

Discussant: *Donald McFetridge, Carleton University*

15:15 - 15:45: Break

15:45 - 17:00: Intellectual Property Rights and Economic Performance (cont.)

Intellectual Property Policy and Diffusion: The Case of the Pharmaceutical Industry

Bohumir Pazderka and Klaus Stegemann, Queen's University

This paper explores the question: What are some of the key critical factors and instruments/levers within our existing statutory provisions that can promote innovation and diffusion and can be used to Canada's advantage?

Foreign Intellectual Property Protection and the Effect on Canadian Trade

Mohammed Rafiquzzaman, Industry Canada

This paper analyses the extent to which Canadian manufacturing trade flows are sensitive to international differences in IP protection.

Discussant: *Michel Patry, École des hautes études commerciales (Montréal)*

19:00 - 21:00: Dinner

Guest Speaker: Thomas Keefer, Assistant Director General, World Intellectual Property Organization

Thursday, May 24, 2001

8:30 - 10:15: Emerging Intellectual Property Issues

Chair: Jeanne Inch, Director, Marketplace Innovation, Innovation Policy Branch, Industry Canada

Intellectual Property Rights, Software and Business Methods: The U.S. Experience

Stuart Graham and David Mowery, University of California, Berkeley

This paper provides a descriptive profile of patenting business methods and computer softwares in the U.S., and assesses the private and social net costs and benefits of allowing patent in those areas.

Intellectual Property Rights and Databases

Stephen Maurer and Suzanne Scotchmer, University of California, Berkeley

This paper outlines the European and the U.S. experience with respect to copyright and sui generis protection for non-original databases, and examines the relevance of copyright protection for non-original databases.

Intellectual Property Rights and Biotechnology

Gary Lazarus, Industry Canada

This paper explores the patenting behaviour of the biotechnology sector in Canada and looks at the role of patents in innovation for this sector.

Discussant: *Wesley M. Cohen, Carnegie Mellon University*

10:15 - 10:45: Break

10:45 - 12:00: Intellectual Property in Practice

Chair: Maureen Dougan, Chief Operating Officer, Canadian Intellectual Property Office

Current Intellectual Property Practices in Canada

Petr Hanel, Université de Sherbrooke

This paper examines how the exercise of IP rights is related to whether the firm is innovative or non-innovative, to the firm's innovation activities (i.e. research and development), to size and the innovation performance.

The Management of Intellectual Property Rights from Public Research

Benedicte Callan and Mario Cervantes, Organisation for Economic Co-operation and Development (OECD)

This paper gives an overview of the IP management challenges facing public research organizations in OECD countries, and describes emerging best practices in IP management and commercialization across the OECD.

Discussant: *Ajay K. Agrawal, Queen's University*

12:00 - 13:30: Lunch

13:30 - 14:45: Intellectual Property in Practice (cont.)

Optimizing Canadian Intellectual Property Office Services for a Knowledge-Based Economy

Gilles Paquet and Jeffrey Roy, University of Ottawa

The paper assesses future directions for the Canadian Intellectual Property Office, and the ways in which it can nurture Canada's knowledge-based economy.

The Enforcement of Intellectual Property Rights in Canada

Steven B. Garland and Jeremy E. Want, Smart & Biggar

This paper looks at the Canadian jurisprudence with respect to IP with a view to analyzing the enforcement of IP. It also assesses whether the Canadian enforcement of IP is "balanced", i.e. whether it stimulates both innovation and diffusion of knowledge.

Discussant: *Michael Erdle, Deeth Williams Wall L.L.P.*

14:45 - 15:00: Break

15:00 - 17:00: Round Table - Intellectual Property Data Availability and Needs

Chair: Jonathan Putnam, University of Toronto

Participants:

Canadian Intellectual Property Office

U.S. Patent and Trademarks Office

U.S. Copyright Office

Statistics Canada

Organisation for Economic Co-operation and Development

CHI Research

Selected invited researchers

The objectives of this session were to examine:

researchers' needs;
the type of information on patents, trademarks and copyright that researchers can obtain through IP offices in Canada, the United States, and in the European Community;
the kind of information that can be obtained through surveys conducted by Central Statistical Agencies, in industry associations and private statistical/consulting firms;
the major synergies and shortfalls; and
the best practices.

17:00 - 17:15: Closing Remarks

Jonathan Putnam, General Editor of Research on Intellectual Property and Innovation in the Knowledge-Based Economy