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Innovation and Intellectual Property

by John Baldwin

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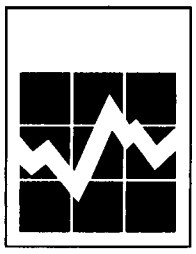

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Preface

This is the fourth in a series of publications on innovation in Canada. Earlier studies investigated the type of innovation regime at work in firms that differ in terms of the novelty and importance of the innovations produced (Catalogue No. 88-513), how firm growth and innovation are related (Catalogue No. 61-523R), how extensive is new computer-based technology use (Catalogue No. 88-512), and the problems and benefits associated with technology use (Catalogue No. 88-514). These studies focused primarily on the type of firm behaviour that creates and exploits new products or processes.

While creative activities of enterprises are at the core of innovation, these activities require a supporting institutional framework. A key part of that institutional framework consists of the legal system within which transactions are carried out. For the innovation system, intellectual property rights are the supporting framework that is provided by the state.

This study examines the extent to which firms protect their intellectual property using the framework that has been provided by the state. It investigates which forms of protection are used by firms and how effective these rights are perceived to be by firms that make use of them. It finds that firms use a wide and varied set of instruments to protect the intellectual capital that they create while innovating.

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Executive Summary

- This study examines the use that is made of intellectual property protection by firms in the manufacturing sector in Canada. It is derived from the first comprehensive survey done in this area of the population of manufacturing firms. It is also unique in that it investigates the use that is made of intellectual property protection by innovators—that is, firms that have just introduced major new products or processes. These innovations range from world-firsts to Canadian-firsts to major imitations. At any one point in time, a relatively small percentage of firms are actively innovating. Only about half of the largest firms (>500 employees) report sales from a major product innovation over the last three years. Only about a third of those with less than 100 employees do the same.

- Several broad forms of protection for intellectual property are supported by the state—patents, copyrights, trade-marks, industrial designs, and trade secrets. These statutory forms range from patents, which are registered by an administrative system and enforced by the courts, to trade secrets, which are supported through the legal system. Less than one-quarter of the population of manufacturing enterprises, both large and small, make use of at least one of these forms of statutory protection. Only about 7% specifically use patents. The importance of these forms of protection for intellectual property increases when the size of the using entities is considered. While only about one-quarter of manufacturing firms use one of these forms of protection, these firms account for 50% of employment.

- The difference in these two measures of use—company-weighted versus employment-weighted—results from large differences in the extent to which small and large firms avail themselves of the statutory forms of protection. Over 62% of firms with more than 500 employees protect themselves with any one of the statutory rights, less than 30% of those with less than 100 employees do so. Part, but not all, of this difference is accounted for by different tendencies of large and small firms to innovate. But even when these differences are taken into account, small innovative firms are seen to make use of the statutory forms of protection less frequently than large firms. Of those large firms reporting sales from a product innovation, almost 64% possess one of the statutory rights; but only 30% of those with between 20 and 100 employees who have recently introduced a major product innovation possess one of the statutory rights.

- Being innovative is a primary determinant of the use of intellectual property protection. There are substantial differences in the use of trade-marks, patents, trade secrets, industrial designs and copyrights between those who introduced innovations in the three years preceding the survey and those who did not. While some of those firms that were not innovating during 1989-92 possessed a form of intellectual property protection, the percentage was small.

- Not all forms of statutory protection are sought equally by innovative firms. When the effect of being innovative is separated from the effect of firm size, nationality, and industry, innovativeness has its largest effect on the use of patents and trade-marks. However, large and significant effects of being innovative on the use of industrial designs, trade secrets and copyrights are also found. Innovative firms concentrate on patents but also use a wide range of other statutory forms of protection.

- Although many innovators make some use of statutory intellectual property protection, there are a substantial group who for several reasons do not. The first reason is that not all innovations have sufficient novelty to be patentable. Only 15% of innovations in large firms are world-firsts, some 30% are firsts for Canada. This study finds almost 80% of world-first innovators protect themselves with a form of statutory protection either in Canada or abroad but less than half of other types of innovations use the statutory forms of protection. The second reason that not all innovative firms avail themselves of statutory forms of protection is that many innovations are of a type that are not suitable for patent protection. Process innovations lend themselves more to protection through secrecy than do product innovations and some 45% of all major innovations in large firms involve just process innovations.

- In addition to providing a broad overview of the extent to which the statutory system is used, this study also examines the extent to which participants value the system. Previous work done for the U.S. has found that, with the exception of firms in chemicals and pharmaceuticals, statutory patent protection was not regarded as essential to the innovation system. Others have found that U.S. R&D managers have not given a passing score to patents as a means of protecting an innovation. Firms gave a higher ranking to alternative protection strategies, such as being first in the market or having a complex product design.

- This study confirms that Canadian manufacturing firms also tend to value alternate strategies, like being first in the market, more highly than the statutory forms of protection. Moreover, the population of manufacturing firms ranks such strategies as patent protection as "less than effective". However, these rankings depend very much on the characteristics of a firm. If a firm is innovative, large, foreign-owned, and is located in one of those industries that tend to produce more innovations, the score given to the statutory forms of protection like patents increases greatly. On average, these users of patents rank them as being effective.

- Previous work gives a different picture of the importance of the patent system when statistics of use are employed as opposed to when firms' own evaluations are used. This is not the case here. The firms that give statutory forms of protection like patents a lower score are those that do not make use of patents. Those who have undertaken the effort to acquire patents tend to give them a passing grade. Patents however, do not provide an ironclad guarantee against competition. The world is too dynamic; innovations are constantly being bettered by competitors. Patents serve their purpose but they are only one aspect of a multi-faceted approach that innovators pursue.

- Innate forms of protection, like being first in the market, or having a complex product design, are seen by almost every subgroup—large, foreign-owned, innovative firms—as being equally if not more effective in preventing an innovation from being copied. Forms of protection, other than just statutory intellectual property rights are seen as being 'effective' in protecting knowledge assets.

- There is much less variance across size classes in the perception of the effectiveness of these alternative strategies than there is for the statutory forms of protection. Small firms do not feel that protection for intellectual assets that they might develop during innovation is lacking; however, they feel that innate strategies, such as being first in the market, are effective while patents are not. As firms get larger, they continue to rate innate strategies as effective and begin to increase the score they give to statutory forms of protection like patents.

- Differential usage patterns between small and large firms also reflect these differential opinions on effectiveness. Small firms use trade secrets more frequently relative to patents than large firms. When other differences between small and large firms, such as differences in innovativeness, nationality, and industry location are considered, size has the greatest impact on patent and trade-mark use.

- There is also a large difference in both the usage and the evaluation given to statutory forms of protection by foreign-owned and domestically owned firms. Foreign-owned firms are more likely to make use of statutory forms of intellectual property rights and to value them more highly. Some but not all of these differences disappear when allowance is made for differences in industry location, degree of innovativeness, and size. When these other characteristics are considered, the effect of nationality on use is more likely to disappear than is the effect of nationality on the evaluation of the effectiveness of the statutory property right. After correcting for these other characteristics, foreign-owned firms do not use the statutory rights more frequently (with the exception of patents), but they are more likely to perceive that they are more effective. Nationality has the greatest impact on the evaluation of patents and trade secrets.

- The study also finds that the industry environment affects the use that is made of intellectual property. Cross-industry differences in intellectual property usage in Canada are closely related to differences in the innovativeness of an industry. There are a core set of industries—chemicals, pharmaceuticals, refined petroleum, electrical products, and machinery—that tend to produce a large number of inventions that are used as inputs or as capital equipment downstream in other industries. These core industries make greater use of almost all forms of statutory protection than do other industries. This is particularly true of patents and of trade-marks. Thus the industrial structure of a country determines the use that will be made of intellectual property protection.

- Firms in different sectors take a very different view of the effectiveness of both the statutory and the innate forms of protection. Even after allowing for differences in size, nationality and innovativeness of the firm, being in the more innovative industries substantially increases the score given to patents and trade-marks—though not to trade secrets. The industry environment conditions a firm's view of the effectiveness of the intellectual property system.

Introduction

Innovation is seen as the most important factor behind increases in economic well-being. As an empirical matter, firms that are innovative in a broad sense, have been found to gain market share relative to non-innovative firms and to increase their profitability relative to others within the same industry (Baldwin, Chandler et al., 1994).

In an attempt to better understand the innovation process, Statistics Canada has initiated a variety of studies. Baldwin and Da Pont (1996) provide a broad overview of innovation—the types of innovations, the origin of ideas for innovation, the benefits of and the problems that stand in the way of innovation. Baldwin and Johnson (1996) examine the extent to which there are a set of policies in marketing, finance, and human resource activities that complement innovation. Baldwin and Sabourin (1995, 1996) investigate various facets of technology that contribute to innovative production processes.

This study examines the extent to which innovative firms use and appreciate various forms of protection for the intellectual property that is developed as part of the innovation process. Innovation involves the development of new ideas that lead to new products or new processes. Investment in the development of new products and new processes will not be made unless the investment is profitable—unless the intellectual property that results from the investment has some private value. Unfortunately, in many cases, ideas can be easily duplicated or stolen. Without some form of protection for the knowledge assets that are developed by the investments in ideas that are required for innovation, innovation will not take place, or at least not in optimal quantities (see Arrow, 1962). When intellectual property is protected, an innovator is able to appropriate the benefits of innovation. Because of the perceived importance of protection, public policy is used to permit the investment in ideas to be appropriated by those who made the original investment.

Appropriability is facilitated by various methods that are used to establish and protect intellectual property rights in knowledge assets. These property rights are protected by statutory protection granted by legislation, by common law, and by strategies that innovators can take that make it difficult for others to imitate or copy the innovation. The political system in creating these rights has continuously wrestled with competing objectives—the creation of property rights that protect ideas versus the desire to diffuse information so as to facilitate the widest possible benefits from the innovation; the consequences of creating monopolies by the provision of protection for ideas against the desirability of having a competitive market structure producing goods and services.[1]

The theoretical literature on the optimal type of intellectual property regime[2] is more extensive than applied studies of the use of intellectual property. One of the reasons for this is that detailed data on intellectual property use is difficult to come by. Empirical studies on the use of intellectual property in Canada by Firestone (1971), Séguin-Dulude and Desronleau (1989), and Consumer and Corporate Affairs (1990) have had to rely on specially designed surveys. Because of their cost, surveys of this nature are done infrequently.

Other studies (Etemad and Séguin-Dulude, 1987; St.-Pierre and Hanel, 1996) make use of patent registrations, either derived from PATDAT data on Canadian patent registrations that are maintained by Industry Canada or international data derived from the World Intellectual Property Organization (WIPO). These international data suffer from several main problems if they are to be used to judge the innovativeness of different countries. First, the international data are not always comparable. For instance, Japan allows narrower criteria for patenting and, therefore, has a larger number of patents than other countries. Second, it is difficult to judge the importance of patents from filing data. Some countries may patent a large number of relatively unimportant new ideas while other countries may create a smaller number of commercially important ideas.

The most significant problem with patent registration data is that alone it does not indicate whether firms are using intellectual property protection, in particular whether the patent is being worked. For example, Firestone (1971, p. 96) found that not more than 45% of Canadian patents were being worked. Moreover, patent data alone tells us little about the characteristics of the firms that are using intellectual property protection. It is difficult, though not impossible,[3] to link firm characteristics to the data on filings. Without having characteristics of those firms that use intellectual property rights, it is difficult to understand who is using them and under what circumstances. Recently, several surveys in the United States (Levin et al., 1987) and in Europe (Bussy et al., 1994; Arundel et al., 1995) have focused more broadly on how intellectual property protection complements the innovation process.

[1] *A discussion of these tradeoffs can be found in Taylor and Silbertson (1973).*
[2] *See Cohen and Levin (1989).*
[3] *See St.-Pierre and Hanel (1996) for a study that links profitability data to PATDAT patent data.*

But while these surveys expanded the information on use and on user attitudes toward the efficacy of the various forms of intellectual property protection, they either did not link the information on use to other characteristics of the firm or they had a relatively limited set of firm characteristics that could be related to intellectual property use.

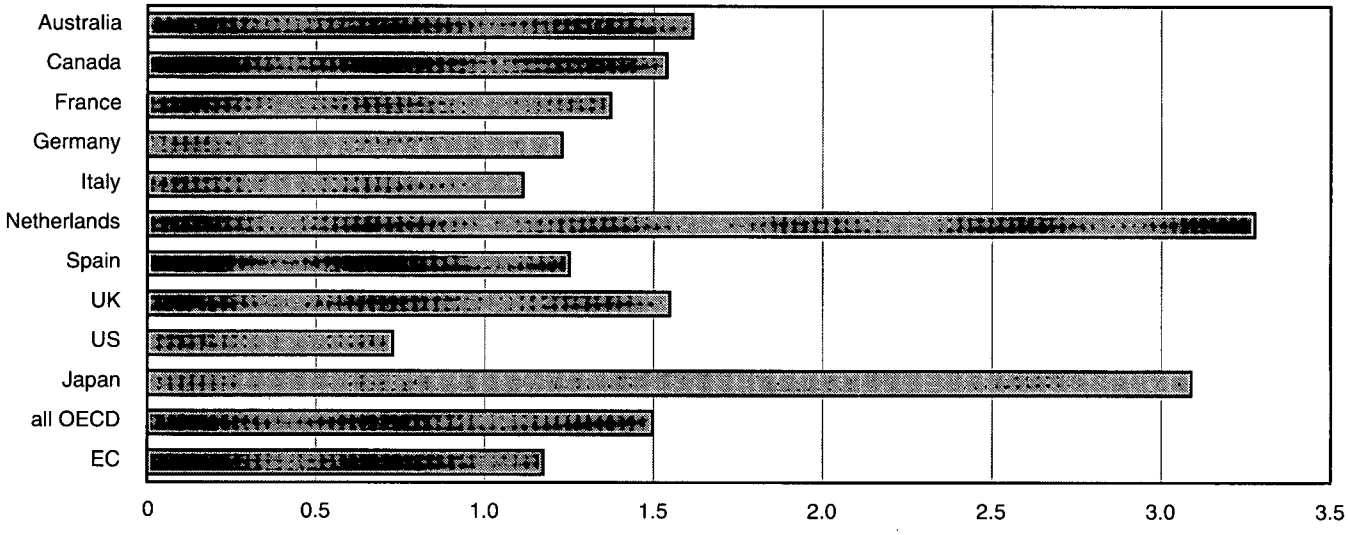
This study builds on these previous studies and extends them. It focuses broadly on the use of intellectual property protection in Canada by examining the extent to which it is an integral part of the innovation system. It focuses on more traditional issues such as the intensity of use—though it tries to obtain a comprehensive picture of the different instruments (both statutory and other forms of protection) that are used to protect intellectual property assets. It also measures the degree to which firms perceive different instruments to be more or less effective in protecting intellectual property. Finally, by also collecting data on the innovative activities of firms, the different forms of intellectual property protection that are used can be related to the innovation profile of the firm.

This study relies on information about the use of various forms of intellectual property protection that was collected by the 1993 Survey of Innovation and Advanced Technology. In this survey, questions about the type of protection used as part of the innovation process and questions that explore the efficacy of various forms of protection in preventing competitors from introducing copies of product and process innovations are posed of manufacturing firms. This allows us to study the extent to which intellectual property rights are regarded as an essential part of the innovation process. The answers given by different firms are then tabulated by their characteristics—whether firms are large or small, foreign- or domestically owned, innovative or non-innovative—to explore how usage of intellectual property at the firm level varies across small and large firms as well as across foreign- and domestically owned firms. In addition, answers to questions about the type of innovation undertaken by these firms are used to classify the degree of innovativeness of a firm; then the use and perceived efficacy of various forms of intellectual property protection are tabulated by the firm's degree of innovativeness.

Since there is evidence that the efficacy of intellectual property rights varies not only by firm but also by type of innovation (Levin et al.,1987), the survey asked firms to describe the use that they make of intellectual property generally and it requested information on the method used to protect a particular *major* innovation. This paper then analyzes whether utilization and efficacy vary by the characteristics of the *major* innovation of the firm. Intellectual property use for the *major* innovation is tabulated by characteristics of this major innovation—whether it was a world-first, and whether it was a product or process innovation.

Figure 1

National Patent Applications per Capita - 1992*



Source: WIPO, OECD

** Total foreign and resident filings per 1,000 inhabitants*

Canada in an International Context

Before discussing the way in which intellectual property protection is used in Canada, it is important to situate the Canadian experience with intellectual property protection relative to that of other OECD member countries. For this purpose, one form of intellectual property protection (patents) will be used to compare intellectual property use. Two measures of patent use will be employed. The first captures the extent to which the citizens of different countries potentially benefit from the consumption of goods and services that are protected by patents. The second is the extent to which the innovation systems of different countries make different use of patent protection.

Patents are one of the primary methods used to protect innovative ideas. Since patent applications are filed to provide protection for knowledge assets, the number of filings is related to the value of capital invested in innovative ideas that are available to benefit the population of a country. The OECD publishes the number of patent applications in each member state—both the total applications and the number filed by just the residents of that country. Patents are filed by foreign residents to protect their right to exploit their own ideas either through trade or through direct production. Since, foreign patent applications provide as much if not more benefits to the inhabitants of the country in which they are filed as resident patent applications, total patents both by residents and non-residents will be used here for cross-country comparisons.[4] In order to standardize for the number of people who are expected to benefit from patent filings, the national totals are divided by the population in each country.[5] The resulting ratios of 1992 patent filings per capita are presented in Figure 1 for Canada and all other OECD countries that have more than 15 million inhabitants. Canada has about 1.54 filings per 1000 inhabitants. The OECD total is 1.49 and the EC total is 1.17. Canada is behind Japan and the Netherlands but equal to or ahead of the other large members of the OECD.

Patent statistics may also be used to characterize the productiveness of different innovation regimes. For this purpose, only patents filed by residents are relevant. In order to reduce the problems referred to previously—differences in standards of patenting and in the importance of patents across countries—Patel and Pavitt (1991) have suggested that patent filings in a third country like the United States be used. This will impose a common standard and will cull out those patents that inventors do not feel possess enough commercial importance to warrant the expenses of protecting them in the largest and wealthiest OECD market. In order to compare the relative productivity of different innovation systems, patents, which are a measure of output in that they are used to protect innovation assets, need to be standardized by a measure of input to the innovation process. The measure used for that purpose is the number of research and development scientists and engineers.[6] The resulting measure of the productivity of the innovation process for each country is presented in Figure 2. With 6.2 patents filed in the U.S. per research scientist, Canada compares favourably to most countries. It is ahead of Japan, France, Belgium, Italy and the U.K., but behind Germany, Sweden, Denmark, Finland and Switzerland.

This comparison does not permit an evaluation of the relative innovativeness of Canada and the United States because it uses U.S. home-market data. However, if Canada and U.S. experience in a third market (patent applications in the U.K., Germany, and France) are compared, then Canada does just as well (over 10 patent applications per 100 R&D scientists) if not better than the United States (less than 5 patent applications per 100 R&D scientists).

Forms of Intellectual Property Protection

The protection given to intellectual property takes different forms. Intellectual property rights can be grouped as works of identification (trade-marks, appellations of origin), works of expression and information (copyright, industrial design, trade secrets) and works of function (patents, copyright on computer software, and trade secrets).

Companies may protect their knowledge assets by keeping them secret and may enforce the responsibilities of their employees not to divulge proprietary information through the courts. Unlike other areas of intellectual property rights in Canada, no distinct statute protects trade secrets though they are protected under common law and will be grouped with other statutory forms of protection for the purpose of presentation herein. Trade secrets can be licensed to others with the requirement that the recipient not divulge information about the secret. Trade secrets are enforced by courts as unfair trade practices under common law. The owner of a trade secret is entitled to its exclusive use, at least until it is lost

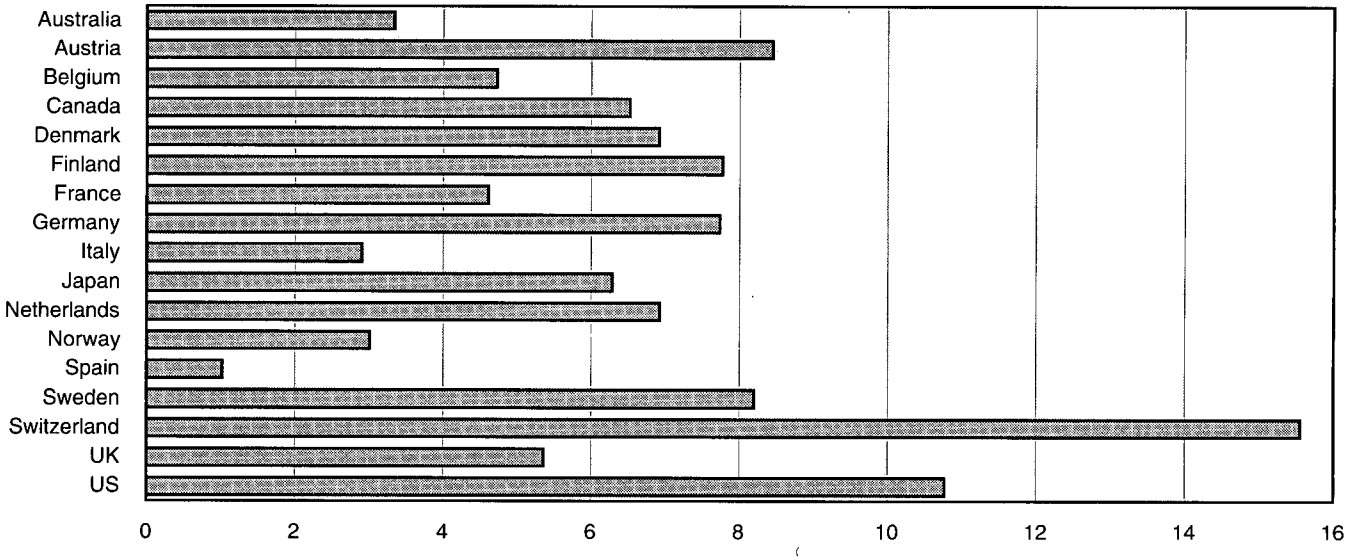
[4] *Firestone (1971, p. 132) reports that over two-thirds of U.S. corporations that were found to own patents in his sample also possessed operating subsidiaries in Canada. Therefore, there is a strong presumption that these patents are being used in Canada.*

[5] *Alternately, GNP could be used. But such a measure is biased against more productive countries.*

[6] *The patent filings data are for 1993 and come from WIPO, Industrial Property Statistics Part 1, 1993, 1995. The data for R&D scientists and engineers are mainly for 1990 and come from the OECD, 1994, part 2, p. 18. It should be noted that the ratio developed here and presented in Figure 2 measures the extent to which innovation activity makes use of patents, not the intensity of innovative activity itself.*

Figure 2

Patents Filings in US Market per 100 R&D Scientists in Home Country



Source: WIPO, OECD

due to independent development by another, reverse engineering, espionage or an unauthorized disclosure. A trade secret is advantageous in that there is protection for an unlimited time if it remains undisclosed and it can be exploited immediately without the time and expense of registration.

Another form of protection for knowledge assets is afforded by statute.[7] These statutes create and protect property rights in these assets. The most familiar type of statutory protection is given by patents. A patent gives to the inventor the exclusive right to exploit an original invention for a limited period in return for the public disclosure of information about the innovation. While patents are the most visible form of protection, there are a number of other types of protection that are provided by legislation, by administrative practices, or by regulation. Trade-marks are devices or words legally registered as distinguishing a manufacturers' goods. The Industrial Design Act protects the ornamental aspects of goods. Copyrights are a form of protection given by federal statute to an author for the right to print, publish, and sell copies of the original work. While copyrights are normally thought of in the context of book publishing, their use extends also to the product and service sector. To the extent that documentation is key to the understanding of the operation of a product, copyrights offer important forms of protection to goods.

Two forms of statutory protection are offered which are highly specific to some industries. Plant breeders' rights protect seeds or other propagation material. Integrated circuit design protection safeguards the original three-dimensional pattern of layout design embodied in an electronic circuit.[8]

Statutory forms of protection essentially enhance the degree of protection provided to knowledge assets. However, it must be recognized that some protection would exist without patents and other forms of statutory protection. Those who stress difficulties in the innovation process associated with a lack of appropriability often treat the process as one in which ideas easily flow from company to company. If this is the case, ideas can be readily stolen and intellectual property will have little value. However, it is argued that, in many cases, the knowledge that is important to the innovation process is "tacit". It is not easily codified or communicated and depends on innate skills that are specific to particular firms. As such, appropriability exists for some innovations (the intellectual property therein is protected) even in the absence of statutory intellectual property rights. Protection for innovation in these instances is given by the difficulty of copying new ideas, new products, or new processes. Even when new products are fully described in patent documents, the act of turning that knowledge into a new product or process is difficult and costly. Since, new

[7] *Throughout this paper, trade secrets are grouped under statutory forms of protection since they are enforced by an arm of the state—the court system.*

[8] *See Appendix A for more comprehensive definitions of various forms of intellectual property protection.*

technology involves a mix of codified knowledge and implicit know-how that is difficult to transmit or to digest (Mowery and Rosenberg, 1989), intellectual property associated with innovation retains its value even in the face of attempts to copy it.

Some innovations have characteristics that give them innate protection. These are forms of protection that do not originate in standard intellectual property legislation. They either result from natural characteristics of the product or are the result of specific strategies adopted by the firm. Process innovations can sometimes be hidden behind factory walls and the know-how required to make them work kept secret. On the other hand, product innovations by their nature circulate. While the secret of new products is difficult to conceal, there are a number of methods that a firm can use to augment the protection that its knowledge assets are given by the inherent difficulty in copying ideas. These include first-mover advantages, exclusive contracting, reputation and goodwill, and tie-ins to services. For example, complexity of design can provide enough of an advantage for the innovative firm to permit research and development expenses to be recouped. Being first in the market can engender enough consumer loyalty or a cost advantage because of cumulative learning that it may also offer substantial protection. In addition, firms can bundle complementary characteristics like service or quality to reduce the chance that new competitors will capture substantial market share. These instruments offer a form of innate protection that derives from a firm's strategy and not from legislative authority.

The Survey

The data presented here are taken from the 1993 Survey on Innovation and Advanced Technology. This survey investigates the use of intellectual property protection by Canadian manufacturing firms, that is, those firms that owned at least one plant located in the manufacturing sector. The survey examines the extent to which different forms of protection—patents, trade-marks, trade secrets, industrial design and copyright—are used by firms to protect their intellectual property and the extent to which they feel the protection offered by these instruments and by several strategies like being first in the market or having a complex product serves to protect their innovation from being copied. Because these questions are posed as part of an innovation survey, the differences in usage patterns can be related to differences in firm characteristics—such as size, nationality and, what is most important for the purpose of this paper, innovative activity. Being able to measure usage in the context of innovative activity is an advantage since this study assesses the extent to which intellectual property (i.e., patents) is usefully employed as part of an innovation strategy. Of course, the use rates calculated here, which are associated with innovative activity, may underestimate the extent to which patents are possessed by manufacturing firms--if firms possess patents that do not serve to protect intellectual property. In this case, our estimated "use" rates will underestimate "possession" rates. The latter is unlikely.

The innovation section of the survey deals with the nature of the research and development process, general innovative behaviour, the characteristics of a specific major innovation, the intensity of technology use, problems experienced in adopting technologies, and finally the general characteristics of the responding firm—nationality of ownership, export intensity, number of competitors and firm strategies.

The Survey of Innovation and Advanced Technology was conducted in 1993 using manufacturing firms of all sizes. There were five sections on the questionnaire. Section 1 contains general questions about firm characteristics; Section 2, R&D questions; Section 3, innovation questions about firm characteristics; Section 4, intellectual property questions; and Section 5, technology questions (Table 1). Firms were asked to describe their innovative activity and their use of intellectual property over the period 1989-91.

Three types of units were sampled: plants of larger firms[9] whose head office is located elsewhere, the corresponding head offices of these firms, and small firms that have both their management and plant located in the same spot. In large firms, the first four sections were put to management in head office, the fifth section was addressed to selected plant managers. A telephone contact was initially made to ascertain the identity of the individual who could best answer each of these sections and, when necessary, each section was sent to different respondents within the firm. In small firms, all of the sections were sent to the same location.

Consequently, for large firms, selected plants were sent the technology section and the corresponding head office was sent the first four sections. Together, the head office responses of large firms on general characteristics, R&D,

Table 1
The Types of Sampling Units and the Sections Answered

Firm Size	Sections				
	General	R&D	Innovation	Intellectual Property	Technology
	1	2	3	4	5
	questions asked				
Head Offices	all	all	all	all	
Small Firms (Group 1)	all		some	all	
Small Firms (Group 2)	all	all			some
Large Plants					all

[9] *Large firms are defined as those in the integrated portion (IP) of the business register, small firms as those coming from the non-integrated portion (NIP) of the business survey. The integrated portion of the register consists of those firms that are big enough that a large proportion of these firms is required on surveys that stratify by size; the non-integrated portion is that set of firms that are small enough that they need only be sampled in relatively small proportions when firms are stratified by size. Large firms (IPS) vary in size from about 20 employees to over 500 employees. Small firms (NIPS) generally have less than 20 employees.*

innovation, and intellectual property, along with the technology questions answered by their plants provide a comprehensive overview of the innovative and technological capabilities of large manufacturing firms.

The small firms were handled somewhat differently. In order to reduce response burden, the small firms were separated into two groups. The first group answered Sections 1, 3 and 4—the general, innovation and intellectual property questions. The second group answered Sections 1, 2 and 5—the general, R&D and technology questions. In certain sections, small firms were only asked selected questions in order to further reduce their response burden.

There were 1,595 head offices (answering the first three sections) sampled, 1,954 large plants (answering the last section) sampled, 1,088 small firms answering the first, third, and fourth section and 1,092 small firms answering the first, second and fifth section. Some 2,683 firms received the section on intellectual property—1,595 large firms and 1,088 smaller firms.

The survey was conducted in several steps. Initially, the unit was contacted to determine who within the firm (both the head office and the plant) should be sent each section. These individuals were contacted by phone to confirm their ability to answer the survey. Then the questionnaire was mailed out to the designated individuals. Finally, where necessary, telephone follow-ups were performed. The response rate for the intellectual property portion of the survey was 92% for small firms and 85% for large firms.

The responses reported herein are probability weighted to provide an accurate representation of the universe of firms from which the survey was taken, that is, all firms that possessed at least one manufacturing plant. Two sets of weights are used throughout. First, company weights are used to present a picture of the average tendencies in the population from which the sample is drawn. The business population consists mainly of small firms and, therefore, company-weighted results reflect primarily the practices of smaller and mid-size companies. Second, employment-weighted results are presented to give a picture of the importance of the economic activity in those firms that make use of intellectual property protection. An employment-weighted characteristic reveals the percentage of employment in the entire population that possesses that characteristic. For example, if the company-weighted use of patents is reported as 20%, this implies that 20% of all firms use the rights bestowed by patents. If the employment-weighted use of patents is reported as 40%, this means that the companies using patents employ 40% of the total employment. This type of difference between company-weighted and employment-weighted results occurs when larger companies tend to use patents more than do smaller companies. As is demonstrated in the accompanying report, this type of size-related difference occurs across a wide range of intellectual property rights.

This survey has several advantages over those done previously in Canada and elsewhere. First, it makes use of a comprehensive frame for sampling firms in the manufacturing sector and, therefore, provides results that can be extrapolated to the population. In general, other Canadian surveys (Firestone, 1971, Séguin-Dulude and Desronleau, 1989) have arbitrarily selected a sample of firms, generally from the group that hold a patent, and the results cannot, therefore, be said to be representative of anything other than the group of firms that were chosen. Second, other surveys have had much lower response rates.[10]

Use of Intellectual Property Rights by Manufacturing Firms Operating in Canada

The use of statutory forms of intellectual property protection provides a measure of the output of the innovation system—at least, of those outputs that receive some form of administrative or legislative protection (see Griliches, 1990). The intensity of use at the level of the firm is investigated here for several forms of intellectual property protection—protection that is granted by statutory rights associated with copyrights, patents, industrial designs, trade secrets, trade-marks, integrated circuit designs, and plant breeders' rights.

Overall, some 24% of firms utilize at least one of these statutory forms of protection (Table 2). Some 14% of firms own only one of these forms of protection. About 6% have two forms of statutory protection. Very few have more than this. Manufacturing firms do not tend to utilize multiple forms of statutory protection very frequently.

The employment-weighted use rates are more than double the company-weighted rates. Those firms that have some form of statutory protection account for 50.2% of total employment (Table 2). The large difference between the company-weighted and the employment-weighted results extends across each of the usage categories. Large firms then are much greater users of the various statutory forms of intellectual property protection.

Use varies substantially by type of intellectual property protection (Table 3). Trade-marks are the most popular form, with 11% of firms using at least one trade-mark. Statutory trade secrets and patents are second and third,

[10] *The response rate for the MERIT survey was only 56%.*

Table 2
Multiple Use of Statutory Forms of Intellectual Property Protection (% of Firms)

Firm Size	Number of Intellectual Property Types				
	At Least One	1	2	3	4+
Company-weighted	23.7	14.0	6.2	2.5	1.1
Employment-weighted	50.2	20.7	12.1	6.5	10.8

Table 3
Usage of Intellectual Property by Type (% of Firms Using Intellectual Property Protection)

Type	All Firms (Company-weighted)			All Firms (Employment-weighted)		
	At Least One	1 to 5	6+	At Least One	1 to 5	6+
Copyrights	4.5	2.8	1.7	13.0	5.5	7.6
Patents	7.1	6.1	1.0	29.0	16.4	12.7
Industrial Designs	5.7	3.9	1.8	15.2	9.5	5.7
Trade Secrets	8.3	5.6	2.7	19.9	10.6	9.4
Trade-marks	11.0	8.9	2.1	31.9	17.5	14.4
Integrated Circuit Designs (Semi-conductor Chips)	0.6	0.3	0.3	1.0	0.5	0.5
Plant Breeders' Rights (Plant Variety Rights)	0.1	0.1	0.1	0.9	0.4	0.4
Other	1.4	1.3	0.1	2.1	1.4	0.7

with 8% and 7%, respectively. Industrial designs are used by 6% of firms and copyrights by 5% of firms. Less than 1% of firms report use of integrated circuit designs and plant breeders' rights.

Once again, the employment-weighted use rates are substantially higher than the company-weighted results—though the relative importance of the various categories is about the same in each case. Those firms that used trade-marks made up only 11% of the population but they accounted for 32% of total employment. Firms that used patents made up only 7% of the population but they accounted for 29% of total employment.

The ranking of trade-marks and patents derived from these use-rates accords broadly with the relative size of the number of trade-marks and patents that are registered annually in Canada. For example, in 1993, some 14,580 patents were granted while 15,121 trade-marks were registered.[11] On the other hand, Canadian manufacturing firms indicate a greater reliance on industrial designs than the figures for formal registration of industrial designs would suggest. In the case of industrial designs, only 1,638 deposits were registered in 1993—a little more than 12% of the number of patents granted. Yet in the survey almost the same percentage of firms indicated they protected their intellectual property with industrial designs (6%) as indicated they used patents (7%). Respondents likely took a broader definition of industrial designs than just those that are officially registered and included in their response those unique features that served to establish a valuable advantage for their product.

Patents offer statutory protection but require that information regarding the invention be placed in the public domain. A patent is a compromise between two offsetting objectives—that of protecting the rights of the innovator and that of disseminating information about the innovation. On the one hand, protection grants appropriability for the innovation and provides incentives for innovation. On the other hand, the information filed with patents facilitates the spread of information that may aid the general process of innovation. More importantly, the establishment and enforcement of property rights facilitate trade in intellectual property. Without well-defined property rights, markets do not function efficiently.

While patents offer protection for a firm, the protection may not always be very strong. Competitors can patent around an invention when there are many known means to achieve an effect equivalent to the patented one. Patents also suffer from difficulties in enforcement (Von Hippel, 1988, p. 52).

[11] *The relative usage rates do not however closely correspond to the relative usage rates of patents and trade-marks by residents that are reported in the WIPO statistics. Here trade-marks registered to Canadian residents outnumber patents granted to Canadian residents by a factor of 7 to 1.*

Secrecy offers an alternative to patents as a way to protect an innovation. An innovator who possesses a trade secret can prevent the disclosure of the secret through fraudulent or dishonest means. Other firms can be licensed to use the secret and bound to keep the information secret. The disadvantage of the secrecy route is that the holder cannot prevent imitation if that imitation is independently discovered, acquired legally, or reverse engineered. Thus trade secrets are most effective for process innovations where the process can be hidden behind factory walls or with products that incorporate various barriers that prevent reverse engineering.

Trade secrets and patents need not be regarded as being strict substitutes. They can be used together. If an innovation involves both a process and product change, as is often the case (Baldwin and Da Pont, 1996), the process innovation may be protected via a trade secret while the product innovation may receive protection from a patent.

In light of these considerations, it is noteworthy that use rates in the Canadian manufacturing sector for patents (7%) and trade secrets (8%) are about the same (Table 3). Secrecy is used just as much as the patent process to safeguard innovations. Secrecy is somewhat less important than patents when the employment-weighted estimates are used.

Most firms do not make use of a particular form of protection more than once. Most firms indicate that they only have 1 to 5 instances of a property right. As such, the relative rankings (company-weighted) in this category of usage are much the same as for overall use. However, for higher use categories, the ranking of trade secrets (company-weighted) rises to first place. Trade secrets are relatively more important for owners of multiple assets. On an employment-weighted basis, trade-marks increases its relative importance and surpasses trade secrets. The large multiple users then are relatively heavy users of the trade-mark system.

Effectiveness of Intellectual Property Protection

a) Overall Evaluations

Information on intellectual property use provides one indicator of the efficacy of different forms of statutory intellectual property protection. If a form of protection is not used, it serves little purpose.

An alternate measure is provided by evaluations given by respondents about the effectiveness of the various forms of intellectual property protection in preventing their innovation from being duplicated (Table 4). The Innovation Survey asks firms to rank the seven forms of protection enumerated in Table 3 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 copyrights, patents, industrial designs, trade secrets, trade-marks, integrated circuit designs, and plant breeders' rights are given in Column 1 of Table 4. In order to provide a comparison to each of these, the average score given to other forms of protection—the complexity of product design, being first in the market, and other strategies—is also included in Table 4. The average score presented in the first column is derived from those voicing an opinion for that category. The second and third columns contain the scores for firms divided into those who indicated they used any of the statutory forms of protection (general users as opposed to those not possessing any of the mentioned property rights). The fourth and fifth columns contain the average score for the firms that indicated they used the particular form of protection in question (specific users as opposed to those not using the property right in question). Thus, the average score for all firms evaluating copyrights is 1.4; for those using any of the forms of statutory protection, it is 1.6; for those indicating that they possessed a copyright, it is 2.8.

When all respondents are considered (Table 4, Column 1), most of the statutory forms of protection receive low scores. None of the statutory forms of protection is deemed to be very effective by the population at large. The most effective of these are trade-marks and trade secrets, which are also the two forms of statutory protection that are most heavily used. Nevertheless, at 1.7 they only receive average scores that are slightly less than "somewhat effective", the second lowest ranking.

Innate protection derived from the complexity of product design and being first in the market receive the highest average scores—2.4 and 3.0, respectively. Both of these are scored significantly above the forms of statutory protection. Thus, innate not statutory forms of protection are valued more highly by the population at large.

When the sample of firms is restricted to those using any one of the forms of statutory intellectual property protection (general users), the average scores increase for each of the forms of intellectual property protection (Table 4, Column 2). The scores also increase for the strategies involving complexity and being first in the market and the latter still receive the highest average scores.

Table 4
Effectiveness of Intellectual Property Protection (Company-weighted)

Intellectual Property Rights Associated with:	Average Score				
	All Firms	Users of Any Statutory Right	Non-users of Any Statutory Right	Users of Specific Statutory Right	Non-users of Specific Statutory Right
	1	2	3	4	5
Statutory					
Copyrights	1.4	1.6	1.3	2.8	1.3
Patents	1.6	2.0	1.5	3.0	1.5
Industrial Designs*	1.4	1.7	1.4	2.3	1.4
Trade Secrets	1.7	2.2	1.6	3.1	1.6
Trade-marks	1.7	2.3	1.5	3.1	1.5
Integrated Circuit Designs	1.3	1.3	1.2	3.0	1.2
Plant Breeders' Rights	1.2	1.1	1.2	2.0	1.2
Other	1.3	1.4	1.3	3.0	1.3
Other Strategies					
Complexity of Product Design	2.4	2.7	2.3		
Being First in Market	3.0	3.3	2.9		
Other	2.4	2.4	2.3		

Scored as: 1—not at all effective; 2—somewhat effective; 3—effective; 4—very effective; 5—extremely effective
** This category probably involves protection granted under the Industrial Design Act and more innate forms of design protection.*

When the sample is further restricted to include just those firms using the forms of intellectual property protection in question (specific users), scores increase somewhat more (Table 4, Column 4). For example, those who possess patents score this form of intellectual property as 3.0 or "effective"; those who have no patents give it a score of 1.5—less than "somewhat effective". The average score given to trade secrets by all firms is only 1.7—"somewhat effective"—but owners of trade secrets give them an average score of 3.1—"effective"—while non-owners rank it only as 1.6—between "not at all effective" and "somewhat effective". This difference, between those who use the particular form of protection in question and those who do not, can be found in almost all the categories. Innovators who use intellectual property protection rank this protection well above those who do not. The low average scores that the population gives to intellectual property rights is due to the large number of non-users who do not regard them as effective.

For users of intellectual property, trade secrets and trade-marks are still at the top in terms of ranking, though now they each receive an average score of 3.1, indicating that users regard them both as "effective". Most of the other forms of protection rank between 2.0 and 3.0. Patents receive a score of 3.0 and are only slightly behind trade secrets.

In the case of non-users, trade-marks, trade secrets, industrial designs and patents all receive scores between 1.4 and 1.6. The reason then for the low overall score given to statutory protection lies in the evaluation of non-users. Users believe that they are effective.

The previous section has examined the value placed on various forms of intellectual property protection by examining central tendencies of the distribution of their scores. An alternate method of evaluating differences across the various forms of protection is to compare the entire distributions for different categories of firms. While this method is data intensive, it provides a more complete picture of the types of evaluations that are made by firms. Distributions can show whether there are particular groups that place no value on a particular category and whether others have more or less normal distributions around a central value.

The differences in the distributions of users and non-users is presented in Table 5, for four different subsets of the population of total firms (Columns c, d, e, and f), cross tabulated by the five major intellectual property types (Column a). The effectiveness of intellectual property protection is scored from 1—not at all effective to 5—extremely effective (Column b). Firms' responses across the scoring categories are depicted as percentage distributions.

Subsets of the total firm population are used to show how the possession of statutory intellectual property protection affects firms' evaluations of the effectiveness of each of the forms of protection. The subsets are: All Firms, i.e., all firms that responded to the survey question; General Users, i.e., all firms that used at least one of the five major forms of statutory protection considered in this table; Specific Users, i.e., only those firms that used the statutory right being scored; and Non-users, i.e., firms that did not make use of any of the five major forms of statutory protection.

Table 5
Effectiveness of Intellectual Property Types
(Distribution of Scores)

Intellectual Property Type (a)	Score (b)	All Firms (c)	General Users (d)	Specific Users (e)	Non-users (f)
			percentage		
Copyrights	1	74	63	15	80
	2	12	17	33	9
	3	7	11	30	5
	4	4	6	14	3
	5	3	4	8	3
Patents	1	61	41	9	71
	2	15	20	26	13
	3	9	18	31	5
	4	7	13	21	5
	5	7	9	13	6
Industrial Designs	1	67	54	25	73
	2	15	21	26	12
	3	11	16	31	8
	4	5	7	10	4
	5	3	3	9	2
Trade Secrets	1	59	40	9	68
	2	17	22	24	14
	3	11	17	30	7
	4	7	12	23	5
	5	6	8	14	5
Trade-marks	1	59	36	14	71
	2	13	16	20	9
	3	13	21	28	9
	4	10	17	23	6
	5	6	11	16	4

Scored as: 1—not at all effective; 2—somewhat effective; 3—effective; 4—very effective; 5—extremely effective

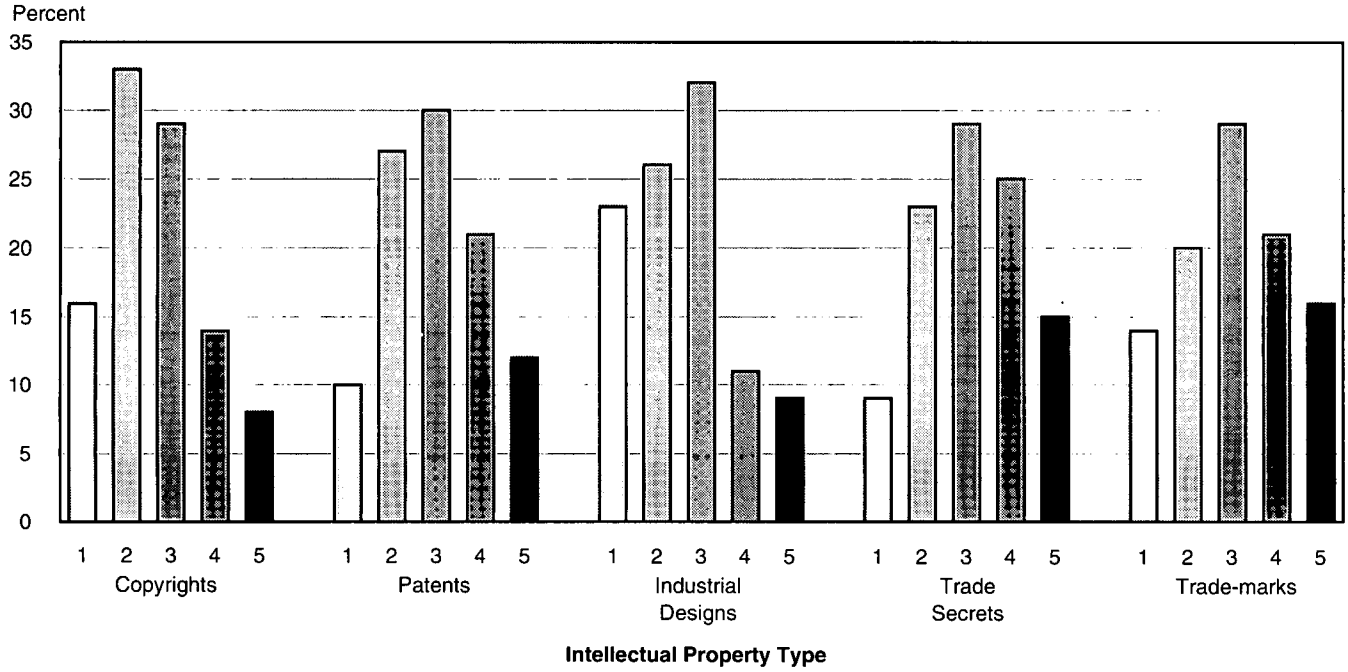
The vast majority of All Firms (Column c), rated all forms of statutory protection as either not effective, a score of 1, or only somewhat effective, a score of 2. The distributions are highly skewed towards these low scoring categories with anywhere from 59%-74% of firms scoring 1 for each of the five property types. Firms generally scored patents, trade secrets and trade-marks as more effective than copyrights and industrial designs. For each of these three forms of protection, a greater percentage provided a score of either 3—effective or 4—very effective or 5—extremely effective, compared to the percentage of firms giving the same score to copyrights and industrial designs.

The scores for General Users—those firms that use at least one of the five major forms of statutory protection (Column d)—remains skewed towards the low effectiveness rankings, but the relationship is not as pronounced as it was when all firms are included. General users are least likely to rank trade-marks as an ineffective form of protection, with trade secrets and patents close behind. Copyrights and industrial designs are found to be the least effective forms of protection by this population subset. General users of statutory forms of protection do not, as a whole, feel that effective protection from competitors is garnered from the use of them. Such a result might be expected if firms are developing product or process innovations that do not easily lend themselves to statutory protection or if the protection is not very effective.

The distribution of scores for Specific Users—firms that use the particular statutory right being scored (Table 5, Column e)—is somewhat more symmetric for trade secrets and trade-marks (see Figure 3). Firms that make use of a given form of intellectual property protection are more apt to score it as effective than would firms who do not use it. This holds true for each of the five major forms of statutory protection. The majority of firms using these forms of protection score them as either 3–effective, or 4–very effective, or 5–extremely effective. Copyrights and industrial designs are once again viewed as somewhat less effective forms of protection than patents, trade secrets and trade-marks, even among firms who make use of them. For both copyrights and industrial designs, 48% and 51%, respectively, of specific users of these latter

Figure 3

Distribution of Scores by Specific Users



two categories scored them either as 1, ineffective or 2, somewhat effective.[12]

Finally, the scores of those firms that do not use any of the major forms of statutory protection (Table 5, Column f) are extremely skewed, with between 68% and 80% of non-users rating each form of protection as not at all effective. This may be attributed to the fact that non-users are generally not innovative and, therefore, have little use for statutory protection of intellectual property. It should be noted, however, that even among the non-users, anywhere from 11%-19% of firms, depending on the form of protection in question, believe that intellectual property protection is effective (aggregate percentage of firms providing scores of 3, 4 or 5). This subset of non-users may include firms that have found statutory forms of protection to be an effective roadblock to their adoption of new process or product innovations and hence, evaluate the protection afforded to innovative firms using them as quite effective.

b) Canada/U.S. Comparisons

The Canadian experience that patents are not valued as much as alternate non-statutory protection has a parallel elsewhere. Mansfield (1986) asked some 100 firms in twelve 2-digit industries how many innovations would not have been developed in the absence of patent protection. His findings were that, except in pharmaceuticals and chemicals, patents were not judged to be essential for innovation. Patents were described as essential in about 10 to 20% of commercially-introduced inventions in petroleum, machinery and metal products—less in other industries. If patents have little value, alternate forms of protection for innovation must solve the appropriability problem.

Research by Levin et al. (1987) that uses a different strategy confirms that other forms of protection are more important than patents. Some 650 individuals—high level R&D managers—representing firms in 130 narrowly-defined lines of business were asked to evaluate the effectiveness of patents, secrecy, lead time, moving down the learning curve and sales or service efforts as a means of protecting the competitive advantages of new products or processes. A 7-point scale (as opposed to the 5-point scale employed here) was used to rank each from "not at all effective" to "very effective". The mean results are reproduced in Table 6.

Other means were found to be just as or more effective than patents. For process innovations, lead time receives

[12] *Firestone (1971) found that some 41% of companies with patents thought that the system was of little or no significance while 46% thought they were of fair significance and 13.1% thought they were of major significance. These are roughly comparable to the distribution for patents reported in column e of Table 5 where 37% of the firms scored less than the median score—effective.*

Table 6
Effectiveness of Intellectual Property Protection in the United States

Method of Appropriation	Overall Sample Means	
	Processes	Products
Patents to prevent duplication	3.52	4.33
Patents to secure royalty income	3.31	3.75
Secrecy	4.31	3.57
Lead time	5.11	5.41
Moving quickly down the learning curve	5.02	5.09
Sales or service efforts	4.55	5.59

Scale: 1—not at all effective; 7—very effective

a mean score of 5.11(standard error (s.e.)=.05), secrecy 4.31(.07), but patents as a means to prevent duplication only receives a score of 3.52(.06). In the case of product innovations, patents are given a higher score relative to secrecy, but lead time and sales or service efforts still outrank patents.

When only firms that use statutory forms of intellectual property protection are considered (a sample closer to the R&D managers used in the U.S. study), the Canadian results compare closely to those of Levin et al., (1987) for the U.S. In the Canadian case, being first in the market receives the highest score; in the United States, it is lead time that is first for process innovations and sales or service efforts that is first for product innovations. In both countries, patents trail these firm-based strategies. In both cases, patents receive an average score less than the median point on the scoring scale.[13]

Cohen et al., (1996) investigate the same issue in a slightly different fashion–asking respondents to indicate the percentage of their product and process innovations for which each appropriability mechanism had been effective in protecting the firm's competitive advantage. They find that secrecy and lead time are ranked as the two most effective appropriability mechanisms for product innovations, ahead of patents. Secrecy also dominates patents for process innovations.

[13] *The median of the U.S. scale is 4. It is 3 for the Canadian survey.*

Large Versus Small Firms

Innovation to some is synonymous with large firms. Schumpeter stressed the seeming advantage of large firms in the innovation process (Scherer, 1992). If large firms are more innovative, they might also be expected to make more use of statutory forms of intellectual property protection. Even if they are not more innovative, they may use intellectual property protection more frequently if there are substantial cost barriers involved with intellectual property protection that only they can overcome.

In order to study differences in the use of intellectual property protection by size of firm, firms were divided into four size classes—those with less than 20 employees, 20-99 employees, 100-499 employees, and more than 500 employees—and use rates were calculated for each group (Table 7).

There is a substantial difference between the percentage of small and large firms that possess any of the specific intellectual properties. Only 20% of the smallest group use any one of the statutory forms of intellectual property protection while more than 50% of each of the two largest groups do so. The largest groups are also relatively more likely to be multiple users. They are six to seventeen times more likely to use 3 or 4 forms of protection than are the smallest group.

Large firms are also more likely to make use of each of the specific forms of intellectual property protection (Table 8). Only 5% of the smallest group are likely to avail themselves of patents, while 37% of the largest group possess at least one patent. Only 7% of the smallest group possess a trade-mark, while 40% of the largest group have at least one trade-mark. There is less of a difference in the use of industrial designs and trade secrets—though even here the differences are still significant. Small firms place relatively greater emphasis on trade secrets compared to the emphasis they place on other forms of protection. In contrast, large firms make relatively greater use of patent protection. As firms progress from small to large, they continue to focus more on trade-marks than any other statutory instrument but they reduce the emphasis that they place on trade secrets and increase the emphasis that they place on patents.

The valuation placed on the effectiveness of the forms of protecting intellectual property also differs by size class. The average scores attributed by firms in each of the four size classes are presented in Table 9 for patents, trade secrets, trade-marks, complexity of product design and being first in the market.

The average score for large firms is above that of small firms for all the statutory forms of protection. The largest difference occurs for patents; the smallest for secrecy. The differences between the largest and smallest group are statistically significant (at the 1% level) for patents, trade-marks, and for trade secrets. As firms grow, they move from giving trade secrets their highest score to placing their highest value on patents. This change in valuation also accords with the differences in the relative patterns of use across size classes.

There is much less of a difference in the scores across size classes attributed to the effectiveness of being first for protecting investments in intellectual property. However, there is a difference in the case of complexity of design. Both small and large firms assign a higher value to the innate strategies than they do to the statutory strategies.

Table 7
Multiple Use of Intellectual Property Protection by Size Class (% of Firms)

Firm Size (employees)	Number of Intellectual Property Types				
	At Least One	1	2	3	4+
Less than 20	19.7	11.9	5.3	1.8	0.7
20-99	27.2	17.4	6.2	2.8	0.8
100-499	52.1	23.5	16.7	7.4	4.4
500+	62.1	28.0	12.5	10.0	11.7

Table 8
Usage of Intellectual Property Protection by Type and by Size Class
(% of Firms Possessing a Property Right)

Type of Protection	Size Class (employees)			
	<20	20-99	100-499	500+
Copyrights	3.9	4.0	11.9	12.4
Patents	4.9	8.2	22.2	37.0
Industrial Designs	4.5	6.5	15.6	16.6
Trade Secrets	8.2	5.3	17.7	23.3
Trade-marks	7.4	16.1	29.5	40.0
Integrated Circuit Designs (Semi-conductor Chips)	0.5	0.3	0.4	2.3
Plant Breeders' Rights (Plant Variety Rights)	0.0	0.0	1.7	0.6
Other	1.6	0.8	0.3	2.2

Table 9
Effectiveness of Intellectual Property Protection
(Mean Score by Size Class)

Type of Protection	Size Class (employees)			
	<20	20-99	100-499	500+
Patents	1.5	1.8	2.3	2.3
Trade Secrets	1.7	1.8	2.1	2.2
Trade-marks	1.6	1.8	2.2	2.2
Complexity	2.4	2.4	2.6	3.0
Being First in the Market	3.0	2.9	3.2	3.3

Scored as: 1—not at all effective; 2—somewhat effective; 3—effective; 4—very effective; 5—extremely effective

Foreign-Owned Versus Domestically Owned Firms

Firms vary in their innovation strategy. Some emphasize research and development and appropriability. Others prefer to be imitators. Intellectual property is protected to different degrees by firms with different innovative strategies.

Foreign and domestically owned firms might be expected to differ considerably in terms of their use of these forms of property protection. Foreign-owned firms are larger and tend to be located within high-tech sectors. More importantly, one of the advantages possessed by multinationals is their superior technological skills and their ability to transfer these skills across national boundaries (Caves, 1982). They might, therefore, be expected to make greater use of intellectual property protection than domestically owned firms.

Since foreign-owned firms are larger than domestically owned firms, differences between the two will be partly the result of nationality and partly the result of size. In order to account for size differences, the population was divided into large and small firms and differences between domestically owned and foreign-owned firms within each size class were examined. For the purpose of this exercise, small firms are defined as those with less than 200 employees, large firms as those with more than 200 employees. Comparisons of domestic- and foreign-owned firms within a size class allows the effect of nationality to be examined, holding size class constant.

Evidence of different tendencies to use intellectual property protection are found both across size classes and across nationality groups. Some 65% of large foreign-owned firms use at least one form of statutory intellectual property, 58% of the large domestically owned firms have at least one statutory intellectual property right. For large firms, the most significant difference occurs for the use of four or more intellectual property rights. In smaller firms, 36% of foreign-owned firms have at least one form of statutory-based right while only 22% of their domestic counterparts have at least one (Table 10). The difference is highly significant.

These differences are reflected in higher foreign use-rates for almost all categories of statutory property protection (Table 11). Innovations in the foreign firms are more likely to use copyrights, patents, trade-marks, industrial designs, and trade secrets. One of the largest differences occurs for patents, where 39% of large foreign-owned firms but only 22% of large domestically owned firms possess this form of intellectual property protection.

Differences in the use of intellectual property protection are reflected in differences in the scores that foreign- and domestically owned firms give to the efficacy of the different forms of intellectual property protection. Table 12 contains the scores for foreign and domestic firms. Foreign-owned firms, as a whole, rank every form of statutory protection higher than do domestically owned firms.

This may be the result of inherent differences in the attitude taken by domestically owned and foreign-owned firms toward intellectual property protection. Whether there are inherent differences in attitudes can be tested by examining whether domestically owned and foreign-owned firms that use statutory intellectual property rights view the effectiveness of these rights differently. When these two groups are compared (Table 12, Columns 2 and 5), the differences between the two groups barely change. For example, foreign and domestically owned firms rank trade secrets at 2.6 and 1.7 respectively; but when this is restricted to users of trade secrets, the scores are 2.9 and 2.1, respectively. Since the differences between foreign and domestic firms are more or less the same for both users and non-users, inherent differences exist in the attitudes of each of these groups towards the effectiveness of the statutory forms of protection. In contrast, when foreign and domestic attitudes to the 'innate' forms of protection—complexity, being first in the market, or "other" are compared, they are found to resemble one another when both users of statutory forms of protection are used (Table 12, Columns 2 and 5) and when the population of all firms is used (Table 12, Columns 1 and 4).

The differences between the scores given by the foreign-owned and domestically owned populations to the efficacy of intellectual property protection come partly from the larger percentage of Canadian firms who do not make use of the form of protection and the lower scores that these firms give to the efficacy of protection. This non-using group tends not to be innovative, tends to utilize imitator strategies, and thus finds intellectual property law to be relatively unimportant.

Table 10
Multiple Use of Intellectual Property Protection (Foreign vs Domestic)

Number of Intellectual Property Types	% of Firms Using			
	Firm Type			
	Small Domestically-owned	Small Foreign-owned	Large Domestically-owned	Large Foreign-owned
At Least One	21.7	35.6	58.0	65.2
1	13.1	21.1	28.7	25.5
2	5.6	6.8	18.7	20.4
3	2.1	6.4	6.5	8.9
4+	0.9	1.2	4.0	10.3

Table 11
Usage of Intellectual Property Protection by Type (Foreign vs Domestic)

Form of Protection	% of Firms Using			
	Firm Type			
	Small Domestically-owned	Small Foreign-owned	Large Domestically-owned	Large Foreign-owned
Copyrights	4.0	8.5	11.0	14.6
Patents	6.0	12.2	22.2	38.6
Industrial Designs	5.2	6.9	14.1	20.7
Trade Secrets	7.9	8.5	19.5	20.2
Trade-marks	9.5	21.2	31.3	42.2

Table 12
Effectiveness of Intellectual Property Protection (Foreign vs Domestic)
(Company-weighted)

Intellectual Property Protection Associated with:	Average Score[1]					
	All Foreign	Foreign Users[2]	Foreign Non-users	All Domestic	Domestic Users[2]	Domestic Non-users
	1	2	3	4	5	6
Statutory Protection						
Copyrights	1.7	1.8	1.6	1.4	1.6	1.3
Patents	2.4	2.7	2.2	1.6	1.9	1.5
Industrial Designs	1.8	2.2	1.5	1.4	1.6	1.4
Trade Secrets	2.6	2.9	2.5	1.7	2.1	1.6
Trade-marks	2.3	2.7	2.0	1.7	2.2	1.5
Integrated Circuit Designs	1.9	1.8	1.9	1.2	1.3	1.2
Plant Breeders' Rights	1.2	1.1	1.2	1.2	1.1	1.2
Other Strategies						
Complexity of Product Designs	3.0	3.0	3.0	2.4	2.7	2.2
Being First in the Market	3.2	3.1	3.3	3.0	3.3	2.9
Other	2.4	2.4	2.4	2.3	2.3	2.3

[1] *Scored as: 1—not at all effective, 2—somewhat effective, 3—effective, 4—very effective, 5—extremely effective*
[2] *Users are defined as those having the particular property right being scored*

Differences in the Use of Intellectual Property Protection by Innovative and Non-innovative Firms

a) Distinguishing Innovative and Non-innovative Firms

The objective of the innovation survey is to provide measures of innovation that can be used to examine differences in strategies being followed by firms. This section makes use of these measures to investigate the difference in the use of intellectual property protection by innovative and non-innovative firms.

Since intellectual property is the activity being examined, innovation must not be defined as the use of a particular form of intellectual property protection—such as patents. In order to classify firms as innovative as opposed to non-innovative, several questions in the survey that directly focus on innovative output are used. Firms that introduced or were in the process of introducing a product or process innovation during the period 1989 to 1991 (question 3.1), that listed product or process innovations between 1989 and 1991 (question 3.2 and question 4.1), or that reported sales in 1991 resulting from a major product innovation between 1989 and 1991 (question 1.4) are classified as being innovative. Some 44% of the firms that received all of these questions and answered question 1.4 are innovative based on these criteria.

While this approach provides a relatively straightforward and simple criterion for classifying firms as innovative, there are several potential criticisms of it. Only firms that introduced major innovations during the three years prior to the survey, as opposed to just minor ones, are included. In addition, firms that introduced innovations prior to or following this period are not deemed to be innovative.

The method of classification used here is deliberately chosen to provide a fairly strict definition that includes only those who perceive themselves to be truly innovative. Firms that innovated years ago (and may well have been under different management) and are no longer actively innovating are excluded from the definition of innovation being used here. Firms that reported sales resulting from only minor improvements—not major innovations—and that did not respond positively to any of the innovation questions are excluded. By drawing a distinction between major and minor innovations, this classification attempts to exclude firms that only produced minor innovations—as was done by the Science Policy Research Unit (SPRU) at the University of Sussex (Pavitt et al., 1987) for the development of its own database. The difference is that SPRU relied on evaluations of professionals or experts and this survey relies upon self-evaluations by the innovating firms.

The sample that is used for the comparisons of innovative as opposed to non-innovative firms is restricted to those firms that answered the question in section one of the survey—dealing with the percentage of sales accounted for by innovative products—that allows us to distinguish between innovative and non-innovative firms.[14]

b) Intellectual Property Use and Innovativeness

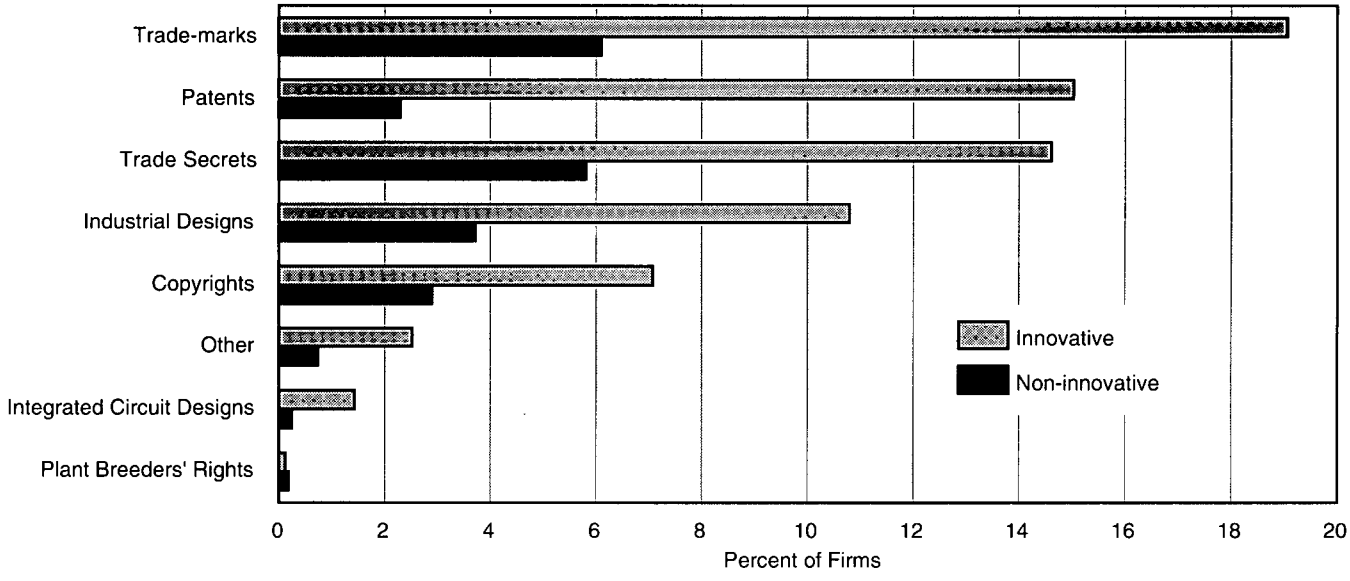
If innovation is closely associated with the use of intellectual property protection, then there should be large differences in the percentage of each group that make use of protection.

Differences between innovative and non-innovative firms with regards to their exploitation of intellectual property rights and other means of preventing imitation of their products or processes are presented in Figure 4. The percentage of firms possessing eight different forms of property protection—copyrights, patents, industrial design, trade secrets, trade-marks, integrated circuit designs, plant breeders' rights and other forms of protection—is plotted for innovative and non-innovative firms. The relative usage pattern of the various forms of intellectual property protection is similar for both groups of firms. Trade-marks, patents, trade secrets, industrial designs and copyrights exhibit the highest use rates. Non-innovative firms make some use of intellectual property protection either because they may have innovated some years ago or because they may have purchased an intellectual asset from another firm and may now be exploiting that asset. However, innovative firms make significantly greater use of each form of intellectual property protection. The greatest difference occurs for trade-marks and patents. Some 19% of innovative firms possess trade-marks and only 6% of non-innovative firms do so. Some 15% of innovative firms use patents, only 2% of non-innovative firms do so.

[14] *The other questions used for the classification of innovative firms did not offer any problem since non-response was interpreted as non-innovative. However, the question on the percentage of sales derived from innovative products has a lower response rate because of the inherent difficulty of answering the question and no-imputation for non-response was made. Therefore, non-respondents to this question are excluded when comparisons are made of innovative and non-innovative firms.*

Figure 4

Incidence of Use of Intellectual Property Protection in Innovative and Non-innovative Firms (Company-weighted)



The effectiveness (on a scale of 1 to 5) of the various forms of intellectual property protection and other protective strategies is presented in Figure 5 for all innovative and non-innovative firms rating the particular factor. Innovative firms generally place a higher weight on both statutory forms of intellectual property protection and the innate strategies—being first in the market and complexity of product design. However, the difference in scores between the two sets of firms is greatest for the latter strategies. Despite the fact that innovative firms tend to attribute greater value to all of the proposed methods, they are primarily distinguished from non-innovative firms in terms of the value that they attribute to the latter strategies.

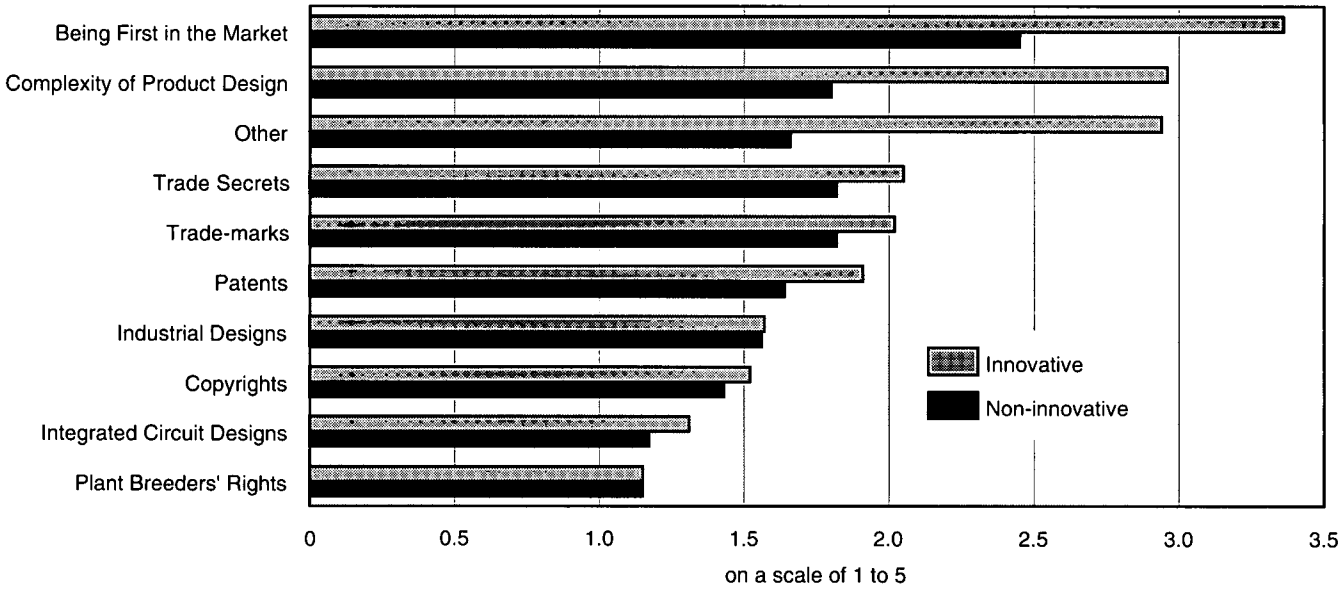
The score that firms give to the various forms of intellectual property protection differs between firms using and those not using the particular form. Since innovative firms are also more likely to use a particular form of protection, the differences in the scores outlined in Figure 5 may be mainly due to different tendencies of firms to make use of a particular form of protection.

To investigate this possibility, firms are divided into four groups—based on whether or not they are innovative and whether or not they make use of one of the statutory forms of intellectual property protection. The mean scores for innovative and non-innovative firms for those firms that possess a specific form of protection and for those that do not make use of one of the statutory forms of protection are presented in Table 13. Innovative firms generally place more value on intellectual property than non-innovative firms both for the group that use statutory forms of intellectual property protection and for those that do not possess intellectual property; but the differences are not significant in the case of most of the statutory forms of protection. On the other hand, there are significant differences between firms using intellectual property rights and those not doing so. Innovative firms that make use of statutory forms of intellectual property protection tend to value them the highest, followed by non-innovative firms that make use of these forms of intellectual property protection. Being innovative affects the perceived efficacy of the various forms of intellectual property protection, but not nearly as much as does the usage of the various forms of protection.

It is also noteworthy that significant differences between innovative and non-innovative firms occur in the area of the innate firm-based strategies—being first in the market and having a complex product design. The innovative group attributes greater value to these methods than does the non-innovative group, regardless of whether the firm utilizes statutory forms of intellectual property protection or not.

Figure 5

Perceived Effectiveness of Intellectual Property Protection and Other Strategies in Preventing Imitation of Products or Processes (Innovative vs Non-innovative) (Company-weighted)



It is apparent then that innovative firms are divided into two groups—based on their use of intellectual property protection. One group utilizes statutory forms of intellectual property protection and perceives them to be valuable, but perceives other strategies, such as being first in the market and the complexity of product design to be equally or more effective strategies in preventing imitation of their new products and processes. The second group of innovative firms does not perceive statutory forms of intellectual property protection to be effective methods of preventing imitation and consequently, does not make use of these methods. The second group of firms believes the other strategies—related to being first in the market and complexity of product design—are the only effective means of reaping the benefits of innovative activity.

Table 13

Effectiveness of Alternative Means of Protecting New Products and Processes from Imitation - According to Whether or Not the Firm is Innovative and Whether it Uses that Particular Form of Intellectual Property Protection (IPP) - Company-weighted

Form of Protection	Innovative	Non-innovative	Innovative	Non-innovative
	Firms that used IPP Mean of a scale of 1 to 5		Firms that did not use IPP Mean of a scale of 1 to 5	
Panel A				
Intellectual Property Protection Associated with:				
Copyrights	2.95	2.53	1.34	1.31
Patents	3.00	3.06	1.51	1.48
Industrial Designs	2.29	2.45	1.39	1.38
Trade Secrets	3.23	2.91	1.58	1.61
Trade-marks	3.05	3.12	1.50	1.51
Integrated Circuit Designs	2.95	3.04	1.22	1.24
Plant Breeders' Rights	2.20	1.82	1.13	1.17
Panel B				
Other Strategies				
Complexity of Product Design	2.96	2.32	2.64	2.13
Being First in the Market	3.49	2.87	3.32	2.77

Note: Use in Panel A refers to specific use of the particular intellectual property right.
Use in Panel B refers to general use of any of the statutory rights.

c) Innovation Differences Across Size Classes

Intellectual property protection is used to protect the fruits of innovation. Since so much emphasis has been placed on differences in the abilities of large and small firms to innovate, it is important to examine the extent to which differences in intellectual property use are linked to differences in tendencies to innovate. To do so, the percentage of firms that were innovative, the percentage that performed R&D continuously, and the percentage that protected themselves with statutory forms of rights are compared across size classes (Table 14).

In order to compare innovation across size classes, innovative firms are defined as those that said they introduced or were introducing a product or process innovation between 1989 and 1991. These firms make up a subset of those used in the previous section. The percentage of firms that are innovative varies substantially by size class. Only 30% of those under 20 employees are innovative while 64% above 500 employees are innovative using this definition. The tendency to be more innovative increases monotonically across size classes. The percentage of firms that are innovative is slightly larger than those reporting they do R&D on a continuous basis. Finally, the percentage of firms making use of any form of statutory protection is quite similar to the percentage of firms that report themselves as innovative or that perform R&D continuously.

It is quite clear then that differences across size classes in the use of intellectual property protection closely mirror other differences in both the use of inputs (R&D) to the innovative process and the production of outputs. While only 20% of the smallest group of firms possess intellectual property compared to 64% for the largest group of firms, small firms are also less likely to have introduced a major product innovation or to be doing research and development. Only about 19% of the smallest group of firms report a research and development program, while 52% of large firms do the same.

While the percentage of firms that perform R&D or which possess intellectual property rights is a little less than the percentage of firms that are innovative, this cannot be used to infer that innovative firms are all performing R&D or that all those performing R&D are innovative. Nor would we expect either condition to occur. Not all new products need R&D; not all R&D is successful. Nevertheless, it is interesting to examine what percentage of innovative firms do perform R&D or use intellectual property. These percentages are tabulated just for those firms reporting sales from a major product innovation (Table 15).[15]

Table 14
A Comparison of Innovativeness, R&D and Intellectual Property Use by Size Class (Company-weighted)

Percent of Firms with:	Size Class			
	<20	20-99	100-499	500+
Sales from a major product innovation	29.9	39.1	43.4	63.6
Performing R&D continuously	19.1	32.3	42.2	52.3
Using any form of statutory intellectual property protection	19.6	29.2	51.0	63.5
Using patents	4.8	9.6	22.3	37.8

Table 15
A Comparison of R&D and Intellectual Property Use by Size Class for Innovators (Company-weighted)

Percent of Firms with:	Size Class			
	<20	20-99	100-499	500+
Sales from a major product innovation	100	100	100	100
Performing R&D continuously	42	53	52	82
Using any form of statutory intellectual property protection	36	45	71	85
Using patents	9	18	34	63

[15] *To divide firms into innovators and non-innovators, we define innovators as those reporting sales from a major product innovation (question 1.4). This variant must be used because it is the only innovation question that was answered by firms that were sent both the R&D and the intellectual property questions.*

In the largest size class, some 82% of product innovators perform R&D on a continuous basis, while 85% make use of some form of statutory intellectual property protection. About 63% possess at least one patent. The percentage of innovators doing R&D on a continuous basis falls to 53% for the middle size classes and to only 42% for the smallest size classes. The smallest innovators then tend to make less use of the R&D process. The use of statutory intellectual property also falls off for the smaller size classes.

In conclusion, the tendency of smaller firms to make less use of intellectual property does not stem entirely from differences in tendencies to innovate. Within the group that innovate, a smaller percentage perform R&D and also a smaller percentage use intellectual property.

d) Intellectual Property Protection and the Characteristics of Innovations

A firm's attitude toward intellectual property will depend upon how innovative it is. Innovative firms make greater use of different forms of intellectual property protection and value them more.

Innovation has many dimensions. Firms can choose to be at the technical frontier and break new ground in products and processes, to be first or a close second, to initiate or to imitate, to licence technologies or to develop them from scratch. Since firms choose quite different innovation strategies, their responses to the importance of intellectual property protection will vary. More importantly, a firm may produce different types of innovations and adopt different intellectual property strategies for different types of innovations. If this is so, a firm-based response to the importance to intellectual property protection may hide significant differences in the use of intellectual property for different types of innovations.

In order to investigate how intellectual property protection varies for different types of innovations, large[16] firms were asked whether they had an important innovation during the period 1989-91, its type (product or process), and whether the innovation was a world-first or otherwise. In addition, they were asked to describe how this innovation was protected—by copyrights, patents, industrial designs, trade-marks, by secrecy agreements, by integrated circuit designs, plant breeders' rights, or through other means. In what follows, methods of protection used by large firms are tabulated by innovation characteristics.

i) Intellectual Property Protection for Major Innovations

Some 47% of large firms with a major product or process innovation use at least one of the listed forms of intellectual property protection in Canada (Table 16). Over 30% do so in the United States, 12% in Europe, and 10% in the Pacific Rim. The statutory system of intellectual property protection is used by about one out of every two innovative firms for their major innovation.

The percentage of large firms reporting an important innovation that uses patents to protect that innovation is about the same as those who answered that they used patents as part of their general business. Some 20% of large firms introducing a major innovation make use of patent protection in Canada or elsewhere (Table 16), a little higher than the 17% of large firms indicating that they possessed patents.[17] This means that about 1 in 5 innovations that are classified by the respondents as major innovations makes use of the patent process.

Table 16
Usage of Intellectual Property Protection by Type and by Region for Major Innovations of Large Firms

	(% of large firms reporting a major innovation)					
	Canada	U.S.A.	Europe	Pacific Rim	Other	At Least One Region
Copyrights	4.1	2.1	0.1	0.1	0.3	4.4
Patents	19.0	17.0	7.4	5.6	2.1	19.9
Industrial Designs	8.6	4.0	1.1	0.7	0.9	9.0
Trade-marks	14.1	6.7	2.1	1.7	1.2	14.4
Secrecy Agreements	15.4	8.9	3.2	3.0	1.6	16.3
Integrated Circuit Designs	1.3	0.8	0.4	0.3	0.6	1.6
Plant Breeders' Rights	0.4	0.3	0.0	0.0	0.3	0.6
Other	3.6	2.2	0.8	0.8	1.6	4.7
At Least One	46.6	31.1	12.1	9.6	5.5	48.9

[16] *These are large firms as defined in footnote 9.*
[17] *These are the figures for large firms that are comparable to those reported in Table 3 for all firms.*

While the use of most forms of intellectual property protection abroad is less important than in Canada, this is not the case for patents. Almost as many of the firms indicate that they protect their innovations by taking out patents for their innovations in the United States (17%) as do so in Canada (19%). Patents are taken out in Europe at less than one-half the rate they are used in the United States. The Pacific Rim follows at about one-third the U.S. rate. Cross-border protection is important for innovations of considerable magnitude such as those being investigated here.

The second most important manner of protection used for major innovations are secrecy agreements.[18] Some 15% of large firms with a major innovation indicate that secrecy agreements in Canada made up part of their strategy that was used to protect their innovation. This is slightly higher than the 12% of large firms that indicate they use trade secrets to protect their intellectual property.[19] Secrecy agreements are relatively less important in other countries than are patents. Some 17% of innovations are protected by patents in the U.S.A., but only 9% via secrecy agreements.

The third most important method of protection for a major innovation in Canada (14%) involves the use of trade-marks. This is below the 23% of large firms that indicate they use trade-marks in general to protect intellectual property.[20] Trade-marks are more important than industrial designs (9%) and copyrights (4%).

In summary, information on the use of intellectual property protection for major innovations confirms the general importance that is attached to protection at the firm level. It also shows some differences. When the protection afforded to the major innovation of the company is examined, the importance of both patents and trade secrets increases while it falls for trade-marks.

When the use of intellectual property is tabulated by different characteristics of firms' major innovations, even more marked differences from the earlier profile emerge. Two characteristics are used here. The first is whether the innovation was a product or process. The second is whether the innovation was a world-first or otherwise.

ii) Products Versus Processes

Previous work (Firestone, 1971; Levin et al., 1987) suggests that products are better suited to patent protection than processes. Processes by their very nature can be better protected by trade secrets because they can be kept behind closed doors. Dividing major innovations into those involving only new products as opposed to only new processes allows us to test this hypothesis in a Canadian context.

Of the large firms that were asked whether their major innovation involved the introduction of a product or process, 32% indicate that they had introduced or were in the process of introducing a product or process innovation between 1989 to 1991. Of the firms introducing innovations, some 35% of firms introduce a product innovation without a change in technology; 45% introduce a process innovation that does not involve a product change; 46% introduce a product innovation that requires a simultaneous change in process technology (Baldwin and Da Pont, 1996). Most firms (73%) located in Canada are involved in process innovation, either exclusively or in conjunction with product changes.

Major innovations involving products are more likely to make use of a statutory form of intellectual property protection than are major process innovations (Table 17). Some 60% of firms indicating that they introduced product innovations make use of formal statutory protection either in Canada or abroad. Only 35% of those focusing just on process innovations do the same.

The relative tendency to make use of the intellectual property protection system in Canada as opposed to protection abroad also varies between products and process innovations. Some 59% of large firms indicating that their major innovation involved only a new product used statutory forms of protection in Canada, but only 42% did so in the United States. On the other hand, about an equal percentage of large firms noting they only had major process innovations protected themselves in both Canada and the United States, 31% and 25% respectively.

The use of the various forms of protection varies considerably between products and process innovations. Of those large firms introducing just a product innovation, some 29% make use of patents to protect their major innovation. Trade-marks are second (21%) and secrecy agreements come third at 9%. By way of contrast, for those large firms introducing only process innovations, secrecy agreements are used most (20%) and patents are used by only some 10%. Not surprisingly, for cases where the innovation involved both a product and process change, patents and secrecy agreements are adopted by about the same percentage of firms within Canada, 23% and 19%, respectively.

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[18] *The reader should note that secrecy agreements used here are more proactive than trade secrets. A trade secret is simply a knowledge asset that is protected by non-disclosure; secrecy agreements are pacts that are made with other firms.*

[19] *These are the figures for large firms that are comparable to those reported in Table 3 for all firms.*

[20] *Ibid.*

Table 17
Usage of Intellectual Property Protection by Type in Large Firms by Region, for Product and Process Innovations (% of Large Firms with a Major Innovation)

Panel A	Product and/or Process				
	Canada	U.S.A.	Europe	Pacific Rim	At Least One Region
Copyrights	6.2	3.4	0.3	0.1	6.2
Patents	22.2	19.5	9.7	6.9	23.9
Industrial Designs	11.6	5.8	1.3	0.6	11.8
Trade-marks	17.6	7.7	2.9	2.1	17.9
Secrecy Agreements	19.4	11.1	4.4	4.5	19.7
Integrated Circuit Designs	1.6	0.8	0.1	0.0	1.6
Plant Breeders' Rights	0.6	0.6	0.0	0.0	0.6
Other	3.9.	1.9	0.8	0.6	5.1
At Least One	54.5	33.7	14.5	10.8	56.5
Panel B	**Product Only**				
	Canada	U.S.A.	Europe	Pacific Rim	At Least One Region
Copyrights	4.9	1.5	0.0	0.0	4.9
Patents	26.5	23.7	6.7	4.4	28.5
Industrial Designs	6.2	5.2	2.6	2.6	6.2
Trade-marks	21.0	11.8	0.3	0.8	21.0
Secrecy Agreements	8.7	3.3	2.6	2.6	9.3
Integrated Circuit Designs	2.4	3.3	2.4	2.4	2.4
Plant Breeders' Rights	0.3	0.0	0.0	0.0	0.3
Other	5.3	3.5	2.9	3.2	5.7
At Least One	59.0	42.2	14.6	13.1	60.4
Panel C	**Process Only**				
	Canada	U.S.A.	Europe	Pacific Rim	At Least One Region
Copyrights	0.0	0.0	0.0	0.0	1.4
Patents	8.8	8.5	2.8	2.8	10.3
Industrial Designs	5.4	0.0	0.0	0.0	6.8
Trade-marks	5.2	2.4	2.4	2.4	6.6
Secrecy Agreements	16.7	12.6	2.1	0.9	20.4
Integrated Circuit Design	0.2	0.0	0.0	0.0	1.6
Plant Breeders' Rights	0.0	0.0	0.0	0.0	1.4
Other	1.8	1.8	0.0	0.0	1.8
At Least One	31.0	25.3	7.3	6.1	34.7

In all three cases, patent protection is taken out in U.S. markets almost as frequently as in Canadian markets. On the other hand, other instruments such as secrecy agreements tend to be used less frequently in the U.S. than in Canadian markets.

iii) World-first Versus Other Types of Innovations

Not all innovations are equally significant. In order to rank the type of innovation by its importance, large firms were asked to indicate whether their most important innovation was a world-first, a Canadian-first or "other". Only 15% of innovations are classified as being world-firsts, some 30% are firsts for Canada, and the remaining 56% are essentially improvements of existing products or processes.[21]

Innovations that are world-firsts are most likely to involve the need for intellectual property protection. Firms that are imitators either purchase patents or invent around existing patents. In the latter case, they have less of an incentive to register their new designs or processes for two reasons. Registration will not be successful unless they have created a new product or new process with sufficient originality to pass the patent examiners. Or the very act of registration may provide information to the original innovator that would allow it to challenge the validity of the innovation in court. Innovations that are world-firsts are hypothesized to make greater use of intellectual property laws.

In order to test this hypothesis, innovations are divided into two groups—those which are a world-first and all

[21] *Only some 9% of firms indicating they had a major innovation did not answer this question.*

Table 18
World-first/Not World-first Usages of Intellectual Property Protection by Type for Large Firms by Region (% of Large Firms with a Major Innovation)

Panel A	World-first				
	Canada	U.S.A.	Europe	Pacific Rim	At Least One Region
Copyrights	10.5	7.4	0.3	0.3	12.2
Patents	39.6	36.4	21.6	17.3	42.6
Industrial Designs	11.7	8.1	6.7	4.2	14.3
Trade-marks	28.8	18.1	8.8	6.5	31.0
Secrecy Agreements	29.8	23.2	9.5	9.7	32.3
Integrated Circuit Design	1.0	1.0	0.0	0.0	2.8
Plant Breeders' Rights	0.0	0.0	0.0	0.0	1.8
Other	4.9	2.7	0.0	0.4	5.5
At Least One	74.8	59.8	28.8	23.3	78.4
Panel B	**Not a World-first**				
	Canada	U.S.A.	Europe	Pacific Rim	At Least One Region
Copyrights	3.0	1.2	0.1	0.0	3.0
Patents	15.5	13.7	5.0	3.6	16.0
Industrial Designs	8.1	3.2	0.1	0.1	8.1
Trade-marks	11.5	4.7	1.0	0.9	11.6
Secrecy Agreements	12.9	6.5	2.1	1.8	13.6
Integrated Circuit Design	1.4	0.8	0.5	0.4	1.4
Plant Breeders' Rights	0.4	0.4	0.0	0.0	0.4
Other	3.4	2.1	1.0	0.9	4.5
At Least One	41.8	26.2	9.3	7.3	43.9

others. There are very different tendencies to make use of intellectual property laws in these two groups (Table 18). Some three-quarters of world-firsts make use of some form of statutory protection in one or other of the geographical regions compared to 44% for the other group. The gap is largest between the two groups for patent protection. Some 43% of world-firsts make use of patent protection. Only 16% of the rest make use of patents. Some 31% of world-firsts make use of trade-marks; only 12% of the other group do so. Some 32% of world-firsts used secrecy agreements; only 14% of the other innovations do so.

The relative importance of each of these forms of intellectual property protection differs between world-first and other types of innovations. The dominant form of statutory protection used by world-firsts is patent protection (43%).[22] Secrecy agreements are well behind at 32%. Other innovations are protected about equally by patents and secrecy agreements, 16% and 14%, respectively. World-firsts are also more likely to be protected in other countries. The ratio of patents taken out in Europe and the Pacific Rim relative to their use in Canada is higher than for other innovations.

[22] *Mansfield (1986) found that in pharmaceuticals and chemicals over 80% of patentable inventions were patented but that this dropped to 68% in industries where patents were less important. However, Mansfield's sample included only very large firms and was not randomly distributed across industries.*

Industry Differences

The use of statutory forms of intellectual property protection might be expected to vary across industries for a number of reasons.

First, the scientific climate that is conducive to the discovery of new product entities is not the same everywhere. The science base for some industries means that more scientific discoveries are made in these sectors than elsewhere.

Second, industries differ in the extent to which statutory forms of protection for intellectual property provide the most efficacious method of protecting innovations. Patents and other forms of intellectual property protection are not equally useful across industries. Patents, it has been stressed, require clear standards for definition and for defence against infringements. Research by Taylor and Silbertson (1973) and Mansfield (1986) suggest that pharmaceuticals and chemicals, followed by mechanical engineering, benefit most from the patent system. Chemical entities are relatively easy to define and, therefore, to protect; mechanical inventions satisfy the same preconditions of discreteness and identifiability (Levin et al., 1987).

In order to allow for inherent differences in the scientific climate in each industry, industries are grouped here into three sectors based on the intensity of innovative activity in each. These are the core, secondary and 'other'—a taxonomy developed by Robson et al., (1988). The core sector consists of chemicals, machinery, mechanical engineering, instruments and electronics. The secondary sector includes metals, electrical engineering, shipbuilding/offshore engineering, vehicles, building materials, rubber and plastic goods. The remainder of the industries—textiles, paper, food, beverages, furniture, wood, leather, printing, and clothing—fall into the 'other' category.

This taxonomy is based, in the first instance, on the "innovativeness" of an industry; but it also closely corresponds to an industry's tendency to generate spillovers, that is, innovations that are used in other industries. Moreover, the taxonomy, though it was developed for the United Kingdom initially, also appears to be applicable to the United States. Robson et al., (1988) compare the sectoral pattern of innovation using this industry taxonomy for both the United States and the United Kingdom. American data on innovation are derived from a study by Scherer (1982) who develops a large matrix of technology production and use based on the patented inventions of 443 large U.S. companies in 1974. The data for the U.K. are derived from 4378 U.K. innovations over the period 1945-83. The UK/US comparisons are reported in Table 19. An innovation is referred to as a 'technology produced'. Innovations produced in one sector and used in another are called 'product' innovations. Innovations that are produced and used in the same sector are called 'process' innovations.

The core sector is highly innovative in that it produces the majority of technological innovations of both types (Column 1). Since the ratio of 'product' to 'process' innovations is highest in the core sector (Column 2), this group produces more innovations than it uses. Thus a classification based on the intensity of innovations also corresponds closely to one based on the degree of spillovers—since the core sector produces more innovations than other sectors and also has the greatest proportion of its innovations used in other sectors. If the distribution of 'process' innovations is examined (Column 3), the sectors are more equal in importance than if 'product' innovations are compared (Column 4).

Table 19
Comparison of Innovation Patterns in the United Kingdom and the United States

	Percentage of 'technology' produced		Ratio of 'product' to 'process' technology produced		Percentage of all 'technology' used		Percentage of all 'product' technology used	
	1		2		3		4	
	UK	US	UK	US	UK	US	UK	US
Core	68.3	62.8	3.26	2.64	18.3	18.8	3.3	2.3
Secondary	20.6	23.9	1.30	2.10	16.4	12.7	11.1	7.3
Other Manufacturing	8.3	12.0	0.45	1.04	26.0	11.4	30.4	8.0
Non-manufacturing	2.9	1.3	0.16	0.29	39.4	57.1	55.1	82.4
All groups	100	100			100	100	100	100

Source: Robson et al., 1988

Both the United States and the United Kingdom show a similar pattern. The core sector is highly innovative, producing mainly 'products' used elsewhere. The secondary sector is somewhat less innovative and is more equally balanced between 'products' used in other sectors and 'processes' that are used in the same sector. The secondary sector uses 'technology' from the core sector but also diffuses technology via new 'products' to the other sector—though with less intensity than the core sector. The remaining industries are the least innovative. In contrast to the first two sectors, the other group focuses more on 'process' innovations that are germane only to themselves and less on 'product' innovations used in other industries. Technical progress in the other sector is due in large part to the adoption of innovative 'products' that are produced by the core and secondary sectors—whether these products are materials inputs such as chemicals or capital inputs such as machinery and equipment.

Since the patterns of production and use of technology are much the same in both the U.S. and the U.K., this industry taxonomy captures basic differences in the technical characteristics that should be expected to exist in most industrial countries. Therefore, it will be used to analyze cross-industry technological patterns in Canada.

This taxonomy also corresponds to differences that previously have been found in the efficacy of the use of patents. Mansfield (1986) notes that patents are more important to the innovation process in chemical and pharmaceutical industries and machinery—all industries in the first tier of core innovative industries. Levin et al., (1987) report that chemicals, pharmaceuticals, and petroleum—all in the core sector—rank patents very high relative to alternatives, such as being first in the market, in protecting process innovations. Plastics and steel, two industries in the secondary grouping, rated patents about as important as most of the alternatives.

Canadian patent statistics reflect these differences between the three sectors. These statistics are kept both on an industry-of-manufacture basis (the industry where the patent is taken out) and on an industry-of-use basis (the industry that will use the product or process that is covered by the patent). The cumulative totals of all patents granted between 1972 and 1987 are presented in Table 20, for both industry of manufacture and for industry of use.

Table 20
Industry Patterns of Patent Use and Manufacture

Industry Sector	Cumulative Patents Granted 1972-87		
	Industry of Use	Industry of Manufacture	Industry of Use/ Industry of Manufacture
Core Sector	**104,628**	**173,349**	**0.6**
Refined Petroleum	2,000	626	
Electrical	45,651	58,320	
Chemicals	29,010	44,694	
Machinery	21,244	52,344	
Scientific Instruments	6,723	17,365	
Secondary Sector	**40,483**	**37,429**	**1.1**
Transportation	16,602	12,021	
Non-metallic	2,861	2,454	
Primary Metals	4,676	2,322	
Fabricated Metals	8,347	14,751	
Plastics	6,472	4,657	
Rubber	1,525	1,224	
Other Manufacturing	**16,985**	**6,349**	**2.7**
Beverages	545	15	
Wood	1,177	459	
Printing	2,630	332	
Clothing	725	129	
Food	3,367	964	
Primary Textiles	1,740	803	
Furniture	659	901	
Textiles	2,171	957	
Paper	2,874	1,347	
Leather	464	159	
Tobacco	629	283	

Source: Table E.4: Research Markets for Intellectual Property: Economic and Statistical Analysis. Consumer and Corporate Affairs

The core group of industries is responsible for the highest intensity of patent creation (industry of manufacture), with electrical and electronic products leading the way, but with machinery a close second and chemical products following third. The secondary group produces goods covered by fewer patents than the core group. In the secondary group, transportation and metal fabrication industries take out the most patents for their innovations. Industries in the "other" group of industries generally produce fewer patents. The most active industry here is paper products. It uses as many patents as non-metallic minerals, primary metals, and rubber products, all of which are in the secondary group.

The core group tends to produce more patentable innovations than it uses. The ratio of patents used to those manufactured is 0.6 for this group. The secondary group makes use of about the same number of patents as it creates—with a ratio of use to manufacture of 1.1. The "other" sector uses 2.7 times what it makes. Canada's experience in these three sectors—core, secondary, and "other"—conforms to the same pattern that has been observed in the U.K. and the U.S.

a) Use of Intellectual Property Protection

Data on the actual usage of intellectual property protection taken from the survey also show that there is a considerable variation across the industry groups in the intensity of use of patents, trade-marks, trade secrets, and industrial designs (Table 21). The most frequent users of patent protection are machinery, rubber, plastics, and chemicals. Industries in the core group have the greatest intensity (17%), those in the secondary group are next (11%), and other industries come last (3%). These differences have the same sign as the number of patents registered (applications), but not the same magnitude. Patent registrations in the core sectors are about five times those in the secondary sector (Table 20).

There are a number of reasons for these differences. First, patent registrations do not have to be made by firms operating in Canada. Second, patent registrations measure total output and not output per firm. Third, the intensity of use presented in Table 21 does not differentiate between multiple use and single use per firm.

The use of industrial designs exhibits an intersectoral pattern similar to that of patents. Industries in the core and secondary industries have the highest intensity of use—8% and 9%, respectively. Only 4% of firms in 'other' industries make use of industrial designs. The industries that most frequently use industrial designs are rubber, plastics, textiles, transportation equipment, fabricated metal and electrical. The industries that least frequently use industrial designs are beverages, printing, primary textiles, and clothing.

Table 21
Usage of Intellectual Property Protection by Type and by Industry

Industry Sector	Percent of Firms Using				
	Patents	Industrial Designs	Trade-marks	Trade Secrets	At Least One
Core Sector	**16.9**	**8.2**	**17.7**	**10.2**	**31.6**
Refined Petroleum	10.2	6.8	19.4	19.1	26.0
Electrical	13.0	9.0	16.8	10.6	27.5
Chemicals	19.6	6.1	30.2	13.9	38.1
Machinery	18.8	8.5	12.5	7.8	31.9
Secondary Sector	**11.4**	**8.9**	**8.4**	**10.5**	**23.9**
Transportation Equipment	11.9	10.7	10.9	13.1	30.3
Non-metallic	6.5	2.9	7.9	13.2	20.6
Primary Metals	9.6	7.3	9.8	9.4	21.5
Fabricated Metals	11.6	9.6	5.5	8.1	21.3
Plastics	16.0	10.3	15.1	12.1	27.5
Rubber	18.3	18.7	19.7	18.7	44.4
Other Manufacturing	**2.9**	**3.6**	**10.6**	**6.9**	**17.8**
Beverages	0.7	0.5	34.1	1.4	34.8
Wood	0.7	3.5	4.4	2.5	9.0
Printing	1.2	0.7	7.6	3.4	11.2
Clothing	1.6	0.9	8.2	4.7	12.3
Food	2.6	3.0	22.9	13.2	28.3
Primary Textiles	3.6	12.0	10.2	1.6	22.2
Other Manufacturing	6.5	5.9	12.1	11.0	27.9
Furniture	2.2	8.2	5.5	5.0	15.3
Textiles	8.1	5.4	11.3	11.6	18.9
Paper	5.0	7.8	17.7	12.9	26.6
Leather	5.6	3.6	10.1	8.5	16.8

The pattern evident with patents and industrial designs disappears for trade-marks. Industries in the core group are most likely to use trade-marks (18%), but it is the 'other' set of industries that comes second (11%). The highest using industries—beverages, chemicals, refined petroleum, food, and rubber—are scattered across all three groups.

The pattern for trade secrets falls somewhat between the two other models. The core group and the secondary groups are the heaviest users of trade secrets—10% and 11%, respectively—while the third group follows more closely behind (7%) than in the case of patents or industrial designs. The most frequent industry users come from all three groups—refined petroleum, rubber, paper, food and non-metallic. The least frequent users are found in the "other" industry group.

Thus, electrical, chemicals, petroleum, plastics and rubber are particularly intensive users of several different forms of intellectual property--patents, trade-marks, industrial designs and trade secrets. Food and paper are particularly strong users of trade secrets. Beverages, food and paper use trade-marks intensely. Textiles are among the more intensive users of industrial designs. Wood, clothing, and primary textiles are infrequent users of almost all forms of intellectual property protection.

The various forms of intellectual property protection are related in use—partly because their use corresponds to the innovativeness of an industry. Industrial designs, patents, and trade secrets are the most closely related. Cross-industry correlations are high between design and patent use (0.7) and design and trade secrets use (0.6), and patents and trade secrets (0.6).

Trade-marks has a somewhat different industry pattern of use, though it is still positively related to the others. The use of trade-marks is not closely correlated with either industrial designs (0.1) or with patents (0.3). It has a slightly stronger correlation with trade secrets (0.4).

b) Effectiveness of Intellectual Property Protection

Industries differ with regards to their evaluation of the efficacy of intellectual property protection for two reasons. First, firms may have views regarding the efficacy of the various forms of protection that do not depend upon whether they use the protection but which differ by industry because conditions in some industries make it easier to protect appropriability using patents. In this case, average scores per sector would be similar for most firms in an industry but would differ across industries. Second, firms may not differ in the extent to which they value intellectual property protection if they use it but they may differ in the extent to which they use protection. The latter would occur if different scientific environments lead some industries to offer more scope for innovative activities than others. In this case, the evaluation of the form of intellectual property protection will differ across users and non-users in an industry but would be relatively similar across industries for users. Industries would differ with regards to average scores of users and non-users taken together, primarily because the proportion of users and non-users varies across industries.

To examine whether one or both of these explanations is at work, the average scores given to different forms of intellectual property protection are tabulated in Table 22 by industry sector. Three different methods are used. The

Table 22
Evaluation of Individual Forms of Intellectual Property Protection by Sector (Company-weighted)

Sector	Copyrights	Patents	Industrial Designs	Trade Secrets	Complexity	Lead Time	Other
A) All Firms							
Core	1.6	2.0	1.6	1.9	2.7	3.0	2.1
Secondary	1.4	1.7	1.5	1.8	2.6	3.1	2.2
Other	1.3	1.5	1.4	1.7	2.2	3.0	2.4
B) Firms With Any Intellectual Property							
Core	1.8	2.5	1.9	2.1	2.8	3.0	2.3
Secondary	1.5	2.1	1.8	2.3	2.9	3.3	2.6
Other	1.6	1.7	1.5	2.1	2.6	3.4	2.3
C) Firms With Specific Forms of Intellectual Property							
Core	2.8	3.0	3.0	3.3			
Secondary	2.5	3.0	2.4	3.4			
Other	2.9	3.1	1.9	2.9			

average score for all firms is given in Panel A. It will differ across industries either because the percentage of firms using intellectual property protection varies across industries or because the valuation of those who use it differs. The average score of all firms that actually use any form of intellectual property protection is given in Panel B. The average score of all firms that use the particular property right being evaluated is given in Panel C. If the scores differ by sector in Panel A but not in Panel B or C, firms differ not so much in terms of their evaluation of the efficacy of protection as in their tendency to be innovative and to make use of the protection.

The score given to the various forms of protection by all firms in Panel A tends to be highest in the core sector and declines in the secondary and "other" sectors. Innate forms of protection—such as complexity, lead time, and other means—receive higher scores in all sectors compared to the statutory means of protection.

When only firms that possess an intellectual property right are used for tabulations (Panel B), the gradation between the core, secondary and 'other' sectors remains, with the exception of trade secrets where the difference disappears. It is still the case that complexity, lead time and other natural strategies are given higher scores than copyrights, patents, industrial designs, and trade secrets.

By contrast, the average score given to the efficacy of patents by just the users of the patents (Panel C) tends to vary much less than in Panel A or Panel B. This suggests that the average differences across industries for patents for all firms do not reflect inherent differences in the efficacy of patents; rather they reflect differences in inherent opportunities for innovation. This confirms findings in the United States. Cockburn and Griliches (1988) attempt to explain cross-industry differences in patent/R&D ratios using the U.S. data on the effectiveness of patents, but found the latter had little effect on the number of patents taken out per dollar expenditure on R&D—primarily because the measures of effectiveness have very little cross-industry variation (Griliches, 1990). The gradation does, however, remain for industrial designs and trade secrets.

Multivariate Analysis

Previous sections have examined how two different aspects that measure the importance of intellectual property protection vary by the characteristic of reporting firms. The first aspect involves use, the second consists of evaluations of the usefulness of different instruments in protecting innovative ideas. Both use and self-evaluations were generally found to be higher for larger firms, for foreign-owned firms, for more innovative firms, and for firms in certain core industries that are responsible for the largest proportion of innovations.

These findings are all based on simple two-way comparisons of use of different forms of intellectual property or on evaluations of these forms of protection—tabulations by size or by ownership or by innovativeness. This section asks whether each of these characteristics still matters once the others have been taken into account. It may be, for instance, that foreign-owned firms make greater use of different forms of intellectual property protection simply because they are larger. Being able to correct for the effect that size has on use, permits conclusions to be drawn about whether foreign ownership matters once the effect of size has been taken into account.

In order to disentangle the various effects, a multivariate analysis is used to examine the connection between use or the scores attached to intellectual property protection and various firm characteristics. Two regressors are employed for each of the five major statutory forms of intellectual property protection—copyrights, patents, industrial designs, trade secrets, and trade-marks. The first is a binary variable that measures use—zero if the form of intellectual property protection in question is not used, 1 if there is at least one use made of it. For this variable, a probit regression is employed. The second variable used is the score attached to the form of intellectual property protection. For this ordinary least squares is used. In both cases, weighted regressions (using company weights) are employed.

The regressors are size of firm (Size), nationality (Foreign), innovativeness (Innovate), and three industry classifications—core (Core); secondary (Secondary); other manufacturing industries (Other mfg) and all other industries.[23] They follow the definitions in the previous section. Size is a binary variable that is zero for the smallest class and 1 for the larger class. Nationality is a binary variable that is zero for domestically owned firms and 1 for foreign-owned firms. Innovativeness is a binary variable that is zero for non-innovative firms and 1 for innovative firms. The definition of innovativeness is the comprehensive definition that was used previously. Each of the industry sectors is also represented with an industry variable.

The results presented in Table 23 are for usage. The omitted category here is a small domestically owned non-innovative firm located outside the core and secondary sectors. Table 24 includes results for the score attached to the form of intellectual property protection. The omitted category is a small domestically owned non-innovative firm located outside the manufacturing sector.

Looking first at use, it is evident that the innovativeness of a firm has a significant (at the 1% level) impact everywhere. With the exception of copyrights, size is also significant across all the categories. Nationality of ownership is not significant everywhere. It is insignificant in three areas—in the case of patents, trade secrets and

Table 23
Regression Coefficients for Utilization of Intellectual Property Protection

Variable	Patents	Copyrights	Design	Trade Secrets	Trade-marks	At Least One
Size	0.66	0.14	0.25	0 .20	0.60	0.60
	(0.0001)	(0.24)	(0.018)	(0.03)	(0.0001)	(0.0001)
Innovate	0.90	0.43	0.61	0.51	0.69	0.31
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Foreign	0.11	0.38	0.09	-0.008	0.38	0.77
	(0.48)	(0.03)	(0.61)	(0.96)	(0.006)	(0.0001)
Core/Sec	0.87	-0.14	0.41	0.08	-0.14	0.13
	(0.0001)	(0.15)	(0.0001)	(0.30)	(0.07)	(0.03)
Log Likelihood	-466.3	-415.9	-470.8	-647.2	-730.2	-1312.5
N	2350	2350	2350	2350	2350	2350

Note: Number in brackets is the probability of the null hypothesis that the coefficient is zero being true.

[23] *Although only manufacturing establishments were sampled, some of the owning enterprises fell outside the manufacturing sector.*

Table 24
Regression Coefficients for Score Attached to Intellectual Property Protection

Variable	Patents	Copyrights	Design	Trade Secrets	Trade-marks	Complex	Being First in the market
Size	0.49	0.14	0.32	0.13	0.43	-0.09	-0.14
	(0.0001)	(0.19)	(0.001)	(0.29)	(0.001)	(0.48)	(0.23)
Innovative	0.22	0.02	0.01	0.15	0.21	0.90	0.78
	(0.016)	(0.78)	(0.88)	(0.14)	(0.03)	(0.0001)	(0.0001)
Foreign	0.53	0.33	0.36	0.49	0.39	0.47	-0.007
	(0.003)	(0.07)	(0.04)	(0.02)	(0.03)	(0.02)	(0.97)
Core	0.48	0.31	0.43	0.18	0.22	0.69	0.61
	(0.007)	(0.08)	(0.014)	(0.38)	(0.30)	(0.002)	(0.003)
Secondary	0.55	0.27	0.44	0.28	0.17	0.48	0.53
	(0.003)	(0.13)	(0.01)	(0.17)	(0.41)	(0.035)	(0.01)
Other Manufacturing	-0.06	0.31	0.18	-0.02	0.43	0.25	0.52
	(0.73)	(0.07)	(0.29)	(0.91)	(0.02)	(0.24)	(0.007)
R^2	0.11	0.007	0.04	0.03	0.05	0.13	0.07
F	18.18	1.81	6.31	3.20	6.51	19.48	12.53
Prob>F	0.001	0.095	0.001	0.004	0.0001	0.0001	0.001
N	804	673	645	704	825	694	806

Note: The figure in brackets is the probability of the null hypothesis that the estimate is zero being true.

industrial designs. Foreign-owned firms are therefore not more likely to make use of patents, trade secrets or industrial designs once other characteristics of these firms are taken into account. Firms in the core and secondary sectors are also more likely to have higher use rates for patents and industrial designs.

Several variants of the regressions reported in Table 23 were also estimated. The first utilized a continuous size variable, employment in the firm, as opposed to the binary variable reported here. It was included to see whether nationality might partially be capturing size. The inclusion of the continuous variable has no effect on the significance of the nationality of ownership variable, except in the case of patents, where its inclusion makes the nationality variable positive and significant. The continuous size variable is significant (at the 5% level) for patents and trade secrets, but not for industrial designs.

The second variant includes the score given to each intellectual property right on the grounds that firms may only acquire intellectual property where they feel it is useful. In each case, the score was associated with a highly significant coefficient. But its inclusion does not remove the other regressors as significant explanatory variables, with a few minor exceptions.

In the case of the score given to the different categories (Table 24), the same general patterns are not evident across all categories.[24] For patents, all categories are significant. Firms give a higher rating to patents if they are larger, more innovative, foreign-owned and in the core or secondary sector. Both trade-marks and industrial design scores are generally related to all the explanatory categories. By way of contrast, the scores given to copyrights and trade secrets are not as significantly related to size, innovativeness, ownership and sector. Trade secrets are, however, given a higher evaluation by firms that are foreign-controlled.

The same regression that was performed for the various forms of statutory intellectual property protection was performed for the two innate or natural forms of protection—being first in the market and having a complex product design. In both cases, almost all the coefficients, with the exception of size, are significant and positive.

Variants of the multivariate analysis for the scores were also estimated with a continuous employment-size variable and with the usage included as separate regressors. As was the case for the use equations, neither of these variants changed the reported results substantially.

In conclusion, the multivariate results show that each of the characteristics that was previously examined—size, nationality, innovativeness, industry location—is significant in its own right. This is particularly the case for the scores attached to the two innate forms of protection—being first and complexity of product design—but it also applies to the scores given to patents, trade-marks, and industrial designs.

[24] *There are fewer observations available for estimation of Table 24. Therefore the results in Table 23 were rerun to test to see whether there was anything unusual about the sample that responded to the efficacy question. Results similar to those reported in Table 23 were generated.*

The multivariate results are not quite so clear-cut when it comes to the use of intellectual property protection. Here too, size and innovativeness generally are significant; however, nationality is not as frequently significant as it is in the case of the score attached to the efficacy of the intellectual property right in question. In particular, foreign-owned firms are not more likely to possess a patent than domestically owned firms. On the other hand, they are more likely to attach a higher value to patents as a method of protection. This may occur because foreign-owned firms hold a patent elsewhere than in Canada or because the size variable is capturing most of the foreign-ownership effect. The latter is likely the case, since the inclusion of the continuous-size variable results in the nationality variable gaining significance in the equation that estimates use.

Both the innate or natural forms of protection are perceived to be more effective in firms that are innovative, and in the core or secondary sectors. However, size is not significantly related to the scores given to these forms of protection. Large firms may be more inclined to value statutory forms of protection like patents, industrial designs, and trade secrets; but they are not different from small firms in their evaluation of strategies like complexity of design and leadership. Both groups find them equally important.

In conclusion, innovative firms are more likely to make use of each of the statutory forms of intellectual property—patents, copyrights, industrial designs, trade secrets, and trade-marks. They also assign a higher score to patents, trade-marks, and to being first in the market and to having a more complex form of product. Both size and nationality are also frequently related to either use or the scoring given to the effectiveness of intellectual property. Both size and nationality are probably capturing other aspects of innovativeness that the innovative variable used here does not reflect—either the importance of the innovation, its originality, or its use of proprietary knowledge.

Conclusion

This study sets the use of intellectual property protection in the context of innovation activity. As such, it reveals much about both the intensity of innovation and the use of intellectual property protection. Innovation is defined herein as the recent introduction of major new products and processes. These innovations range from world-firsts to Canadian firsts to major imitations. At any one point in time, a relatively small percentage of firms are actively innovating. Only about half of the largest firms (>500 employees) report sales from a major product innovation over the last three years. Only about a third of those with less than 100 employees do the same.

Several broad forms of protection for intellectual property are supported by the state—patents, copyrights, trade-marks, industrial designs, and trade secrets. These range from patents which are registered by an administrative system and enforced by the courts to trade secrets which are supported through the legal system. Less than one-quarter of the population of manufacturing enterprises, both large and small, make use of at least one of these forms of protection. Only about 7% specifically use patents. The importance of these forms of protection for intellectual property increases when the size of the using entities is considered. While only about one-quarter of manufacturing firms use one of these forms of protection, these firms account for 50% of employment.

The difference in these two measures of use—company-weighted versus employment coverage—results from very large differences in the extent to which small and large firms avail themselves of the statutory forms of protection. Over 62% of large firms protect themselves with any one of the statutory rights, less than 30% of those with 20 to 100 employees do so. Part, but not all of this difference, is accounted for by different tendencies to innovate. But even when these differences are taken into account, small innovative firms are seen to make use of the formal forms of protection less frequently than large firms. Of those large firms reporting sales from a product innovation, almost 85% possess one of the statutory rights; less than 50% of those with less than 100 employees who have recently introduced a major product innovation do so.

Being innovative is a primary determinant of the use of intellectual property protection. There are substantial differences in the use of trade-marks, patents, trade secrets, industrial designs and copyrights between those who had just innovated in the three preceding years and those who had not. It is, of course, possible that a significant portion of the group of non-innovators had innovated in the not too distant past. If they were significant innovators, they would have still had a significant amount of intellectual property at the time of the survey. However, while some of this group possessed some forms of intellectual property protection, the percentage was small. For example, the proportion of firms that were innovative over the three-year period preceding the survey and that possessed a patent was about 14%, but only 2% of firms that had not innovated over these three years did so. The size of this difference suggests that the non-innovating population possesses relatively little of the knowledge-based capital that would be based on past activities. This in turn suggests that the innovative group have not supplanted a previous set of innovators; rather the innovative group have been the leaders in the development of intellectual property for some time.

While being innovative is a prerequisite for the need for protection, not all forms of statutory protection are sought equally by innovative firms. When the effect of being innovative is separated from the effect of size, nationality, and industry, innovativeness has its largest effect on the use of patents and trade-marks. However, large and significant effects are also found on the use of industrial designs, trade secrets and copyrights. Innovative firms then concentrate on patents but also use a wide range of other statutory forms of protection.

Although many innovators make some use of statutory intellectual property protection, there are a substantial group who do not. There are a number of reasons why firms do not seek to protect their intellectual property from being copied by using such statutory forms of protection as patents. First, while each of the innovating firms has developed new products or processes, not all of the ideas imbedded in these innovations are unique enough to be patentable. Some 15% of innovations in large firms are world-firsts, only 30% are firsts for Canada. This study finds almost 80% of world-first innovators protect themselves with a form of statutory protection either in Canada or abroad. It is, however, the case that less than half use patents. Processes lend themselves better to protection through secrecy than do products. Some 45% of all major innovations in large firms involve just process innovations. Process innovation is only about half as likely to make use of any one of the statutory forms of protection as are product innovations.

In addition to providing a broad overview of the extent to which the statutory system is used, the study also examines the extent to which participants value the system. Previous work has asked whether forms of protection

such as patents are essential to the innovation process. Mansfield (1986), using a sample of 100 firms, asked whether patent protection was essential to innovation and found that most firms felt it was not—with the exception of those in chemicals and pharmaceuticals. Levin et al. (1987) had R&D managers score the effectiveness of patents as a means of protecting an innovation and found that the average score received was "less than effective". Firms gave a higher ranking to alternative protection strategies like being first in the market or having a complex product design.

This study confirms the findings of Levin et al. (1987). The population tends to value alternate strategies more highly than the statutory forms of protection. Moreover, the population as a whole ranks strategies like patent protection as being less than "effective". However, these rankings depend very much on the characteristics of a firm. If a firm is innovative, large, foreign-owned, and is in one of those industries that tend to produce more innovations, the score given to the statutory forms of protection like patents increases greatly. On average, users of patents find them effective; so too do large foreign firms.

Mansfield (1986) observed that although firms may not have thought the patent system was essential to innovation, they nevertheless took out patents on most patentable products. Thus measures of use tend to give a different picture of the importance of the patent system than firms' own evaluations. This is not the case here. The firms that tend to give statutory forms of protection like patents a lower score are those that do not make use of patents. Those who have undertaken the effort to acquire patents tend to give them a passing grade.

The findings do, however, confirm that statutory protection is only one of the methods used by firms to defend their intellectual property. Innate forms of protection are seen by almost every subgroup—large, foreign, innovative—as being equally if not more effective.

Interestingly, there is much less variance across size classes in the perception of the effectiveness of these alternative strategies than there is for the statutory forms of protection. Small firms do not feel that protection for intellectual assets that they might develop during innovation is lacking. They feel that innate strategies such as being first are effective while patents are not. In the multivariate analysis that holds other characteristics like innovativeness and industry of location constant, the size of firms has a strong positive effect on the evaluation given to patents and trade-marks, but it is negative for the strategies of being first or of having a more complex product.

Differential usage patterns between small and large firms also reflect these differential opinions on effectiveness. Small firms use trade secrets more frequently relative to patents than large firms. When other differences between small and large firms, such as differences in innovativeness, nationality, and industry of location are considered, size has the greatest impact on patent and trade-mark use.

There is also a large difference in both the usage and the evaluation given to statutory forms of protection between foreign and domestic firms. Foreign-owned firms are more likely to make use of statutory forms of intellectual property rights and to value them more highly. Some but not all of these differences disappear when allowance is made for differences in industry of location, degree of innovativeness, and size. Interestingly, when these other characteristics are considered, the effect of nationality on use is more likely to disappear than is the effect of nationality on the evaluation of the effectiveness of the statutory property right. After correcting for these other characteristics, this study finds that foreign-owned firms are not as likely to use the statutory rights more frequently (with the exception of patents), but they perceive that almost all are more effective than domestic firms. Nationality has the greatest impact on the evaluation of patents and trade secrets.

Finally the study confirms the findings of others (Taylor and Silbertson, 1973; Levin et al., 1987) that the industry environment affects the use that is made of intellectual property. Cross-industry differences in intellectual property usage in Canada are closely related to differences in innovativeness that have been described by Robson et al., (1988). There are a core set of industries—chemicals, pharmaceuticals, refined petroleum, electrical products, and machinery—that tend to produce a large number of inventions which are used downstream in other industries as inputs or as capital equipment. These industries make greater use of almost all forms of statutory protection than do other industries. This is particularly true of patents and of trade-marks. This relationship is also found in the multivariate analysis after other characteristics of the firm are considered. Thus the industrial structure of a country very much determines the use that will be made of its intellectual property system.

The study also indicated that certain industries outside the core group were almost as heavy users of intellectual property protection as the core group. For example, the intensity of patent use in rubber and plastics was greater than the mean usage rate for firms in the core group. Food, beverages, and paper products may not use patents very frequently but they have one of the highest usage rates of trade-marks and trade secrets. Innovation

in these industries is not absent—it just takes a form that would be greatly underestimated if patent statistics alone were used to judge innovativeness.

Finally, it should be noted that firms in different sectors take a very different view of the effectiveness of both the statutory and the innate forms of protection. Even after allowing for differences in size, nationality and innovativeness of the firm, being in the core sector substantially increases the score given to patents, copyrights, and design—though not to trade-marks and trade secrets. The industry environment conditions a firm's view of the effectiveness of the intellectual property system. Some have suggested that differentials in the evaluations given to patents across industries may simply reflect the fact that patents are easier to defend in some industries because of the specificity of the product (Levin et al., 1987). However, there is something else at work here since this effect is found across almost all of the statutory forms of protection. If a firm is in an industry that is generally innovative, it develops an attitude that engenders the use of protection—probably because a learning process is required before a firm understands how to exploit and protect its advantage. This study has found evidence to support this view. Invariably, users of intellectual property manifested a different view of the effectiveness of the various forms of protection. These consistent differences suggest that intellectual property use—like any other strategy—involves acquired skills that only develop in use. As firms innovate, they learn which strategies best protect their knowledge assets. The study also suggests that these skills, in that 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 grows.

Appendix A – Definitions

Historically, intellectual property rights have been classified as either industrial property or copyrights. Internationally, patents, trade-marks and industrial designs are included in the Paris Convention whereas copyrights are included in the Berne Convention. More recently, *sui generis* intellectual property rights protection have been established for integrated circuits and plant varieties. In Canada, intellectual property rights are granted under federal statutes except trade secrets which are protected through civil law. In most cases, IPRs are registered; the main exception being copyrights which are not normally registered and trade-marks which are usually registered, however, trade-mark ownership can also be established under Common Law.

Patents

Patents are granted for inventions relating to new technologies. An invention can be a product, manufacture or composition of matter (e.g. a chemical), an apparatus (a machine), a method or process (a method of manufacture) or an improvement on any of these. The invention must be novel (a first), useful (functional and operative) and non-obvious to someone skilled in the art (inventive ingenuity). Through a patent, the government provides inventors with the right to exclude others from making, using or selling their invention for 20 years from the date of filing a patent application. Besides obtaining a degree of market exclusivity for manufacturing and distributing the invention, inventors may also profit by selling or licensing their patents or using it as an asset for debt and equity financing. In return the patentee must provide a full description of the invention in order to enable any person skilled in the art to perform or practice the invention. As a result, Canadian researchers and inventors can benefit from the public knowledge of advances in technology.

Copyrights

Copyright protection applies to all original expression of ideas in the form of literary, artistic, dramatic or musical works and computer software. The Copyright Act prohibits others from copying a work without the copyright holder's permission. Only the owner of the copyright is allowed to produce or reproduce the work or to permit someone else to do so. Generally, copyright protection lasts for the life of the author plus 50 years. Copyrights differ from other statutory IPRs in that they are not normally registered.

Trade-marks

A trade-mark is registered for words, symbols or pictures used to distinguish proprietary goods or services from those of competitors. Trade-marks come to represent not only actual wares and services but the reputation of the producer. Trade-marks are valid for fifteen years from the date of registration and they can be renewed every 15 years upon payment of a renewal fee. Individuals are not required to register their trade-marks since using a mark for a certain length of time can establish your ownership through Common Law. Registration enables firms to more easily protect their rights and facilitates business expansion through franchises. There are three basic categories of trade-marks. Ordinary marks identify the wares and services of a specific firm or individual. Certification marks identify goods and services which meet a defined standard. Distinguishing guise identifies the unique shape of a product or its package.

Industrial Designs

Industrial designs law protects those features of shape, configuration, pattern or ornamentation that are applied to a useful article and appeal solely to the eye. For most manufactured products, success in the marketplace will depend not only on its functionality but also on its aesthetic appeal. Registration enables industrial designers to prevent others from making, using, renting or selling their design for up to ten years. Registration also ensures that industrial designs are publicly disclosed to the benefit of society. Unlike trade-mark and copyright protection which allow owners to claim ownership without registration, unregistered designs have no legal claim of ownership and therefore provide no protection from imitation.

Integrated Circuit Topographies

Integrated circuit topographies refer to the three-dimensional configuration of the electronic circuits embodied in integrated circuit products or layout designs. Semiconductor integrated circuits are at the heart of modern information, communications, entertainment, manufacturing, medical and space technologies and are now being used increasingly in consumer products such as automobiles, cameras and household appliances. The Integrated Circuit Topographies Act provides protection against copying of registered topographies, but does not prevent others from developing integrated circuit products which use other topographies to provide the same

electronic functions. The Act provides for ten years of protection which enables the registered owner to exclude others from reproducing the topography, incorporating the topography in manufactured products or importing either an infringing topography or integrated circuit product.

Plant Breeders' Rights

A grant of a plant breeders' right gives the holder the exclusive right to control the multiplication and sales of the new plant variety for up to 18 years from the date the certification is granted. To be protected, varieties must be new, distinguishable from all commonly known varieties, and its characteristics must be uniform and stable after repeated propagation, reproduction and multiplication.

Trade Secrets

A trade secret is any plan, formula, device, method of doing business, process or other information applied to commercial advantage, known only to the owner and his authorized associates, and treated as confidential. Trade secrets can be any product of time, skill, cash or effort, but they must be distinct from common knowledge and skill. As the entire basis of a trade secret is its secrecy, protection is lost as soon as it is disclosed or discovered by another. Unlike other areas of intellectual property rights in Canada, no distinct statute protects trade secrets but it may be enforced under common law. The owner of a trade secret is entitled to its exclusive use, at least until it is lost due to independent development by another, reverse engineering, espionage or an unauthorized disclosure. A trade secret is advantageous in that there is protection for an unlimited time if it remains undisclosed and it can be exploited immediately without the time and expense of registration.

Appendix B – Survey Questionnaire

The following includes a list of the survey questions used in the preparation of this study.

1. GENERAL FIRM CHARACTERISTICS

1.4 Please estimate the percentage distribution of your 1991 product sales and exports according to the classification below:

PRODUCTS	SALES %	EXPORTS %
Unchanged products during 1989-91		
Products with minor improvements during 1989-91		
Products resulting from major innovations introduced during 1989-91		
Total	100%	100%

2. RESEARCH AND DEVELOPMENT (R&D)

2.1 Please indicate (✓) the frequency of R&D in your firm.

CHECK (✓) AS MANY CATEGORIES AS APPLY

	✓
R&D is performed on an ongoing basis	
R&D is performed on an occasional, or as needed, basis	

3. INNOVATION

3.1 During the period 1989-91, did you introduce (or were you in the process of introducing) any PRODUCT or PROCESS innovations?

❑ Yes

❑ No - *Please go to next section (or end)* -

3.2 Please indicate (✓) the categories of your innovation activity for the period 1989-1991:

	PRODUCT INNOVATIONS		PROCESS INNOVATIONS
STAGE	Without change in manufacturing technology	With a simultaneous change in manufacturing technology	In manufacturing technology without product change
Introduced			
In progress			

4. CHARACTERISTICS OF INNOVATION

4.1 Please name and/or briefly describe your most important* innovation commercialized during the period 1989-91.

* The innovation which made the greatest contribution to the firm's profit.

4.5 This innovation was:

	✓
A world first	
A Canadian first	
Neither of the above	

4.12 Please indicate (✓) which, if any, of the following methods you used to protect your innovation, and the geographic areas in which you used these methods.

METHODS	Canada	U.S.A.	Europe	Pacific Rim*	Other
Copyrights					
Patents					
Industrial designs					
Trade-marks					
Secrecy Agreements					
Integrated circuit designs					
Plant breeders' rights					
Other					

* Pacific Rim is defined as: Hong Kong, Indonesia, Japan, Malaysia, Singapore, South Korea, Taiwan and Thailand.

5. INTELLECTUAL PROPERTY

5.1 Please indicate (✓) the extent to which the following methods have been used by your firm to protect its intellectual property IN CANADA over the last three years (1989-91).

INTELLECTUAL PROPERTY	1989 - 1991				
	NONE	Number of usages (where relevant)			
		1 - 5	6 - 20	21 - 100	100 +
Copyrights					
Patents					
Industrial designs					
Trade secrets					
Trade-marks					
Integrated circuit designs (semi-conductor chips)					
Plant breeders' rights (plant variety rights)					
Other					

5.2 How effective* are the following means of preventing your competitors from bringing to market copies of your new product or process technology?

*1: NOT AT ALL EFFECTIVE;
2: SOMEWHAT EFFECTIVE;
3: EFFECTIVE;
4: VERY EFFECTIVE;
5: EXTREMELY EFFECTIVE

MEANS	SCALE
INTELLECTUAL PROPERTY RIGHTS ASSOCIATED WITH:	
Copyrights	
Patents	
Industrial designs	
Trade secrets	
Trade-marks	
Integrated circuit designs	
Plant breeders' rights	
Other	
OTHER STRATEGIES:	
Complexity of product design	
Being first in the market	
Other	

5.3 During the last three years (1989-91), has your firm granted the right to use intellectual property to, or acquired the right to use intellectual property from, another firm?

❑ Yes

❑ No

5.4 Please indicate (✓) the type and direction of such intellectual property transfer:

INTELLECTUAL PROPERTY	GRANTED RIGHT(S) TO:		ACQUIRED RIGHT(S) FROM:	
	Canadian Firms ✓	Foreign Firms ✓	Canadian Firms ✓	Foreign Firms ✓
Copyrights				
Patents				
Industrial designs				
Trade secrets licensing agreements				
Trade-marks				
Integrated circuit designs				
Plant breeders' rights				
Other				

Appendix C – Standard Error Estimates

Table C2
Standard Errors for Table 2
Multiple Use of Statutory Forms of Intellectual Property Protection

Firm Size	Number of Intellectual Property Types				
	At Least One	1	2	3	4+
Company-weighted	1.16	0.95	0.65	0.37	0.24
Employment-weighted	2.94	2.16	1.73	1.01	2.51

Table C3
Standard Errors for Table 3
Usage of Intellectual Property Protection by Type

Type	All Firms (Company-weighted)			All Firms (Employment-weighted)		
	At Least One	1 to 5	6+	At Least One	1 to 5	6+
Copyrights	0.56	0.43	0.37	2.43	1.38	2.14
Patents	0.64	0.62	0.17	2.86	2.30	2.25
Industrial Designs	0.62	0.53	0.33	2.35	2.07	1.33
Trade Secrets	0.74	0.61	0.44	2.66	1.91	2.15
Trade-marks	0.78	0.74	0.27	2.78	2.11	2.29
Integrated Circuit Designs (Semi-conductor Chips)	0.18	0.12	0.13	0.33	0.22	0.25
Plant Breeders' Rights (Plant Variety Rights)	0.06	0.04	0.04	0.41	0.24	0.33
Other	0.33	0.33	0.005	0.98	0.90	0.41

Table C4
Standard Errors for Table 4
Effectiveness of Intellectual Property Protection by Type (Company-weighted)

Intellectual Property Rights Associated with:	Average Score				
	All Firms	Users of Any Statutory Right	Non-users of Any Statutory Right	Users of Specific Statutory Right	Non-users of Specific Statutory Right
	1	2	3	4	5
Statutory					
Copyrights	0.02	0.06	0.03	0.16	0.02
Patents	0.03	0.06	0.03	0.10	0.03
Industrial Designs *	0.02	0.05	0.03	0.12	0.02
Trade Secrets	0.03	0.07	0.04	0.11	0.03
Trade-marks	0.03	0.07	0.03	0.09	0.03
Integrated Circuit Designs	0.02	0.04	0.02	0.38	0.02
Plant Breeders' Rights	0.01	0.02	0.02	0.32	0.01
Other	0.03	0.05	0.03	0.25	0.02
Other Strategies					
Complexity of Product Design	0.04	0.07	0.05		
Being First in Market	0.04	0.07	0.05		
Other	0.05	0.08	0.05		

Scored as: 1—not at all effective; 2—somewhat effective; 3—effective; 4—very effective; 5—extremely effective
** This category probably involves protection granted under the Industrial Design Act and more innate forms of design protection.*

Table C7
Standard Errors for Table 7
Multiple Use of Intellectual Property Protection

Firm Size (employees)	Number of Intellectual Property Types				
	At Least One	1	2	3	4+
Less than 20	1.44	1.18	0.80	0.46	0.30
20-99	2.22	1.96	1.07	0.62	0.26
100-499	3.34	2.59	3.27	1.40	1.45
500+	3.98	3.42	2.10	1.81	2.20

Table C8
Standard Errors for Table 8
Usage of Intellectual Property Protection

Type	Size Class (employees)			
	<20	20-99	100-499	500+
Copyrights	0.71	1.02	2.08	2.20
Patents	0.80	1.13	2.45	3.54
Industrial Designs	0.74	1.22	3.37	2.48
Trade Secrets	0.98	0.72	3.36	2.98
Trade-marks	0.92	1.79	2.84	3.58
Integrated Circuit Designs (Semi-conductor Chips)	0.23	0.51	0.20	0.76
Plant Breeders' Rights (Plant Variety Rights)	0.04	0.00	0.92	0.29
Other	0.45	0.43	0.22	0.90

Table C9
Standard Errors for Table 9
Effectiveness of Intellectual Property Protection

Type of Protection	Size Class (employees)			
	<20	20-99	100-499	500+
Patents	0.04	0.07	0.09	0.11
Trade Secrets	0.04	0.07	0.08	0.13
Trade-marks	0.04	0.06	0.09	0.10
Complexity	0.05	0.07	0.08	0.09
Being First in the Market	0.06	0.08	0.08	0.08

Scored as: 1—not at all effective; 2—somewhat effective; 3—effective; 4—very effective; 5—extremely effective

Table C10
Standard Errors for Table 10
Multiple Use of Intellectual Property Protection (Foreign vs Domestic)

Number of Intellectual Property Types	% of Firms Using			
	Firm Type			
	Small Domestically-owned	Small Foreign-owned	Large Domestically-owned	Large Foreign-owned
At Least One	1.22	5.35	4.47	3.80
1	1.01	4.75	3.74	3.76
2	0.67	2.16	5.23	3.07
3	0.39	1.71	1.41	1.73
4+	0.26	0.71	1.17	2.43

Table C11
Standard Errors for Table 11
Usage of Intellectual Property Protection by Type (Foreign vs Domestic)

Form of Protection	% of Firms Using			
	Firm Type			
	Small Domestically-owned	Small Foreign-owned	Large Domestically-owned	Large Foreign-owned
Copyrights	0.60	2.74	2.45	2.74
Patents	0.68	2.40	3.05	3.83
Industrial Designs	0.65	2.33	5.14	3.26
Trade Secrets	0.79	2.19	5.09	3.08
Trade-marks	0.82	4.49	3.76	3.88

Table C12
Standard Errors for Table 12
Effectiveness of Intellectual Property Protection (Foreign vs Domestic)
(Company-weighted)

Intellectual Property Protection Associated with:	Average Score[1]					
	All Foreign	Foreign Users[2]	Foreign Non-users	All Domestic	Domestic Users[2]	Domestic Non-users
	1	2	3	4	5	6
Statutory Protection						
Copyrights	0.10	0.12	0.16	0.03	0.06	0.03
Patents	0.14	0.17	0.20	0.03	0.07	0.04
Industrial Designs	0.10	0.14	0.11	0.02	0.05	0.03
Trade Secrets	0.14	0.16	0.22	0.04	0.08	0.04
Trade-marks	0.12	0.14	0.16	0.03	0.08	0.03
Integrated Circuit Designs	0.17	0.22	0.26	0.02	0.04	0.02
Plant Breeders' Rights	0.03	0.03	0.05	0.02	0.03	0.02
Other Strategies						
Complexity of Product Designs	0.01	0.02	0.02	0.03	0.06	0.03
Being First in the Market	0.16	0.18	0.24	0.04	0.08	0.05
Other	0.15	0.16	0.24	0.05	0.09	0.06

[1] *Scored as: 1—not at all effective, 2—somewhat effective, 3—effective, 4—very effective, 5—extremely effective*
[2] *Users are defined as those having the particular property right being scored*

Table C13
Standard Errors for Table 13
Effectiveness of Alternative Means of Protecting New Products and Processes from Imitation - According to Whether or Not the Firm is Innovative and Whether it Uses that Particular Form of Intellectual Property Protection (IPP) - Company-weighted

	Innovative	Non-innovative	Innovative	Non-innovative
	Firms that used IPP Mean of a scale of 1 to 5		Firms that did not use IPP Mean of a scale of 1 to 5	
Panel A				
Intellectual Property Protection Associated with:				
Copyrights	0.20	0.23	0.04	0.03
Patents	0.11	0.29	0.05	0.04
Industrial Designs	0.15	0.21	0.04	0.03
Trade Secrets	0.15	0.14	0.05	0.04
Trade-marks	0.12	0.15	0.05	0.04
Integrated Circuit Designs	0.45	0.67	0.03	0.03
Plant Breeders' Rights	0.16	0.53	0.02	0.02
Panel B				
Other Strategies				
Complexity of Product Design	0.09	0.12	0.09	0.05
Being First in the Market	0.08	0.14	0.09	0.06

Note: Use in Panel A refers to specific use of the particular intellectual property right.
Use in Panel B refers to general use of any of the statutory rights.

Table C14
Standard Errors for Table 14
A Comparison of Innovativeness, R&D and Intellectual Property Use by Size Class (Company-weighted)

Percent of Firms with:	Size Class			
	<20	20-99	100-499	500+
Sales from a major product innovation	1.62	2.24	3.16	3.70
Performing R&D continuously	1.36	2.06	3.10	3.59
Using any form of statutory intellectual property protection	1.38	1.90	3.09	3.57
Using patents	0.77	1.10	2.30	3.42

Table C15
Standard Errors for Table 15
A Comparison of R&D and Intellectual Property Use by Size Class for Innovators (Company-weighted)

Percent of Firms with:	Size Class			
	<20	20-99	100-499	500+
Sales from a major product innovation	0.00	0.00	0.00	0.00
Performing R&D continuously	4.80	5.56	7.45	4.02
Using any form of statutory intellectual property protection	4.35	5.37	5.15	3.69
Using patents	2.54	3.54	5.37	5.08

Table C16
Standard Errors for Table 16
Usage of Intellectual Property Protection by Type and by Region Ownership for Major Innovations of Large Firms

	(% of large firms reporting a major innovation)					
	Canada	U.S.A.	Europe	Pacific Rim	Other	At Least One Region
Copyrights	0.95	0.66	0.07	0.04	0.23	0.98
Patents	1.82	1.76	1.16	1.02	0.59	1.85
Industrial Designs	1.51	0.97	0.43	0.37	0.43	1.53
Trade-marks	1.70	1.17	0.61	0.57	0.48	1.71
Secrecy Agreements	1.73	1.33	0.76	0.74	0.57	1.77
Integrated Circuit Designs	0.54	0.38	0.27	0.26	0.35	0.59
Plant Breeders' Rights	0.30	0.30	0.00	0.00	0.23	0.38
Other	0.82	0.64	0.36	0.36	0.71	1.04
At Least One	2.43	2.22	1.43	1.31	1.13	2.44

Table C17
Standard Errors for Table 17
Usage of Intellectual Property Protection in Large Firms by Region, for Product and Process Innovations (% of Large Firms with a Major Innovation)

Panel A	Product and/or Process				
	Canada	U.S.A.	Europe	Pacific Rim	At Least One Region
Copyrights	1.56	1.15	0.13	0.07	1.55
Patents	2.50	2.39	1.69	1.42	2.53
Industrial Designs	2.24	1.54	0.48	0.30	2.24
Trade-marks	2.48	1.56	0.84	0.74	2.48
Secrecy Agreements	2.41	1.88	1.17	1.18	2.41
Integrated Circuit Designs	0.85	0.48	0.09	0.00	0.85
Plant Breeders' Rights	0.53	0.53	0.00	0.00	0.53
Other	1.22	0.89	0.39	0.35	1.56
At Least One	3.18	2.95	1.98	1.72	3.16
Panel B	**Product Only**				
	Canada	U.S.A.	Europe	Pacific Rim	At Least One Region
Copyrights	2.60	1.03	0.00	0.0	2.60
Patents	5.73	5.59	2.77	2.49	5.80
Industrial Designs	3.15	3.03	2.36	2.36	3.15
Trade-marks	5.31	4.41	0.24	0.41	5.31
Secrecy Agreements	3.84	2.43	2.36	2.36	3.87
Integrated Circuit Designs	1.87	1.87	1.87	1.87	1.87
Plant Breeders' Rights	0.29	0.00	0.00	0.00	0.29
Other	2.48	2.14	2.09	2.12	2.51
At Least One	6.43	6.49	4.37	4.26	6.41
Panel C	**Process Only**				
	Canada	U.S.A.	Europe	Pacific Rim	At Least One Region
Copyrights	0.00	0.00	0.00	0.00	1.29
Patents	3.34	3.33	1.95	1.95	3.54
Industrial Designs	3.53	0.00	0.00	0.00	3.71
Trade-marks	2.66	2.12	2.12	2.12	2.93
Secrecy Agreements	4.84	3.98	1.07	0.55	5.10
Integrated Circuit Design	0.18	0.00	0.00	0.00	1.30
Plant Breeders' Rights	0.00	0.00	0.00	0.00	1.29
Other	0.96	0.96	0.00	0.00	0.96
At Least One	5.60	5.16	3.00	2.88	5.72

Table C18
Standard Errors for Table 18
World-first/Not World-first Usages of Intellectual Property Protection by Type for Large Firms by Region

Panel A	World-first				
	Canada	U.S.A.	Europe	Pacific Rim	At Least One Region
Copyrights	3.76	3.17	0.27	0.27	3.98
Patents	5.37	5.29	4.49	4.08	5.44
Industrial Designs	3.84	2.86	2.74	2.37	4.07
Trade-marks	5.19	4.33	2.92	2.59	5.27
Secrecy Agreements	5.46	5.13	3.70	3.70	5.50
Integrated Circuit Design	0.86	0.86	0.00	0.00	1.74
Plant Breeders' Rights	0.00	0.00	0.00	0.00	1.52
Other	2.45	1.63	0.00	0.33	2.48
At Least One	4.39	5.39	5.04	4.69	4.12
Panel B	**Not a World-first**				
	Canada	U.S.A.	Europe	Pacific Rim	At Least One Region
Copyrights	0.88	0.52	0.07	0.00	0.88
Patents	1.87	1.80	1.06	0.92	1.90
Industrial Designs	1.65	1.02	0.07	0.10	1.65
Trade-marks	1.74	1.12	0.48	0.47	1.74
Secrecy Agreements	1.74	1.20	0.58	0.55	1.78
Integrated Circuit Design	0.62	0.42	0.32	0.31	0.62
Plant Breeders' Rights	0.35	0.35	0.00	0.00	0.35
Other	0.87	0.70	0.43	0.41	1.14
At Least One	2.65	2.34	1.37	1.25	2.67

Table C21
Standard Errors for Table 21
Usage of Intellectual Property Protection, by Type and by Industry

Industry Sector	Percent of Firms Using				
	Patents	Industrial Designs	Trade-marks	Trade Secrets	At Least One
Core Sector	**2.26**	**1.70**	**2.40**	**1.90**	**3.06**
Refined Petroleum	3.60	3.05	6.63	6.70	7.30
Electrical	3.61	3.50	4.54	3.61	5.46
Chemicals	4.74	2.30	5.54	3.57	6.03
Machinery	3.69	2.64	3.29	2.92	4.82
Secondary Sector	**1.62**	**1.57**	**1.28**	**1.63**	**2.22**
Transportation Equipment	2.66	3.05	2.94	3.54	4.48
Non-metallic	2.45	1.14	2.93	3.69	4.35
Primary Metals	3.62	4.08	3.57	3.69	5.66
Fabricated Metals	2.95	2.89	1.93	2.69	3.82
Plastics	3.77	3.20	4.08	3.90	5.14
Rubber	7.88	7.83	7.28	7.22	9.64
Other Manufacturing	**0.56**	**0.63**	**1.05**	**0.90**	**1.37**
Beverages	0.60	0.44	8.52	0.90	8.55
Wood	0.30	1.57	1.64	1.20	2.46
Printing	0.94	0.53	2.41	1.67	2.94
Clothing	1.23	0.68	2.41	2.35	3.25
Food	0.74	1.41	3.42	2.95	3.76
Primary Textiles	2.15	10.19	3.97	1.50	10.30
Other Manufacturing	2.38	2.28	3.17	2.95	4.34
Furniture	1.61	3.14	2.43	2.49	4.05
Textiles	3.92	2.78	4.39	4.57	5.30
Paper	1.65	3.67	5.12	4.81	6.07
Leather	2.49	2.12	3.70	4.64	5.57

Table C22
Standard Errors for Table 22
Evaluation of Individual Forms of Intellectual Property Protection by Sector
(Company-weighted)

Sector	Copyrights	Patents	Industrial Designs	Trade Secrets	Complexity	Lead Time	Other
A) All Firms							
Core	0.08	0.09	0.07	0.09	0.09	0.09	0.11
Secondary	0.04	0.06	0.05	0.07	0.07	0.08	0.08
Other	0.03	0.04	0.03	0.05	0.05	0.06	0.06
B) Firms With Any Intellectual Property							
Core	0.11	0.15	0.13	0.12	0.13	0.14	0.17
Secondary	0.09	0.12	0.09	0.15	0.16	0.13	0.16
Other	0.09	0.08	0.07	0.10	0.11	0.11	0.11
C) Firms With Specific Forms of Intellectual Property							
Core	0.20	0.16	0.27	0.16			
Secondary	0.33	0.19	0.14	0.20			
Other	0.23	0.14	0.20	0.14			

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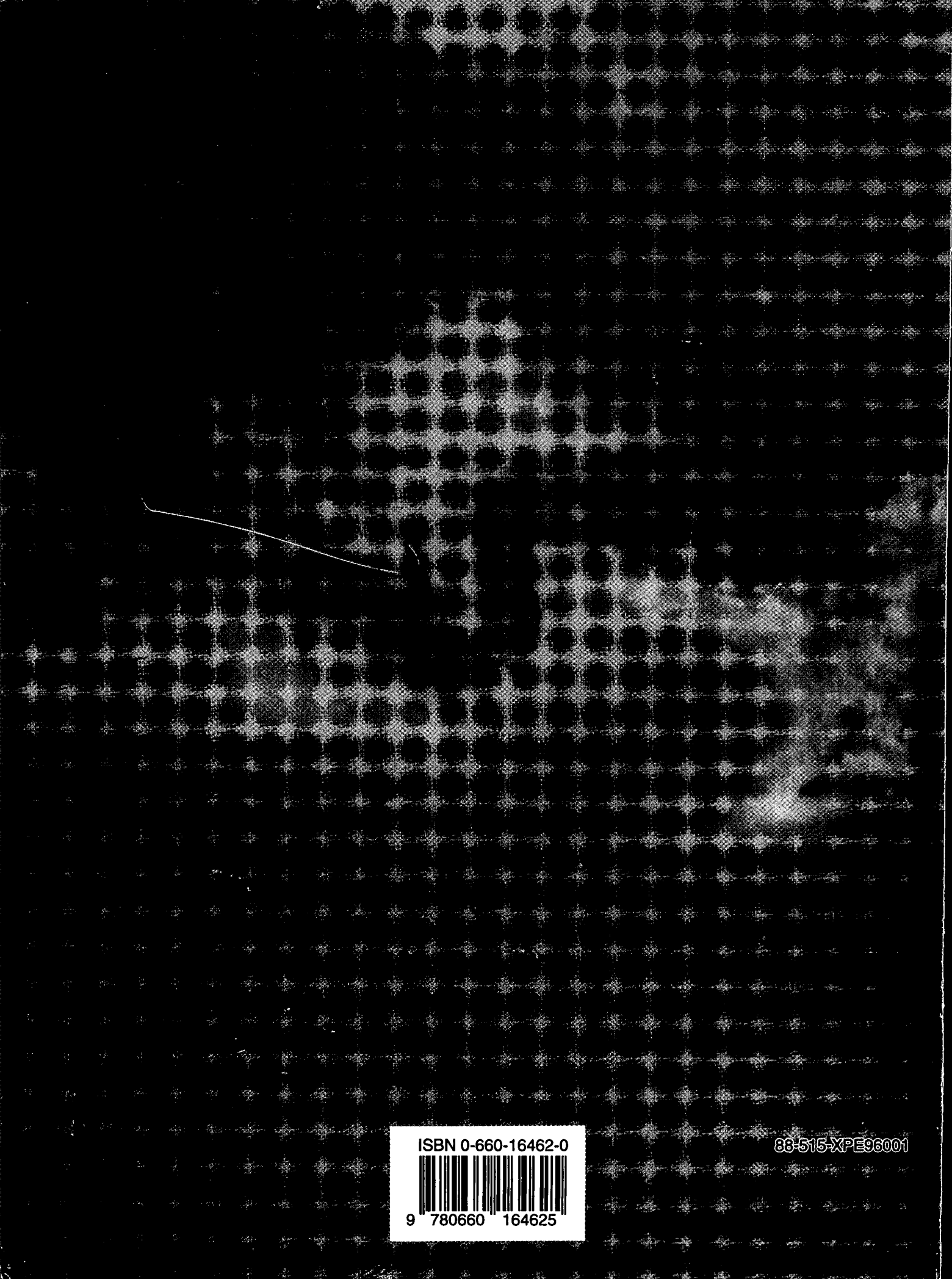

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