# Key Implications of the Global Economic Environment For PCT Filings: A Survey of the Issues

**DMI/LECG Ltd.**

**prepared for the**

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**EXECUTIVE SUMMARY**

## Objective

**This report is a survey of economic factors that could influence the development of the PCT in the future. The overall aims of this study are essentially to understand more about how the PCT is being used and what the PCT can do to pursue its policy objectives more effectively. This includes an analysis of who is using the PCT and why, what trends the PCT should be prepared for, and what it can do to ensure it continues to be successful. Why do firms, and especially Multinational Enterprises, use the PCT filings as an avenue for international patenting? Why do some Multinationational Enterprises not use the PCT? What factors might lead to changes in corporate strategy which would lead to changes in the decisions of firms to use the PCT? What are the potential effects of the financial crisis in Asia and emerging markets? From a policy viewpoint, how can the PCT ensure it is more relevant to the needs of the developing countries and contributes to their economic growth? The aim is not just "commercial" success but also to improve the effectiveness of international patenting for the general welfare.**

## What this Report Does

**The purpose of this initial study is to survey existing studies and research on these questions, to undertake some preliminary statistical analysis on the basis of data available from the PCT or other sources, and to undertake some interviews of IP managers in Multinational Enterprises and patent attorneys. Thus, this report is only the first step in the process of understanding some of the economic factors influencing the use of the PCT in the context of the evolving arrangements for protection of IP at the national, regional and international level.**

**There is an extensive literature on the role of intellectual property protection in fostering innovation and economic growth at the national level. In the last decade there has been sharply increased interest in the protection of IP across national boundaries. In our survey of this literature, we were surprised that there has been no analysis of the strategy of firms in international patenting (and the use of the PCT in particular), but based on this extensive literature at the national level, we have developed the analytical framework for this analysis at the international level.**

**The study reports some preliminary statistical analysis based on available data. The conclusion is that predictive models that have good explanatory power for national patent filings do not do a good job of predicting or explaining PCT filings. This may be due to the "catch-up" factor as the PCT has captured a growing market share of overall international patenting activity, but much more analysis is required to clarify the determinants of PCT filings.**

**What Needs to be Done**

**In this respect the current report should be seen as an indicator of areas that need to be pursued in more depth. One area of future work which seems absolutely necessary as a first step to this understanding is a more complete analysis of the data on PCT use, in the context of international patenting as a whole. Some initial indications of the characteristics of the users of the PCT gathered from the available data have been examined. This analysis should be pursued to give more definite results, based on detailed data from the PCT and other private and public sources including national and regional patent offices. Analysis of the characteristics and importance of different user groups, and national groups, and the trends in use by such groups within the overall growth rate, should help understand the structure of demand for PCT services.**

**A further crucial area of further work is a survey of users and potential users of the PCT to understand the factors affecting their use or non-use of the PCT. The limited inputs from users that was possible in this current study has shown the variety of issues that are considered important. This survey needs to be undertaken on a systematic basis covering as large a sample as possible. This should include the views of those users with whom the PCT does not normally come into contact, i.e., major participants in international patenting but who do not use the PCT. The survey should combine a formal questionnaire survey, aimed to quantify the main influences, with a number of in depth interviews to identify specific issues and obtain detailed views.**

**From our interviews of IP managers in major multinational enterprises it is evident that there are significant differences among MNE's in their perception of the utility of the PCT and in their use of the PCT. Further analysis of these issues through interviews, survey research and quantitative analysis is a clear priority. This process of interviews and a formal survey of major MNEs would examine differences among industries and firms of different "nationality" in their origin. For example, is the use of the PCT by US MNEs maturing in the sense that the growth of PCT filings will begin to align with the slower overall growth of international patent filings? What factors influence the relatively lower use of the PCT by Japanese MNEs? Will**

**the use of the PCT by Japanese MNEs continue to grow rapidly despite a prolonged recession in Japan?**

**This work program would lead on from the current study, as the basis for the design of the survey and detailed qualitative and quantitative analysis in an extended study.**

**Immediate Priorities**

**Based on this analysis, the immediate priorities for further work are:**

- **more detailed statistical analysis of PCT data on users integrated with detailed data from national and regional patent offices and data on overall filing costs at the national level disaggregated for different industries;**
- **further interviews and a detailed questionnaire of major multinational enterprises in Europe, Japan and North America examining their understanding and perceptions of the PCT and their corporate strategies for international patenting; and**
- **examination of the role of developing countries in the PCT especially in terms of their capacity to implement national patent systems and how the PCT could assist them to achieve their economic policy objectives.**

**These activities could be conducted on an ongoing basis. For example, surveys of major MNEs both those who are, and those who are not users of PCT, could be conducted on a regular basis in order to privide benchmarks for assessing the utility of the PCT.**

**Preliminary Conclusions**

**There is no evidence that the economic crisis in Asia and Emerging Markets has had significant affects on PCT filings as yet. This is not surprising since the origins of almost all PCT filings are the high-income industrial countries, which apart from the special case of Japan, have continued to experience steady economic growth. Even in the case of Japan, prolonged recession has not slowed the growth of PCT filings, perhaps because utilization of the PCT as a vehicle for international patenting in the case of Japan has lagged behind North America and Europe and, thus, Japanese use of the PCT is still in catch-up mode.**

**The potential spread of the financial crisis from Asia and other emerging markets such as Russia to Latin America and other developing countries could have implications for whether MNEs use the PCT or the direct national filings for international patenting. Furthermore, as the PCT matures, in the sense that the growth of PCT filings begins to track the overall growth**

**of international patenting, then the level and growth of PCT filings would become more vulnerable to a prolonged recession in the major industrial countries.**

**In general, initial PCT filings are likely to be less sensitive to cyclical factors than are other decisions that firms must make about their patent portfolios, such as which patents to renew and in which markets to proceed to national filings. Indeed, in times of economic uncertainty, the "option value" of the extra priority period under the PCT may become more valuable, because of the deferral of the costs of national filings and increased uncertainty about the viability of certain innovations.**

**This initial survey confirms the obvious point that the PCT has benefited from a virtuous circle of increased awareness of the significance of international IP protection because of the competitive pressures of globalization, of significant and ongoing changes in the national, regional and internationals arrangements to protect IP (including, but not limited to TRIPS), of more companies and patent attorneys becoming aware of the advantages of the PCT, and of more countries joining the PCT. Since the PCT has been in a "catch-up" mode of acquiring a growing share of international patent filings, it seems so far at least to be less sensitive to macroeconomic factors than are national patent filings.**

**At the same time it is important to guard against complacency. Some major MNEs, who are significant potential users of the PCT do not regard it as a useful vehicle for international patenting. The factors influencing firm patenting strategies need to be better understood and it is very important that the PCT be adapted to meet the needs of users on an ongoing basis. The decision about whether to use the PCT is a matter of corporate strategy and is subject to change as the economic and legal environment changes.**

**Longer Term Strategy**

As a matter of its own corporate strategy, WIPO needs to have a better understanding of the factors that affect decisions by firms about whether to use the PCT. Much more analysis is required to gain some insights and accumulate some evidence on these factors, but WIPO needs to undertake this task on an ongoing basis. The legal and institutional environment for protection of IP at the national, regional and international level will continue to evolve and the implications for firm strategies of these developments in combination with economic and technological factors need to be examined, and their potential implications for PCT and WIPO need to be assessed on a regular basis.

The PCT has been a successful instrument, but as with all successes in the marketplace, new opportunities to add value in a rapidly changing global marketplace should not be overlooked. WIPO faces commercial challenges in the marketplace that it must continue to meet, but it also must serve the overall policy objectives of serving the interests of member states and promoting global economic welfare through promoting cooperation in the protection of intellectual property.

**PREFACE**

**In preparing this report, we have benefited from assistance from a number of officials at WIPO and IP managers and patent attorneys in the private sector, all of whom gave generously of their time and knowledge. Any errors in this report, are solely the responsibility of the authors. One of our themes is that the interplay of national, regional and international legal and institutional arrangements for protection of intellectual property(IP) is continuously evolving. We have sought to keep the material as up-to-date as possible, but both the literature and the data tend to become available with time lags.**

**Peter Grindley**
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## CHAPTER 1: INTRODUCTION

### 1-1 Objective:

**The objective of this study is to analyze the key determinants of international patent filings in order to assess the implications of the uncertain global economic environment for the prospects for overall patent filing over the next two to three years and to obtain a clearer perspective on the key factors influencing PCT filings over the longer term. This report is an interim report, because it is only the first step in a series of steps that could give greater insights into the factors influencing international patenting activities and the utilization of the PCT.**

### 1-2 Context

**The macroeconomic outlook for the global economy in1999 and beyond is marked by a high degree of uncertainty. At the end of 1998 international organizations such as the IMF and the OECD have revised downwards substantially their forecasts for global economic activity over the next two years, and have stressed that there is a much higher degree of uncertainty associated with their forecasts than is normally the case. Indeed the IMF took the unusual step of issuing a special update to its twice yearly forecast in late December 1998.[4] Moreover, with the spread of the Asian financial crisis to other emerging markets in the second half of 1998, global financial markets experienced remarkable volatility in the risk premia for debt and equity finance in emerging markets. In the second half of 1998 there was volatility in financial markets in the major industrial markets and some uncertainty associated with the launch of the Euro. However, the volatility in financial markets in the major industrial economies has diminished somewhat in early 1999.**

**International patent filings have grown rapidly in recent years, but there has been relatively little analysis of the factors influencing this growth in filings. Recent experience with the financial crisis in Asia and in other Emerging Markets demonstrates that it can be risky to simply extrapolate past growth rates in order to predict future growth rates.**

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[4] The International Monetary Fund, *World Economic Outlook and International Capital Markets: Interim Assessment,* December 1998, IMF (1998)

**Patent filing is a strategic decision by firms, which is influenced by the competitive and economic environment in the key markets of the firm. Firms make decisions about international patent filings as part of their overall strategies for investment, innovation and protection of intellectual property assets. Normally firms make these decisions based on their longer term competitive strategies. However, cyclical and macroeconomic factors, such as the Asian financial crisis and the volatility of other emerging markets, can have significant effects on the overall investment and innovation strategies of firms.**

**Yet it is not clear what the implications of the financial crisis in Asia and some other Emerging Markets will be for international patent filings. Are patent filings determined by past research and innovation investments, which thus are relatively insensitive to current economic developments? Or will the liquidity problems and the dramatic re-valuation of risk in some economies lead to significant changes in firm strategies? Are the effects of the Asian crisis likely to be transitory, or are they likely to persist, perhaps with significant lags? Will the potential effects of the financial crisis be largely confined to Asia? Or will the global investment and intellectual property strategies of European and US-based multinational enterprises be affected in a significant way? Do Japanese MNE's pursue similar patenting strategies to other MNE's? What are the potential implications in other emerging markets?**

**Although the Asian financial crisis and its aftermath including the weakness of commodity prices and the spread of the financial crisis to other emerging markets will be important influences on the global economy over the next two or three years, other factors will influence the patent filing strategies of firms. Among these are:**

- **the changing corporate strategies of major multinational enterprises based in the industrial countries;**
- **changes in the intellectual property regimes of countries implementing the obligations of Agreement on TRIPS under the WTO[5];**
- **policy changes by countries intended to promote long term investment(instead of short term financial investment) and increased competition among countries to provide adequate and effective protection of intellectual property; and**
- **changes in the coverage of the PCT.**

[5] Under the transition provisions of the TRIPS agreement, a large group of developing countries must implement patent laws by January 1, 2000 and the least developed have another five years in which to implement the relevant provisions of TRIPS.

**Of course, the medium-term impact of the financial crisis in Asia and Emerging Markets will go beyond the severe contractions in output and investment, -- the economic crisis , that many of these economies are experiencing, but the nature of these impacts will depend upon the *policy responses* of the countries involved, and the *strategy responses* of enterprises who are trading with, and/or investing in, these economies.**

**The *policy responses* of Emerging Markets to the financial crisis will influence the global policy context for years to come. Will countries change policy to encourage long term foreign direct investment or will they be preoccupied with regulating short term capital flows? Will Emerging Markets improve their legislative and judicial framework for intellectual property protection in an effort to attract investment, or will they delay improvements in intellectual property protection because of lack of financial resources and concerns about the cost implications of more comprehensive and effective protection of intellectual property?**

**The *strategy responses* of enterprises to this more uncertain global economic environment will be a major factor shaping the medium term prospects for patent filings. Thus, the strategy responses of firms will be a major focus of this study.**

### 1-3 Strategy for Analysis

**Implementing quickly a comprehensive program of analysis and research would be both costly and potentially risky. The key elements in a comprehensive empirical research program, --which would involve elements such as extensive work in data base development and in the design, administration and compilation of a comprehensive questionnaire to thousands of firms--, are expensive and time consuming.**

**Thus, the approach pursued in this study is a sequential strategy to develop an analytical framework to analyze incentives for international patent filings, to undertake quantitative analysis of available data sets, and to begin survey research through surveys of patent offices, patent attorneys and the strategic planners for major multinational enterprises. The analytical framework is developed within a comprehensive research program, but the comprehensive approach could have been implemented immediately only at much greater cost.**

**Thus, the first priority for analysis to assess the effects of possible changes in firm strategies should focus on major Multinational Enterprises.[6] A comprehensive survey of**

[6] We agree that the response of SMEs is also significant, but this is much harder to assess on a comprehensive basis across firms and regions.

**SME's in different regions would be desirable, but this would be much more expensive to design and to implement.**

### 1-4 Methodology

This section discusses how the effects of the economic crisis in Asian and Emerging Markets on PCT filings, as well as other prospective developments in the legal and policy regimes for investment and intellectual property protection are to be assessed. Information is needed on patentees' perceptions of the crisis. In particular, what is their view of the effects of the crisis on the market size, patent rights, and filing costs, and do they believe these effects to be temporary or very much long term? Information is also needed on what their optimal business decision, policy, or practice has been, in the face of these kinds of circumstances: is it to reduce R&D and patenting activity, change the timing of their applications, or shift between markets?

*Survey information* may be obtained directly (ideally) from firms (or patentees themselves), or indirectly from international patenting attorneys or PCT "Receiving" Offices. It would be necessary to derive a sample of firms (or information about firms) in Asia *and* outside Asia. Questionnaires could be developed for each set or type of firms to determine: a) firms' outlooks on the state of the market and patent enforcement regime, b) previous, current, and future PCT filings in Asia and outside Asia, c) plans to postpone or cancel PCT applications, d) plans to postpone or cancel R&D projects, and e) reasons for their decisions: exchange rate factors; market expectations; financial/liquidity problems; government policies in Asia (with respect to intellectual property protection, monetary and fiscal matters, regulations, and so forth), and others.

*Statistical information* that could supplement the interview questionnaires include: a) data on trends in PCT filings during the past few years, so as to get an idea of whether a change in the pattern of filing can be detected among Asian patentees (filing abroad or at home) and among non-Asian patentees (who designate Asia); b) estimates of currency depreciations or devaluations on patent filing costs, for example on the official fees; and c) data on market size (i.e. per capita incomes, profitability). By relating historical patterns of PCT activity to some fundamentals, one can estimate quantitatively, for example, how a 1% decrease in an Asian country's per capita GDP changes PCT filing in that country by x%, or changes this country's PCT filing abroad by z%. The statistical analyses could independently support or challenge some of the survey results.

The survey and statistical information must be analyzed bearing in mind that there are a multitude of factors that can drive PCT filings, so that to isolate the "effect" of the recent Asian crisis, it is necessary to control for the other important determinants of PCT filings.

Finally, it would also be useful to tie the survey results to the characteristics of the respondents. It is likely that their perceptions of, and responses to, the crisis would vary according to certain firm or national characteristics -- whether the firm is large or small; multinational, exporter or licensor; a frequent or infrequent patentee; from a developed or less developed economy. The results should also depend on the technological field(s) of the firm.

In summary, it is necessary to break the investigation down: first, what factors motivate PCT filings? Secondly, how are those factors affected by the Asian economic crisis or other developments in the global economy? Thirdly, what is - or has been - the patentees appropriate business decision, policy, or response, to those circumstances? The investigation needs also to distinguish between types of firms and between Asian and non-Asian firms. The overall framework for the analysis is laid out in Annex 1.

### 1-5 Outline of the Interim Report

**This interim report provides in Chapters 2 and 3 a survey of the economic, legal and business strategy literature on the links between protection of IP, innovation and economic growth. Much of this literature has focussed on the national level or on the utilization of IP regimes in the major industrial country markets. This review seeks to identify the implications for patenting decisions and intellectual property management strategies of firms of the evolving international framework for IP protection. Chapter 4 provides some preliminary statistical analysis based on available data. In Chapter 5 we examine specific issues related to the PCT, report some preliminary results from interviews of MNE representatives, consider some of the macroeconomic factors, make some tentative conclusions, and outline some of the additional work and analysis that could be undertaken.**

## Annex 1: Incentives for Patent Filing: The Analytical Framework

### I. Determinants of Patenting Decisions

**1.Role of patents in the strategy of firms:**

- **role of innovation in firm strategies,**
- **patents versus alternative strategies to protect IP assets,**
- **industry structure and appropriability strategies,**
- **differences across industries, regions and size of firm**
- **impact of globalization and information technology**

**2.Comparison of IP protection from national, regional and international filings:**

- **acceptance and validity of claims**
- **market coverage**
- **enforceability**

**3. Cost factors**

- **cost of filings(fees and external costs such as translation)**
- **cost of filings(internal costs to firms)**
- **administrative costs (eg patent examination)**

**4. Cyclical factors**

- **impact of Asian financial crisis and liquidity problems on innovation and investment strategies**
- **impact of cyclical developments, eg Asian Crisis on market entry strategies,**
- **impact of cyclical developments on trade, production and investment,**
- **impact of cyclical developments on contestability and innovation strategies**

**5. Stock adjustment effects**

- **globalization of national patent holdings**
- **sectoral differences**

**II. Program of Analysis**

**1.Literature survey**

**- analysis of country *policy responses* and firm *strategy changes*,**

**- determinants of innovation and patenting strategies.**

**2. Development of the analytical framework**

**- identification of key factors influencing patenting decisions,**

**- examination of incentives for patenting decisions under national, regional and international patent regimes.**

**3. Quantitative research**

**- development of data bases,**

**- statistical and econometric analysis of determinants of patent filings.**

**4. Survey Research**

**- development of interview format and questionnaire,**

**- selective interviews of firms with an emphasis on major multinational enterprises,**

**- interviews and survey of attorneys and patent offices,**

**- development of survey questionnaire,**

**- design of sample, countries, sectors, firm size etc for a comprehensive survey.**

**5. Analysis and Conclusions**

**- data analysis and refinement of results,**

**- analysis of medium term prospects for patent filings,**

**- identification of longer term factors influencing patent filings at national, regional and international level.**

## CHAPTER 2: GROWING IMPORTANCE OF IP IN THE WORLD ECONOMY

### 2-1 Intellectual property, innovation, and economic growth

Numerous economic studies have shown the overriding importance of technological innovation to long term growth and economic development. There are high rates of return to the economy as a whole from investment in innovative activities, and therefore to investment in intellectual property. The returns to innovation are exceptionally high, both for the private returns to the individual entrepreneur and for the much larger social returns to society as a whole.

The impact of innovation on the economy is enormous. This is evident at a global level from the remarkable increases in prosperity and per capita incomes over decades and indeed centuries. Most studies of innovation have focussed on the US economy or the largest industrial countries. For example, seminal studies by Fabricant and by Solow in the 1950s estimated that over 80% of the growth in economic performance, over the period 1909-49, in terms of output per work hour may be attributed to improvements in technology, broadly construed, while less than 20% was attributed to increased capital intensity (Solow, 1957). A more exhaustive subsequent study for the US economy concluded that "advance in knowledge" contributed about 40% of the total increase in national income per person employed during 1929-57, having allowed for increased capital intensity, improved workforce education, scale economies and the negative impact of decreased worker hours (Denison, 1985). Numerous estimates for other countries have put the contribution at between 50% and 90% of total growth (Denison, 1967). Equally relevant to the IP debate, declines in the rate of innovation in the US may have been partly responsible for the fall in US business sector productivity from 3% per year over 1947-73 to 1% per year over 1973-87 (Baily, 1986; Scherer, 1986; Scherer and Ross, 1990, p. 614). The re-emergence of sustained growth in productivity in the US economy in the 1990s is attributed by many observers to increased innovation and the spread of information technology.

The available empirical evidence looking at the returns to individual innovations indicates that societal or social returns to innovation are high, and that the social returns are markedly greater than private returns. There has been a limited number of studies at the innovation level, looking at social returns. Looking at returns from the development of hybrid corn, one of the most significant innovations in agriculture this century, which increased corn productivity by 15%, Griliches (1958) found that the investment in R&D by state and private research establishments had a 35-40% internal rate of return, or expressed differently, returned each year 700% of the lump sum equivalent of the R&D costs. Mansfield showed that social rates of return on a sample of 17 industrial process innovations had a median internal rate of return lower bound of 56%, with a wide variation between individual innovations from over 200% to less than zero. Private returns for the same innovations were also high, with a median return of 25%, and were also highly variable (Mansfield, 1968; Mansfield et al., 1971, 1977).

**The private earnings from innovation have on occasion been considerable. Yet these are typically dwarfed by the social returns from the innovation, in the form of new products, lower prices and higher quality, as well as the earnings of the licensees and the eventual widespread use throughout the economy once patents or other IP protection have expired.**

### 2-2 Individual returns from innovation and the protection of IP

Strong IP rights are often critical to an innovator's ability to earn an attractive return on its innovative activities. The strength of the IP regime determines the environment for original invention as well as for improvements or follow-on innovations. IP rights give the innovator some ability to exclude imitators from the patented technology, and afford the possibility of above normal returns from particular investments.

The manner in which IP rights are defined and enforced, is of great interest to entrepreneurs, managers, and investors, since issues such as the breadth and duration of patent rights, the applicability of copyright, and the effectiveness of trade secret protection influence decisions about what innovations to develop and how to commercialize them. These decisions in turn determine the performance, quality, quantity, variety and prices of products offered in the market. From the firm's point of view, the critical issues are how to make best use of the available forms of protection to build value, and how to combine this with other decisions in the development and commercialization of new technology.

**For policy makers the basic questions are to do with the relationship between IP protection and economic welfare. At the macroeconomic level this includes the effect on growth and on international trade.**

### 2-3 Increasing importance of IP protection

**The protection of IP has become an increasingly important issue at the current time for many reasons. First, product and process innovations are increasingly important in overturning the established order in industries. Moreover, imitation is now inherently swifter and more complete than in the past, abetted at least in part by developments in information technology. This has made the protection of IP more critical to success. Also, the cost of developing technology has risen to the point that innovators often must consider joint ventures and alliances to develop and commercialize new technology. Technological development is complex and risky. Investments are made with long payoff periods and unpredictable outcomes. The viability of such arrangements depends on the innovator's ability to define and protect its rights to the technology brought to the venture. By the same measure, firms are increasingly likely to use out-licensing as a revenue source, and in-**

**licensing as a means of cheaply accessing new technologies. As a result concerns about the interaction between legal rights and innovation strategy are greater today than ever before.**

**Second, the protection of IP has become an international issue. Many markets have become more global, especially those markets that depend on the introduction of new technology. It has become easier for technology to cross borders, so markets for know-how are increasingly global. IP is important to the maintenance of incentives to innovate in such markets, as innovators are increasingly faced with a number of highly capable and well financed competitors around the world able to exploit new technology. In technologically progressive industries, new products and processes arrive continuously, often from quite unexpected sources, domestic and global, and with quite unexpected implications for the competitive position of firms. Since structural and institutional barriers to technology transfer have lessened, it is imperative for firms to seek legal protection of their technology, nationally and internationally.**

**Third, many firms have adopted a more active strategic management of IP. Licensing decisions are now a more integral part of the firm's overall business strategy. This has been assisted by stronger IP rights, both within the industrial countries through changes to IP legislation and more effective judicial mechanisms for enforcement. There have also been greater efforts at the international level, to strengthen protection of IP rights outside the industrial countries. Moreover, there has been a significant move towards international harmonization of IP law. However, in countries where this protection is weak or non-existent, firms are often unable to obtain an acceptable return on innovation. The obvious implications for world trade have put IP protection as one of the leading items on the agenda for trade discussions. Basic agreements on the recognition of IP rights and enforcement procedures were included with trade agreements on market access for good and services in the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) of the Uruguay Round of the GATT incorporated in the World Trade Organization, (WTO) signed at Marrakesh in April 1994 and implemented on January 1, 1995.**

**Fourth, firms have evolved strategies to address these new conditions. Firms are paying more attention to their patenting strategies and managing their national and international patent portfolios more closely than ever before, in order to protect their IP as effectively and broadly as possible. This has tended to increase the level of patenting activity, and to make firms more aware of the cost effectiveness of their patenting strategies. Cross licensing has taken on a new meaning in economies where many equally capable manufacturers compete to develop and exploit similar technologies, and where each may have strong IP portfolios which could mutually block the use of technologies. Cooperative alliances to develop a particular area of new technology are now commonplace, founded partly on the ability to define and protect IP. Information exchanges via industry**

**institutions, to share non-critical technical knowledge or to establish standards for new products, are often a necessary, and pro-competitive, part of innovation.**

**Fifth, the efficient generation and use of innovation depends on an efficient market for know-how, whether by manufacturing and marketing of innovative products, or the provision of services using new technology, or by licensing of IP. This market is likely to be enhanced by "strong" IP rights, in the sense that they are clearly defined and enforceable. If the extent of the innovator's rights are predictable this reduces the risks surrounding innovation, and encourages it. Clear transferable rights increase the holder's ability to commercialize the innovation in a number of ways, and in different markets. In many instances, efficient licensing will require restrictions on the use of IP by the licensee. These may include territorial restrictions, field of use restrictions, bundling of licenses, grantbacks of improvements, exclusivity, sublicensing rights, or a combination of these. Such restrictions may be critical to the innovator's ability to license out new technology and earn an adequate return, without losing control over the innovation to its licensees, and so may be a precondition for licensing to take place. As such they are typically pro-innovative and pro-competitive. Over time strong, predictable and effective IP systems contribute to the development and diffusion of technology.**

**For these and other reasons, firms, especially MNEs, are following increasingly sophisticated approaches to patenting and are placing great emphasis on this as part of their overall business plans. This lies behind the continuing increase in patenting activity over the past one to two decades, and the greater attention firms are placing on the effectiveness, and costs, of the patenting process. This has become a global issue, with increasing attention to international patenting to support international product strategies.**

### 2-4 Factors in the demand for IP protection

The level of use of the patent system depends not only on the demand for products incorporating the patented IP, but also on the degree of protection achieved by the patent, compared with that achieved by other means such as secrecy, or designing products to be hard to imitate, or simply avoiding some markets. This may help explain different levels of use of an international patenting system according to the nature of the technology, the industry, the country in which patent protection is sought, the nature of competition in the product market, and others. This may help give a finer understanding of the demand for patents in different technical, economic and national areas, and differences in the demand response to changes in the costs and convenience of the patenting process.

In general, there are likely to be differences in patenting intensity according to the "appropriability" of the IP, or the degree to which an innovator can keep imitators at bay. There are a number of strategic and institutional factors determining appropriability. Some are inherent

to the technology, some to the firm, and some to the industry. They work in concert with the conditions set by the legal system. Hence, there is more to protection than legal rights.

There are costs associated with appropriability. In addition to the social costs of market power, there are transactions costs associated with operating and enforcing a given IP regime, including the adjustments made by firms to compensate for an IP regime which is seen as too weak or too strong. Some of the private appropriability factors (such as the firm's use of secrecy or development of complementary assets) may have evolved to compensate for perceived limitations of legal protection.

Appropriability factors change over time, and as they evolve, so the level of IP protection needed to shore up an appropriability regime needs to evolve also. Technologies change, imitators' ability to access and use information changes, competitive conditions change. These changes also affect how firms behave in a given IP regime, and should help to explain behavior in areas such as licensing, and the variation in such behavior between different firms and industries.

### (a) Nature of technology

The nature of the technology itself is a main determinant of how inherently easy an innovation is to imitate. A key characteristic is the degree of 'codification' and the costs of transfer. Codifiable knowledge can be articulated in some way, and captured in product descriptions, engineering drawings, models, and operational procedures. It is then relatively easily transferred. Transfer is further facilitated by greater availability of formal channels of communication, for example printing, telecommunications, and data networks.

Tacit knowledge, on the other hand, can not easily be written down. It must be learned by experience or face-to-face communication. Errors of interpretation can be corrected by prompt personal feedback and use of examples. The transfer of tacit know-how is difficult to accomplish via impersonal communication channels. Tacit know-how is inherently more difficult to transfer than codified knowledge; hence it is harder to imitate. The more a given item of knowledge or experience has been codified, the lower the costs of transfer, and the easier the inherent imitation (Teece, 1981).

Setting aside the inherent appropriability, one must observe that the more codifiable an innovation, the more clearly IP rights may be defined. The clearer the IP rights, the easier to identify infringement. This makes it easier to imitate but also easier to detect and prove infringement.

This is part of the reason why there are differences between the effectiveness of protection in different types of technology in different industries, i.e. why the tradeoff between incentives to innovate and to disclose have different outcomes for different technologies. A new

pharmaceutical, which is defined more or less completely by its molecular structure (readily discernible from analyzing the product), may be technically easy to imitate, but it is difficult to avoid infringing the patent, which applies to the molecule and its functional equivalents. Thus patents are highly effective in pharmaceuticals. In electronics an innovation is also highly codified and readily revealed by reverse engineering the product. Although patent infringement is also easily detected in electronics there are often several ways to achieve the same ends with a non-infringing design. Electronics firms thus tend to rely to a greater extent on other methods of protection, such as lead time, in addition to patents (Levin et al, 1987). These considerations complicate business strategy.

A further key characteristic of technology is the extent to which an innovation may be kept secret; in other words how much of the technology must be revealed in order to put a new product on the market. This distinction is illustrated by the differences between product and process innovations. Details of product innovations are revealed by examining (and reverse engineering) the product. Details of a process innovation are not usually revealed by examining the product, and may be kept hidden within the physical confines of the firm. It is also the case that process innovations are likely to contain a higher proportion of tacit know-how than product innovations, making them still more difficult to imitate. Studies have found that firms report significant differences between product and process innovations in the effectiveness of forms of protection other than legal protection, such as secrecy and lead time. They are more likely to rely on secrecy than patents in the case of processes than they are for products (Levin et al, 1987).

The appropriability of an innovation is also linked to the ability of the innovator to combine the use of the innovation with other complementary assets inside the firm, such as manufacturing, marketing, and distribution. This makes it easier for a firm to commercialize an innovation without disclosing it by going outside to a licensee or alliance partner. If potential imitators do not have the specialized complementary assets needed to commercialize the innovation, then imitation is unlikely to be a serious commercial threat. On the other hand, if the innovating firm needs to access the marketing or manufacturing capabilities of other firms to successfully commercialize an innovation, it must share knowledge with such firms, which are in a position to demand a portion of the profits flowing from the innovation. The bargaining power is obviously facilitated by IP rights.

Appropriability also depends on competitive conditions in an industry as a whole. Imitation is likely to be quicker in an industry characterized by a large number of equally capable, well financed companies, than in one with wide differences in business capabilities, and the more firms with the requisite complementary assets, the worse off the innovator. However, the overall effect of industry structure on incentives to innovate is complicated. For example, there may be lower than socially optimal incentives for innovation in highly competitive industries if the rents from innovation are quickly competed away by imitators. Yet the incentives to innovate may be high in competitive industries if the innovation is not easily copied, or can be protected, since this may be the only means by which a firm may rise above the normal level of profits.

The debate in the economics literature over the links between industry structure and innovation has yet to resolve the issue, and we will not attempt to do so here. The debate centers on Schumpeterian concepts of competition by innovation, and the relative importance of the ability of monopolists to finance innovation versus the incentives for firms in competitive industries to innovate. In their review of the empirical literature, Cohen and Levin note that: "Most of this literature focuses on testing two hypotheses associated with Schumpeter: (1) innovation increases more than proportionately with firm size and (2) innovation increases with industry concentration. ... [W]e find that the empirical results bearing on the Schumpeterian hypotheses are inconclusive, in large part because investigators have failed to take systematic account of more fundamental sources of variation in the innovative behavior and performance of firms and industries", (Cohen and Levin, 1988, pp. 1060-61). For other summaries see Scherer and Ross (1990), pp. 630-60, (who argue for a U-shaped relation between monopoly power and industry innovativeness); and Tirole (1988), pp. 389-99 (who reviews theoretical models related to Schumpeter). For a modern treatment of innovation and industry structure see Teece (1995). The implication is that there are likely to be significant differences between industries with respect to the balance of incentives.

**(b) Transactions costs of administering IP rights**

IP systems involve certain transactions costs. These include the administrative costs of the system (such as for Patent and Trademark Offices (PTOs) or for the PCT), the costs to the innovator of preparing patent applications and maintaining IP rights, the costs of detecting infringement, and the costs of enforcing one's rights in the courts.

There are also transactions costs associated with buying and selling IP rights (see Williamson (1975, 1985, 1987); Teece (1982)). These include the costs of writing and enforcing licensing contracts. Such contracts must attempt to provide for various contingencies regarding the rights of the parties over the use of the innovation. The nature of IP rights is a key factor in determining the governance structure of the licenses. Poorly defined rights involve significant contracting inefficiencies. Such problems flow from the absence of clarity in IP rights, and stand apart from scope or other measures of IP "strength".

**(c) Strategic adjustments to maintain secrecy**

Appropriability is partly under the control of the innovator. The innovator has some capacity to minimize the risk of imitation. Firms can make private adjustments to minimize imitation risk and compensate for the lack of legal protection. The costs associated with such adjustments may be high, and they may also affect the type of innovation which takes place in an economy.

Relevant costs include (inefficient) investments made to bolster appropriability in the absence of IP. This may include investing in duplicative complementary assets, which minimize the need to transfer know-how to strategic partners. Firms may even vertically integrate into manufacturing

the product which uses the innovation so as to capture value without disclosure. The firm may go further and develop patentable complementary technologies to leverage its unpatentable technology. This could well be a counterpart to duplicative R&D aimed to invent around a competitor's IP. Wasteful inventing-around is often portrayed as a cost of overly strong IP protection; yet duplicative invention may be a response to a competitor's unwillingness to license out due to the weakness of its IP.

The balance between secrecy and disclosure is a central issue in IP protection. The main response to weak IP rights is to protect innovations by keeping them secret. This has a number of private and social costs, in addition to the basic problem of limited dissemination. Preventing leakage is not easy, especially for products which can be reverse engineered once they are on the market. Firms may spend resources making innovations more difficult to copy, such as by using special packaging or anti-copying devices, or may direct development towards innovations which are inherently difficult to reverse engineer. Firms may exploit their innovations in markets and geographic areas where they are unlikely to be copied. Perhaps most worrying for innovation in the long term is that organizational controls to limit leakage may create a culture of secrecy which inhibits the exchange of information both within the firm and with the outside.

Weak IP also changes the kinds of innovations developed. Efforts may be directed towards process innovations, which are not on public view and are harder for competitors to copy. Firms may favor minor innovations which individually are not worth copying, or with life cycles so short that they can not be copied in time to catch the market. If so, weak IP rights may lead to more faddish innovations rather than long term development programs (Ordover, 1991).

We should recognize these endogeneities, and that there are complex routes by which changes in IP policy affect behavior. Weak IP affects the supply of innovations in a variety of ways, and innovators are likely to compensate in ways which may deeply affect the type of innovation developed and limit the commercialization of innovations. Paradoxically, weaker rights may in some cases lead to narrower use of the technology, limit commercialization, and reduce the amount of spillover into other areas. They may bias innovation towards incremental and away from radical innovations, and towards products and processes which are protected in other ways. The effect is to reduce transactions in the market for know-how.

### (d) Changing conditions for IP protection

The various conditions affecting appropriability and competition change, and the balance of costs and benefits is likely to shift over time. In technologically progressive industries these conditions change especially quickly, and the application of law in the areas of IP must keep abreast of these changes. International competitive conditions in general have changed greatly in the past few decades, as global competitors have grown in strength. There have been huge advances in the

ease with which information flows between individuals and companies, and across borders. IP issues clearly have global dimensions.

In addition, new industries arise which pose new challenges to the IP system. In a new field there are often greater incentives with respect to the efficiency of different forms of IP. For example, it was believed that semiconductor maskworks were not properly protected by existing forms of IP and a new, *sui generis* category of protection was created in 1984. Currently controversial examples are computer software and biotechnology. Computer software has characteristics which make it unclear whether it is most appropriate to protect it by copyright, patents, trade-secrets, or by sui generis protection. There are institutional problems concerning the knowledge of prior art and the experience of patent examiners in software evaluation which make the reliability of patent coverage unclear. In a new field of innovation such as biotechnology a particular concern is the appropriate scope of protection, in that a pioneering innovation may be taken to cover an entire field of research, although made in a narrow area of research. There are basic questions of what a genetic patent may legitimately cover.

Given the many variables and the underlying changes in conditions, there is a case for continually reviewing IP protection. Partly this will be reflected in court decisions and case law. However, there is also a continual need to review IP and the interface with competition/antitrust policy.

**(e) International differences in IP protection**

**One should also remember that the relative importance attached to innovation and diffusion is itself a policy choice. The comparison of international IP systems reflects different balances struck by different nations. For example, in the past the Japanese patent system was often said to place greater emphasis on the diffusion of innovations than the US system. The Japanese system in previous decades, with patents granted on a first to file basis, narrowly defined patents, early publication of the patent application, many opportunities to challenge and delay a competitor's patent application, and the common practice requiring cross licensing of original and improvement patents, was considered more effective in encouraging incremental innovation and diffusion.**

**There is a complex relationship between industrial organization, IP protection, and innovation, typified by the contrasting styles of innovation in the US and Japan in past decades. The traditional Japanese prowess in the transfer and adaptation of existing knowledge, implies more open access to basic innovations, as well as "overlapping" organizations. The greater US ability to develop and exploit new breakthrough ideas, implies the need for stronger protection of basic knowledge, and a "pioneering" organizational style (Nonaka, 1989, 1990).**

**The US system, with patents granted to the first to invent, relatively broad patents, traditionally with publication only when the patent is granted, and challenges only after the**

**patent is granted, appears to tilt more to the inventor. Thus the different systems, at least as they were in previous decades, reflected different choices made in the past regarding the best balance between encouraging innovation and diffusion.**

**We would expect national IP systems to change, as the policy objectives of different nations shift to reflect changes in the overall competitive focus of the world economy. Thus as innovation becomes a more important element of competitiveness globally, we might expect nations such as Japan, which were once mainly importers of technology but have now also become important developers, to put gradually increasing stress on protecting innovation. More generally, the importance of technological innovation in competition is increasing worldwide, so that a general trend towards policies favoring stronger protection of IP is may continue despite some resistance. These issues form the backdrop for the moves toward convergence or international harmonization of IP.**

### 2-5 Patenting and business strategy

The fundamental source of most firms lasting competitive advantage is its invisible assets. Thus: Invisible assets are the real sources of competitive power", Itami (1987), p. 12 (also see Barney (1990) on strategic factor markets). Physical assets such as plant and equipment can usually be purchased or reproduced by a new firm if it has the financial wherewithal. Integrating these physical assets into an effective operation, however, requires special capabilities which the firm will usually need to accumulate over a period of time. (For discussions of the resource-based approach to strategy see Nelson and Winter (1982); Hansen and Wernerfelt (1989); Teece et al. (1994).)

**Such capabilities go beyond the traditional categories of intangibles. They include technological knowledge, organizational knowledge, and reputation. Technological knowledge consists of protected IP in its many forms, as well as unprotected industrial knowledge and more general know-how. Ownership of a standard may also be a key asset. Organizational knowledge consists of formal organizational structures and procedures, informal structures, corporate culture and general management mechanisms. Reputation consists of brand names and customer and supplier goodwill. These are the resources and capabilities which the firm uses to outperform its rivals. They are what makes any firm unique. Their hallmark is that they are often impossible to purchase, difficult to replicate, and remain valuable over long periods. They are usually capable of simultaneous multiple uses.**

**IP is a major component of the firms assets. Excellent companies integrate their management of IP with their overall technology and business strategy. The generation and acquisition of IP, the use of IP rights to protect the innovative capability of the firm, and the management of the IP stock to optimize benefits to the firm, must all occur in an integrated fashion. These elements of strategy are necessarily inter-related, in that the**

**development effort of the firm generates a stock of IP, which may be used in various ways to generate earnings, while the potential strength and usefulness of the IP will normally influence the direction of R&D effort.**

**Key elements of IP management include routinely identifying technologies that require protection; protecting IP with patents, copyright or other formal methods, or designating critical expertise as trade secrets; educating employees on the importance of IP and encourage them to register innovations for protection; building a patent portfolio that can be used to protect against infringements, to defend against lawsuits and for bargaining power in cross-licensing deals; and identifying IP which may be used as a source of royalty revenues, typically excluding key innovations central to future strategy. At one level this means recognizing the potential royalty stream locked inside a patent portfolio; at another it means directing long term strategy towards those areas where the firm believes it can build lasting competitive advantage protected by, amongst other aspects, strong IP rights (Whiting, 1992; Contractor, 1985).**

**The main object for the firm, particularly in high-technology industries, is to build a portfolio to enable the firm to continue with its core business with strong protection of its technology from imitation, and without fear of infringement claims (Smith, 1989; Boyer, 1990). Using patents as sources of royalty income is not necessarily the best way to capture value from technology, but it is often a desirable ancillary strategy.**

**With respect to managing the patent portfolio, attention must be directed towards ensuring a strong portfolio which not only covers the key business areas of the firm, but also is not threatened by "clusters" of related patents held by competitors that might limit the use of the firm's own technological accomplishments.**

**One strategy to strengthen IP protection is for the firm itself to build its own patent "thicket" of ancillary patents around important patents. In addition, one form of IP protection can often be bolstered by another. For example, trade secrets associated with the patent can be identified and their protection bolstered. There are also limits to what property may be protected by patents. In such cases firms may rely on trade secrets or they may follow a rather different strategy, relying on rapid series of innovations with short life cycles to keep ahead of competitors. Indeed, prior to the strengthening of patents which took place in the US in the 1980s, firms were often forced to rely on first-mover advantages to capture value. Such a strategy has obvious weaknesses, however, particularly if one's competitors are better positioned in the relevant complementary assets.**

**There are many other ways in which the patent application process may be managed to maximize the value of patents. IP managers can advantageously nuance the timing of the application, amendments to the application during the pendency period, the degree of disclosure, and the breadth of the claim.**

**However, relying on patents as the foundation of competitive advantage is not without vulnerabilities. Because patenting requires disclosure of information about the firm's most important innovations, competitive information may be obtained by reviewing published patent files. There are limits to this vulnerability, since in many instances this information will be out of date in the US the patent is only published when it is granted, perhaps two to three years after application, which in turn lags invention. This delay is less in Europe and Japan, where publication is required 18 months after filing, although the patent may not be granted until some years later, and the first-to-file system encourages early application. More up to date competitive intelligence of a limited kind may be obtained by routine searches of patent filings to reveal the areas in which competitors are seeking patents to indicate competitors' R&D interests. This may be of most value in industries with short product life cycles, such as consumer goods.**

**The decision of whether to patent or to rely on trade secrets depends largely on the overall appropriability by the firm of the innovation. This is a combination of its inherent patentability which depends on the nature of the innovation and its differentiation from similar innovations in the same field and on the closeness of the connection between the innovation and the core competences of the firm in other words whether the firm has specific competences needed to develop and commercialize the innovation which competitors would find difficult to match. If the innovation depends closely on the particular skills and knowledge base of the firm, then other firms are unlikely to be able to imitate it easily. The higher the inherent patentability, and the closer the connection between the innovation and the particular competences of the firm, the more likely that the innovation may be adequately protected without needing to patent it.**

**The lower the patentability and the closer the connection of the innovation is to the core competences of the firm, then the less need there is for the firm to patent it. One of the main determinants of patentability is whether this is a process or product innovation. Process innovations contain a greater proportion of unpatentable know-how than product innovations, and are more closely connected to the idiosyncratic processes in use by the firm. Thus it is more likely that the firm should rely on trade secrets. As shown in the figure, the higher the cost of patenting and the stronger any other means of appropriation such as the need for specialized complementary assets to commercialize the innovation which the firm possesses but its competitors do not then the greater the likelihood that the firm need not patent.**

### 2-6 Choosing to patent

A patent may be granted on any new and useful process, machine, manufacture, or composition of matter, improvement and plant as well as to new, original, and ornamental designs for an article of manufacture (Chisum, 1989). Patents are the most powerful form of IP protection, enabling the holder to exclude all others from making, selling or using the subject matter for 20

years from the application date (three years less for a design patent). (Until changes made in the US patent law in 1995, the life of a US patent was 17 years from the grant date.)

In the US, patents are issued by the US Patent and Trademark Office (US PTO) following an application by the inventor and examination by the patent examiner. To be granted a patent the innovation must pass tests for novelty, non-obviousness, and usefulness. The inventor must also demonstrate that the idea can be reduced to practice and is under an obligation to demonstrate methods of doing so. The application must divulge enough detail that someone of ordinary skill in the relevant art could put the patent into practice. Roughly 75% of applications to the USPTO eventually lead to the issuance of a patent (Scherer, 1980, p. 440).

Limitations of the patent system are that "mental steps" are not patentable, nor are "pure ideas" or scientific principles. Also the strength of the patent is determined by the ability to police infringement, which may be difficult to observe for some innovations (e.g. the use of a manufacturing process), and enforcing a patent requires that the holder be willing to bring an infringement suit. The validity of a patent is thus ultimately a question for the courts, although there is a presumption that a patent, once granted, is valid.

A further problem in the use of patents is that they require the inventor to disclose much detail about the innovation, which may help competitors to invent around the patent, or direct R&D towards the same area and make improvement innovations which reduce the value of the innovation. Put differently, patents disclose considerable positive and negative knowledge—they give strong hints to competitors as to where they should look for a payoff, and correspondingly give clues as to where not to look.

It is commonly recognized that the effectiveness of patents is usually greater in protecting product innovations than process innovations, because product innovations are available to competitors to reverse engineer, whereas process innovations may be kept physically hidden inside the firm's facilities. Also product design information is codifable, and easier to leak out, but process know-how is more tacit. Limits to the effectiveness of IP protection are indicated in **Table 2.1**, which shows the value attached by executives to patent protection in different industries for product and process innovations in preventing duplication (Levin et al., 1987). Patents are rated only moderately effective overall in preventing duplication. They are also rated more effective in products than processes. They are rated highly effective in only two areas, organic chemicals products and pharmaceuticals products, in others they are moderately effective or not very effective. Overall, patents were rated only moderately effective in preventing duplication of process innovations (rated 3.5 on a 1-7 scale) and slightly more effective for product innovations (rated 4.3 on a 1-7 scale). Also they were generally rated as less affective than the other main means of preventing duplication: secrecy, lead time, moving quickly down the learning curve and sales or service efforts.

These results are borne out by an earlier survey which asked firms what percentage of innovations would not have been developed or introduced if patent protection could not have been obtained (Mansfield, 1986). Patents had a major influence only in pharmaceuticals (where 65% of innovations would not have been introduced and 60% would not have been developed) and in chemicals (where 30% of innovations would not have been introduced and 38% would not have been developed). The same survey also showed little support for the view that patent protection tends to be more important for small firms than large ones. (However, the survey, of 100 randomly selected firms with R&D expenditures over $1 million per year, did not include any very small firms (sales below $25 million); similar results were found in Mansfield et al. (1981).)

Imitation is a common occurrence, and usually costs less that the original development. Mansfield et al. (1981) found that about 60% of the patented, successful innovations in their sample had been imitated within four years. The study also found that the imitator's costs were on average only 65% of the innovator's costs. (This includes both patented and unpatented innovations; Mansfield et al. (1981) surveyed 48 product innovation in the US chemical, drug, and electronic and machinery industries, of which 70% were patented.) Levin et al. (1987), in the study above, found that even major patented innovations could be imitated within three years in over half the 129 lines of business covered. Imitation costs were less than 75% of the original innovation costs in 80% of the lines of business for unpatented innovations, and in 65% of the lines of business for patented innovations.

However, it is important to note that these and other surveys (e.g. Scherer, 1965; Taylor and Silbertson, 1973) refer to the situation before the recent strengthening of IP rights, following the establishment of the Federal Circuit in 1982 and more liberal antitrust treatment of IP during the 1980s. Arguably, results of surveys administered today might differ because of the stronger enforcement and strengthening of patent holder rights that has occurred (Mowery, 1993).

The effectiveness of alternative methods of learning about new processes and products are indicated in **Table 2.2**. Patents disclosures are an important source of competitive technological information, though considered less valuable than licensing, independent R&D, reverse engineering, hiring employees and publications, and more valuable than conversations with other employees of the innovating firm.

**Table 2-1: Effectiveness Ratings of Patents to Prevent Duplication**

| Line of Business | Processes* | Products |
|---|---|---|

| | | |
|---|---|---|
| Pulp, paper, and paperboard | 2.58 | 3.33 |
| Inorganic chemicals | 4.59 | 5.24 |
| Organic chemicals | 4.05 | 6.05 |
| Drugs | 4.88 | 6.53 |
| Cosmetics | 2.94 | 4.06 |
| Plastic materials | 4.58 | 5.42 |
| Plastic products | 3.24 | 4.93 |
| Petroleum refining | 4.90 | 4.33 |
| Steel mill products | 3.50 | 5.10 |
| Pumps and pumping equipment | 3.18 | 4.36 |
| Motors, generators, and controls | 2.70 | 3.55 |
| Computers | 3.33 | 3.43 |
| Communications equipment | 3.13 | 3.65 |
| Semiconductors | 3.20 | 4.50 |
| Motor vehicle parts | 3.65 | 4.50 |
| Aircraft and parts | 3.14 | 3.79 |
| Measuring devices | 3.60 | 3.89 |
| Medical instruments | 3.20 | 4.73 |

* Range: 1 = "not effective", 4 = "moderately effective", 7 = "very effective"

Note: Mean scores are given for 18 industries with 10 or more respondents

Source: Levin et al. (1987)

**le 2-2: Effectiveness of Methods of Learning About New Innovations**

| Method of Learning | Processes* | Products |
|---|---|---|
| Independent R&D | 4.76 | 5.00 |
| Licensing technology | 4.58 | 4.62 |
| Reverse engineering of product | 4.07 | 4.83 |
| Publication or technical meetings | 4.07 | 4.07 |
| Hiring R&D employees of innovating firm | 4.02 | 4.08 |
| Patent disclosures | 3.88 | 4.01 |
| Conversations with employees of innovating firm | 3.64 | 3.64 |

* Range: 1 = not effective, 4 = moderately effective, 7 = very effective

Source: Levin et al. (1987)

## CHAPTER 3: INTERNATIONAL PROTECTION OF INTELLECTUAL PROPERTY[7]

### 3-1 Introduction

#### (a) Growing importance of global IP

With the increasing globalization of markets, and the greater ease with which information flows across international borders, intellectual property (IP) has become a global issue. Just as IP has become more important domestically in ensuring the efficient working of the market for know-how and incentives for innovation, so the protection of IP in international markets has become an increasingly important aspect of commercializing innovation and limiting imitation. Indeed, some of the most powerful reasons for strengthening IP protection have come from increased competition in the global marketplace, and the growing ability of producers worldwide to imitate innovations, wherever they are originally developed, and incorporate them in products.

One measure of the increasing importance of IP in the global economy is the growth in international payments for IP, in the form of royalties and licensing fees. For the United States these now amount to over $20 billion annually in technology exports, and $5 billion in imports. Although these are sizable figures, and increasing steadily, this is only a partial indicator of the overall impact of technology trade and the importance of international IP. The main reason is that these figures do not account for the technology content of trade in goods and services, and the impact that IP has on these huge trade flows. Also, just considering royalties and licensing fees, the bulk of payments are between affiliated companies associated with foreign direct investment, and the arms-length licensing earnings are probably only a small proportion of their potential level. Payments between unaffiliated enterprises amount to no more than $4 billion in US exports, or about 20% of the total royalty exports. This figure could potentially be much larger, for two reasons. First, licensing is difficult to manage between unaffiliated companies, especially across borders; firms are often induced to use foreign direct investment to commercialize their innovations even though they might prefer arms-length licensing, and this is likely to be on a smaller scale than broad licensing. Second, much IP is used internationally without a licensing agreement, or licensed at low fees. The fact is that there is a vast amount of international pirating of IP. Much technology transfer is effectively unrecorded and, for the innovator, unrewarded. As well as not reflecting the scale of this trade, the statistics give us little indication of the distortions of trade and investment patterns due to national differences in IP treatments.

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[7] THIS CHAPTER DRAWS ON PREVIOUS RESEARCH COLLABORATION OF PETER GRINDLEY WITH DAVID TEECE AND ROSE-MARIE HAMM OF LECG.

International IP protection underpins trade in goods with a high innovative content  in technology and in areas such as entertainment  and those relying on trademarks and brand names. It underpins licensing and technology transfer between countries. Weak or inconsistent international protection of IP distorts global markets for know-how. This has great importance for the dynamic efficiency of global markets, in terms of innovation, the growth of technology-based industries, increased trade, and the development of competition. At the same time the effect of IP strength on the terms of trade and the international distribution of benefits may be ambiguous, and there may be some trade-off between incentives for innovation and the short term effects of market power. These themes echo the general rationale for protecting IP, now in an international context.

**(b) Problems of international IP**

The problems of international IP are two fold. The first is minimum standards for IP. In many countries IP protection is weak or non-existent. Although most major economies have well developed IP systems, there are still many cases where IP laws are less effective than in the major industrial countries. For certain types of IP there may be virtually no legal protection, at least until recently. Most countries have patent systems, yet there are significant differences in the effective strength of patents and in the willingness of courts to enforce patent rights. Issues such as the time and procedures taken in granting a patent, the likelihood of an infringement claim being upheld, and the enforcement options, may be unfavorable to the IP holder. Similar comments apply to copyright. Other areas, notably trade secrets, may not be protected at all, or only rudimentarily.

The second problem is the variability of scope and coverage of IP laws across countries. Not only does the strength of IP protection vary, but the details of what is protected and the conditions under which this applies differ. For example, the US is virtually the only country to grant patents on a first-to-invent rather than first-to-file basis. There are many other differences in national patent laws, such as requirements for publishing patent applications, and the implications of prior use by other firms before the patent is granted. There are differences in the rules for challenging a patent. Allowing for national differences can make worldwide patenting expensive, and firms must take care, otherwise procedures followed in one country may unwittingly disqualify an innovation from protection in other countries. There are great differences in the international treatment of other forms of IP such as trade secrets and trademarks. Even copyright laws differ. There are also important national differences in the interface between IP law and competition policy, which may be even more difficult to harmonize than the IP law itself. Although there are international treaties aimed at reconciling and harmonizing IP laws, national variations in the treatment of IP are typical and remain a central concern in global IP management.

These weaknesses affect the IP strategies of firms, who should be aware of national differences and the need for a global dimension to their IP management. Private firms may be able to offset some problems of weak IP privately by building in safeguards in private contracts. Licenses for the international transfer of technology to unaffiliated firms or joint ventures are usually complex affairs, with carefully drafted terms and conditions. These cover items such as the rights to use technology or the product of the venture, requirements to keep the technology confidential, dispute resolution mechanism such as private arbitration, and the national legal system under which disputes are to be adjudicated.

While the use of private contracts may attempt to compensate for weakness in local IP protection it is only a partial answer, as it is expensive and time consuming, and typically is only undertaken for major agreements. It must be backed by contract law in the countries involved, and may overlap with competition policy issues. For market transactions which individually are small scale, numerous and liable to be repeated frequently, the transactions costs of providing protection within private contracts are too great for the market to function, and the parties must rely on legal IP protection. IP law provides the basis for "off the shelf" (licensing) contracts between buyers and sellers, taking the place of individually negotiated contracts. Firms no longer need to negotiate directly with each other, and this allows for the development of a less concentrated market structure. [8]

Not only does the failure to provide an effective intellectual property regime lead to higher transactions and contractual costs for firms and less competitive industrial structures, but in many cases, countries who do not provide effective IP laws and enforcement cut themselves off from the transfer of technology and technology-intensive investments.

### (c) International policy developments

Given the increasing importance of IP there has been a growing need for the harmonization of international IP legal protection. Various efforts have pursued either through bilateral agreements, regional arrangements, or through multilateral agreements, involving groups of countries around the world. There have been a number of achievements in bilateral agreements. In particular, the US and Japanese positions have been brought significantly closer in the past

[8] This follows themes in the economic governance literature, which conclude that frequently repeated contracts, with many buyers and suppliers, and with low levels of specialized investments, are most efficiently handled by arms-length market transactions, founded on general contract law (MacNiel, 1974; Williamson, 1985, 1991).

decade or so. Similar bilateral negotiations have taken place with other countries, including negotiations with China over establishing and enforcing basic IP protection, ongoing since 1991.

The emergence of the European Patent Office is an example of a regional initiative to facilitate the protection of IP. Another example is the NAFTA, whose members, Canada, Mexico and the United States accepted common obligations for the protection of most types of IP.

There have also been significant efforts to achieve multilateral agreements on the improved treatment of IP. Two major efforts have been underway, mainly over the past decade, to achieve greater uniformity of IP treatments and to establish minimum levels of IP protection throughout the world. The World Intellectual Property Organization (WIPO), an agency of the United Nations, has focused on wide ranging harmonization of IP. It made progress towards a draft patent treaty, but the effort stalled around 1992 due in large part to the basic differences over changing to a first-to-file patent rule by the US. Incremental changes to the PCT and the increased membership of the PCT have contributed to increased use of this instrument for international patenting. Simultaneous with efforts in WIPO, more effort was put into the General Agreement on Tariffs and Trade (GATT) negotiations in the Uruguay Round for the agreement on Trade Related Intellectual Property Rights (TRIPS), which aimed to establish minimum standards for IP. Although initially focused mainly on patents, TRIPS was expanded to cover all types of IP. TRIPS included important mechanisms for the international enforcement of IP rights. Agreement on TRIPS was reached in 1994, and has now been ratified by a 134 countries, who are members of the WTO.[9]

### 3-2 Effect of weak international appropriability

#### (a) International markets for know-how

International IP underpins the global market for know-how, with similar implications for economic efficiency as in a domestic context. Weak IP limits the options a firm has to commercialize or develop an innovation, and typically leads to reduced economic activity in the product. Without adequate IP protection, trade in technology related goods may be reduced as exporters cannot ensure an adequate return. Weak IP may also lead to inefficiencies in the transfer of technology, usually by reducing the opportunities for low risk transfer. The innovator may not develop a market, or invest in production, distribution, and marketing, if the main effect

[9] There are transition provisions in the TRIPS agreement for developing countries, January 1, 2000 and for least developed countries, January 1, 2005.

is to create a market for the innovation and to transfer skills into the country, providing the basis for imitators to take over the market.

The inefficiency due to weak IP can take other forms, by limiting the type of transfer the innovator is prepared to undertake, and biasing investment towards in-house production by the innovator rather than out-licensing to local manufacturers. The innovator may be forced to set up its own production and distribution facilities, so as to keep its IP secret in-house and build up its own local complementary assets, to strengthen the appropriability of the innovation. While the host country may or may not welcome the investment, it may divert the innovator's investment into areas which could more efficiently be provided by local licensees, freeing the innovator to invest more productively in other facilities, and allowing the efficient use of the host country's investment. Out-licensing to a local firm is likely to lead to more rapid and complete transfer of technology. Yet if choosing out-licensing, the innovator may be forced to go to great lengths to protect its IP, such as by making it hard to copy, insisting on secrecy, and by closely defining the recipients' rights to use the innovation in private contractual agreements. This raises the transactions costs of doing business, and hence reduces economic activity.[10]

These same issues affect producers of creative products such as recorded music and movies, computer software, and brand name products, which may be easily pirated and so deprive the originator of the rents from innovation. A difference between items such as these and the more directly technologically dependent products, is the ease with which they can be reproduced, so that pirating music or software is often simply a question of copying the original without great technical expertise needed. With the transfer of major technologies, such as a new chemical process or semiconductor manufacturing facility, the scale of the investment means that large enterprises are involved, and private contractual arrangements can compensate in part for weakness in the local IP law. Pirate copying of recorded music or computer software, or unauthorized use of trademarks, may be widespread but occurs individually on a smaller scale, so that more reliance must be placed on the local IP laws and their enforcement, rather than private contract provisions, which may be too expensive to negotiate repeatedly.

**(b) IP and economic development**

An additional concern in the global context is the relationship between IP and economic development, or the distribution of costs and benefits from innovation. Developing nations are likely to run technology deficits, and as users and consumers of technology, they have been traditionally less concerned about the incentives for innovation than with its (inward) diffusion. They have tended to have poorly developed IP systems, and have often been vocal opponents to

[10] Mansfield (1993).

stronger IP. As customers for foreign technology, weak IP may be a means of turning the "terms of trade" (relative prices of imports and exports) in the developing country's favor, potentially leading to lower licensing fees and lower product prices.[11] This includes IP pirating. According to this view, it may also permit the development of local industries by imitating proprietary products, such as pharmaceuticals, computer software, or ersatz brand name products.

[11] Lower prices and fees for proprietary technology reduce the incentives for local imitation. The concerns of developing nations are discussed more fully later in this chapter (e.g. see Deardorff, 1994; Bhagwati, 1994).

Yet the full effect of weak IP may be counter to what the developing nation wishes, or what groups of developing nations wish. Weak IP may in fact reduce diffusion and the development of local high skill industries, by reducing incentives for inward technology transfer and investment.[12] Innovators may decide that the risks of appropriation of their technology outweigh the (low) returns available, and hence do not develop the foreign market. Multinational firms have noted that the lack of reliable IP protection in such countries has often been a disincentive to technological investment and the development of these markets.[13]

These are familiar issues in the incentives for innovation and diffusion, with the difference that overall efficiency must here be considered in the context of separate national interests and the effects on international trade. Developing nations may see the short term benefits of imitating proprietary technology, but overlook the long term detrimental effects on investment, transfer of technology and local innovation. Partly the balance of benefits depends on the stage of economic development the nation has reached. There are ways in which both technology importing and exporting nations can gain from IP-based trade, which include the maximum use by the developing nation of its advantages in local knowledge to build up valuable complementary assets. Yet such a policy must be based on adequate IP protection. Such strategies for technology importing nations to use to profit from innovation are discussed in Teece (1995).

The longer term benefits to developing countries of protection of IP are discussed in Smith(1991). The lack of an effective predictable and enforceable legal framework for IP impedes economic growth and development. Provision of an effective IP regime often is a necessary, but not sufficient condition to attract investment. More generally a credible and transparent legal and regulatory regime is an important part of the "infrastructure" of an economy.

### 3-3 International differences in IP treatment

#### (a) Comparison of US, Japanese, and European patent systems

Important differences exist among IP systems, even of the major industrialized nations. These systems drive the strategic use of a firm's intangible assets, and ultimately affect the value and importance of IP. This section compares the key features of the patent systems of the three major

[12] Recall that the original motivation for "letters patent" in England in the 16th century, was to encourage the immigration of skilled continental European artisans, by protecting their skills from imitation for a prescribed period (David, 1993).

[13] Mansfield (1993).

industrialized economies: US, Japan, and Europe. Together, in 1991, these three patent systems handled over 70 percent of all worldwide patent applications.[14]

[14] This includes patents filed in and issued by individual European countries (WIPO, 1993).

The patent examination process is broadly similar within these three jurisdictions.[15] The US system is administered by the US Patent and Trademark Office (USPTO). In Europe, patents can be obtained through national patent offices in individual European countries or through the European Patent Office (EPO), formed in 1977. Through EPO a firm may file a single patent application, which will be examined using uniform standards of patentability. The firm can then designate up to 17 European countries in which it would like to receive protection.[16] National laws and courts, however, still enforce the patent rights once granted. IP rights are largely exempt from harmonized European market provisions, and patents in one country are usually not recognized in another. The Japanese patent system is administered by the Japanese Patent Office (JPO), a part of the Ministry of International Trade and Industry (MITI). In Japan the patent system was originally based on the German system, and is fairly similar in structure to the system used by EPO.

The laws and formal procedures of the US, Japanese, and European patent systems differ along a number of key dimensions. A key difference between the US and the other industrialized economies is that the US remains virtually alone in its adherence to a first-to-invent patent system, in which priority is determined by the invention date.[17] In comparison, both EPO and JPO award patents on a first-to-file basis. In practice, the first-to-file and first-to-invent systems typically award patent rights to the same inventor, but the first-to-file rule may push innovators to disclose information to the patent office sooner than they might otherwise elect.[18]

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[15] For a comparison from a legal viewpoint see Beier (1989).

[16] EPO member states are: Austria, Belgium, Switzerland, Germany, Denmark, Spain, France, the United Kingdom, Greece, Ireland, Italy, Liechtenstein, Luxembourg, Monaco, the Netherlands, Portugal, and Sweden (GAO, 1993). About half of US applicants file in Europe through EPO rather than the patent offices of individual European countries (GAO, 1993). Designating all countries is expensive, partly because of the need to translate the application into the designated languages, and to reduce costs firms often patent only in a few major markets.

[17] The Philippines is the only other country with a first-to-invent patent system.

[18] Ordover (1991); Scotchmer and Green (1990). Disputes over determining the first inventor are relatively

rare in the US. Less than one-tenth of 1 percent of all US patents are awarded to someone other than the first-to-file (GAO, 1993, p.14).

Until 1994 the US also differed in that patent life was measured as 17 years from grant; it is now measured as 20 years from the filing date, in line with international norms. Patents in Europe and Japan are likewise valid for 20 years from the filing date. Another distinguishing feature of the US patent system is the publication of patent applications. In the US these are held secret until the patent is granted. If an application is rejected, the innovation may still be protected as a trade secret, if appropriate (assuming that the same application has not already been filed abroad). In contrast, EPO and JPO, and most other industrialized countries, automatically publish patent applications 18 months after they are filed. Information contained on these applications is often publicly available well before exclusive rights have been granted. The US may adopt an 18-month automatic publication system.

In the US, patent applications are automatically examined, and the USPTO maintains only a limited official opposition process. Both JPO and EPO only examine applications upon request, and maintain formal opposition systems whereby third parties can oppose the granting of a patent on specific grounds. In Japan, the applicant can elect to defer this request for examination for up to seven years. In Europe, an applicant must request an examination within six months after the publication of a search report from the examiner. In both cases if the applicant does not request an examination, the application is deemed withdrawn. In 1994 Japan agreed to abolish its "pre-grant" opposition system in which applications were opposed before the actual patent had been granted, and is now aligned with the EPO in allowing patents to be opposed only after they are granted.[19]

Each country allows applications to be filed in native language; a translated version must be submitted within a few months. Prior to 1994 Japan only accepted applications in Japanese. Another difference between the US patent system and that of Japan and Europe is the fixed "grace period" preceding the filing of a patent application during which certain disclosures of the invention to the public are permitted without jeopardizing the patentability of the invention. In the US inventors have one year in which to file an application after they have disclosed their invention to the public (e.g. in scientific publications or conference presentations), with no restrictions on how disclosure takes place. JPO and EPO have a shorter grace period of six months, and allow only certain types of disclosure without loss of patent rights. All three regions are parties to the Paris Convention. As such, foreign applicants are allowed to file their patent applications in any member country up to 12 months after first filing in their country of origin.

[19] The US reexamination system, whereby parties request that USPTO reexamine patents after they are granted to determine their validity, is a type of post-grant opposition system (Zalik, 1990).

Alternatively, if the PCT is used for international filings then filing priority is preserved for an additional 18 months.

**(b) Developments in Developing countries**

Until the 1990s, the main focus of international patenting activity was on the main economies of Europe, Japan and the United States, with some consideration of smaller OECD economies such as Canada and Australia. Although some developing countries have had patent systems in place for some time, these were often perceived as weak and ineffective. One of the remarkable developments of the 1990s was the development of patent systems in many developing countries. In part, this was related to trade frictions and bilateral negotiation with the United States, and the multilateral negotiations discussed below, but it also reflected changing policy perspectives in developing countries who came to recognize that protection of IP provided an element for attraction of investment and stimulated the transfer of technology for development purposes. These developing countries face various kinds of challenges in making the patent systems serve economic development objectives.

**3-4 Changes in international IP protection**

**(a) IP protection and US trade law**

The US began to take a more active role of in the improvement of international IP protection during the 1980s, as the dominance of US firms in several high-technology sectors was eroding and the returns to technologies invented in the US were perceived to be increasingly flowing to foreign firms and economies. The inadequate protection of IP abroad was viewed as a significant contributing factor. Several trade policy instruments were instituted and enhanced during the 1980s, to provide holders of US IP rights, and firms with a substantial industrial presence in the US, with stronger protection and enforcement of IP in individual foreign markets, and relief against the import of infringing goods into the US.

The primary US trade statute used to protect US IP in foreign markets was the Special 301 section of the 1988 Trade and Competitiveness Act. This directed the US Trade Representative (USTR) to identify and investigate priority countries that deny adequate IP protection (the watch list). There is an abbreviated deadline of just six to nine months for investigations. Depending on the USTR s findings, the legislation could (with notable exceptions) require retaliatory actions if the accused trading partner does not promptly eliminate the barriers.

The United States had series of trade disputes with different countries in the late 1980s and early 1990s over the protection of IP in these economies. The United States would threaten unilateral trade sanctions, but often the result was bilateral negotiations about the IP regimes of these economies.

During the past 20 years, holders of US patents and other IP rights in the US have also turned to the US ITC as a second forum within which to seek relief from infringement. The ITC does not try to curb infringement that takes place within foreign markets, rather, it provides more immediate remedies by protecting IP at US borders, utilizing section 337 of the 1988 Trade Act. A successful proceeding may result in an exclusion order to block all infringing imports at the US border. This is an effective weapon, as the exclusion order to bar importation of infringing goods is a very powerful deterrent. Relief is quick, and before 1995 federal law required a decision within one year, with a limited six month extension.[20] Also, because the subject of the investigation is the imports, not the importing parties, personal jurisdiction over foreign individuals or corporations is not required.

### (b) Bilateral agreements - US/Japan 1994 agreement

When negotiations for the WIPO treaty stalled in the early 1990s, key components were folded into bilateral arrangements. The most significant of these was between the United States and Japan. Under the 1994 Memorandum of Understanding, the US and Japanese governments agreed to revise elements of their patent systems that previously stood apart from international norms. On Japan's side, Japan agreed that it would: abolish its pre-grant opposition system; accept English language documents (with subsequent translations and translation corrections); and reduce the time it takes to examine patent applications by instituting a revised system of accelerated examination.

At the same time the US agreed that it would: change its patent term from 17 years from the date that the patent was granted to 20 years from the date that the application was filed; and adopt an "early publication" system whereby all patent applications would (with some exceptions) be automatically published 18 months after they were filed with the patent office. The US did not agree to change its first-to-invent priority rule. These changes have since been approved by the Japanese Diet and some but not all have implemented by the US Congress. The most significant delay is in the adoption by the US of a 18-month publication rule.

These moves have brought the patent system of these two large economies closer together and closer to international norms. The revisions to the Japanese patent system addressed many of the long-standing US criticisms. They also instituted US changes which had been under consideration for WIPO. By harmonizing IP treatment with the rest of the world, the changes are

[20] This timing requirement was removed in 1995 following GATT objections. The short litigation time period discouraged dilatory tactics, limited discovery disputes, and promoted early settlement. Roughly half of all section 337 cases are settled before a final ITC decision (Blakeslee and Zelnick, 1995).

believed to be beneficial to both countries. However, this bilateral arrangement has not changed the US from a first-to-invent system to a first-to-file system.

### (c) Multilateral efforts - WIPO

WIPO's efforts to harmonize worldwide patent laws began in the 1980s. The aim was to develop a treaty to simplify and expedite the process of obtaining a patent and to strengthen the level of protection by unifying differences among national or regional patent systems. During six years of deliberations, the scope of a proposed "harmonization treaty", which had begun with the purpose of establishing a uniform grace period in Europe, grew to include many internationally divergent patent procedures. It called for the adoption of a worldwide first-to-file system, publication of all patent applications, and a post-grant opposition system. Despite WIPO's broad membership, the treaty lacked support from the developing countries and was viewed primarily as a way to resolve differences among the patent systems of developed countries, most notably between the US and Japan. Observers at the time anticipated that only the US, Europe, and Japan would sign the draft harmonization treaty.[21]

In 1994, the US delegation effectively withdrew its active role in the WIPO diplomatic conferences. This US withdrawal largely reflected the lack of consensus within the US over the pivotal move to a first-to-file system, as required by the draft WIPO treaty. This also reflects the success of the subsequent bilateral talks of the US and Japan, which included many of the key patent provisions of the WIPO treaty, as well as the redirection of US negotiating efforts toward the completion of the Uruguay Round.[22]

### (d) Multilateral efforts - TRIPS

The focus of interest in patent harmonization shifted in the early 1990s from WIPO to the Uruguay Round and TRIPS, as these negotiations intensified and appeared to be nearing agreement. The TRIPS agreement offered several advantages over the draft WIPO treaty. First, it covered a wider range of IP rights, not just patents. Second, because TRIPS fell under the larger and more diverse GATT trade agenda, it was more likely that both developed and developing countries would agree to a set of minimum IP standards. Third, TRIPS came equipped with the unified dispute settlement system of the World Trade Organization (WTO) (the successor to GATT), while WIPO lacked any such enforcement mechanism.

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[21] GAO (1993), p.71.

[22] The final TRIPS agreement was essentially unchanged from the 1991 draft; IP negotiations were finalized in 1993-94 as part of the full Uruguay Round agreement.

After seven years of negotiations, the Uruguay Round trade negotiations were concluded at the end of 1993, and within a year the GATT implementing legislation was approved by the US Congress and signed by President Clinton. Soon thereafter, the WTO came into force on January 1, 1995. At the beginning of 1995, the WTO began administering the three multilateral agreements of the Uruguay Round: the previously existing GATT, as amended during the negotiations and other agreements for trade in products under Annex 1A; the General Agreement on Trade in Services (GATS); and TRIPS.

The TRIPS agreement combined the interests of both developed and developing countries. At issue was whether, and to what extent, stronger international IP rights would promote innovation but limit the diffusion of technology, and to whose benefit. Most developed countries argued that the TRIPS accord would both spur innovation and help diffuse technology. The basic argument is that IP rights must be awarded and sufficiently enforced to provide an economic return to the investors who incur the risks and costs of developing and commercializing a new technology. Without such protection, the incentives for innovative activity are likely to decline, to the detriment of economic growth at a global, not just national, level. Further, stronger national IP systems enhance long-run diffusion of technology since stronger IP rights help promote indigenous technological and innovative activities and improve the licensing market. However, the distributional consequences of the agreement, and questions about which countries would benefit at the cost of others, may remain a concern.[23]

Developing countries argued that strong IP would impose heavy and disproportionate costs on their economies by forcing them to pay monopoly prices for foreign proprietary technology. They argued that strengthening IP protection in their economies would impede their ability to acquire new technology by disallowing national policies that force compulsory licensing of patents or require that inventions be produced locally. This in turn would hinder the widespread and low-cost domestic diffusion of technology.

Despite much debate, the evidence for either side remained largely inconclusive. There is some evidence that for the NICs, stronger IP protection may indeed have positive effects on indigenous economic growth. Since the completion of the Uruguay Round, many NICs have adopted new laws and regulations to strengthen IP protection, with the objectives of encouraging inflows of foreign direct investment embodying more advanced technologies, and of promoting economic development by expanding domestic innovation. Yet projections for the poorest countries are less

[23] With stronger local IP protection, multinational firms might (a) conduct more R&D in those countries, (b) transfer more sophisticated technology to their subsidiaries located in those countries, or (c) conduct more licensing agreements with local firms. An effective IP system is only one of many relevant factors that influence the indigenous rate of innovation. See Richards (1988); Benko (1987); Ordover (1991); Grossman and Helpman (1991); Mansfield (1993); Hoekman (1994); Bhagwati (1994); Schott (1994); Bayard and Elliot (1994).

sanguine.[24]

In the end, developing countries in effect traded their support for the TRIPS provisions (with a long transition period) against improved access to industrial markets in agriculture and light manufacturing products especially textiles. This ability to bargain across the broad array of trade-related items contributed to the success of TRIPS. By the time agreement was reached developing countries such as India had unilaterally reversed their opposition to stronger IP provisions as they were increasingly becoming producers, not just consumers, of IP. Others had already enhanced their domestic IP laws as a result of US trade pressure, and saw TRIPS as a way to curtail future US demands. By mid-1995, the TRIPS agreement had been ratified as part of the overall Uruguay Round package by most WTO member countries, and was in the process of being implemented by these national governments.

All members to the agreement, developed and developing alike, are required to comply with the IP provisions regarding national treatment and most-favored-nation treatment by January 1, 1996. Beyond that, the transition periods differ markedly. Developing and least developed countries generally have 5 and 10 years, respectively, within which to meet the TRIPS obligations. This means that the full force of the TRIPS agreement will not be felt until the year 2000 for developing countries and 2005 – 10 years after WTO's establishment for least developed countries.

### 3.5 Description of TRIPS provisions

#### (a) Minimum IP standards

[24] Examining countries' levels of institutional development and R&D capabilities, Evenson (1993) finds that NICs (Singapore, Taiwan, and South Korea) and "near-NICs" (India, Thailand, Hong Kong, and Mexico) have used IP rights to facilitate the development of domestic inventive competence and capacity, but IP rights have not been a major policy instrument. Also, it is often argued that countries that have low scientific and technological capability have little direct economic incentive to revise their weak IP systems, but this does not consider the implications for investment.

Although TRIPS actually restricts some forms of commerce to protect IP rights, its emphasis is on making national IP laws and procedures more uniform. Like a European Union directive, it specifies certain objectives, minimum IP standards, but leaves the signatories to determine how the requirements will be implemented.

TRIPS lays out minimum rights of IP holders. These incorporate but go beyond those set by the four main pre-existing IP accords: the Paris Convention for the Protection of Industrial Property (1883, as amended in 1967), the Berne Convention for the Protection of Literary and Artistic Works (1886, and the Paris Act of 1971), the International Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations, the "Rome Convention" (1961), and the Treaty on Intellectual Property in Respect of Integrated Circuits (1989), the "Washington Chip Treaty"

A basic requirement is that each member nation should treat other members' IP claims as equivalent to its own, and any most-favoured-nation preference given to one nation should be given to all. TRIPS recognizes that national IP laws may need to take account of differences in competition policy between countries, and provisions for these differences are permitted. TRIPS breaks new ground for international IP treaties by incorporating procedures for ensuring national enforcement of the terms of the agreement, and for resolution of disputes between member countries carried out within the mechanism of the WTO.

The content of the TRIPS agreement spans seven types of intellectual property: patents, trade secrets, copyrights, trademarks, lay-out designs of integrated circuits, industrial designs, and geographical indications.. Unlike the prior agreements, the TRIPS accord mandates a minimum patent term, specifies the subject matter to be covered by patents, extends IP protection to new areas such as trade secrets and computer software, and specifies more rigorous enforcement procedures. It also mandates national and most-favoured-nation treatment in a wide range of intellectual property areas, extending the GATT framework beyond the traditional area of trade in goods.

Comparing TRIPS and NAFTA, both span the same range of subject areas – patents, trade secrets, copyright, trademarks, semiconductor integrated circuits, industrial designs and geographic indications. NAFTA also provides explicit protection for encrypted program-carrying satellite signals. An inventor in other NAFTA countries may now rely on a date of local invention in the case of US interference proceedings, treatment which the US agreed to extend to TRIPS members at the beginning of 1996. NAFTA required revisions to aspects of US patent copyright and trademark law, ahead of TRIPS.[25] Unlike TRIPS, NAFTA prohibits compulsory licensing of blocking patents, grants "pipeline" protection to pharmaceutical and agrochemical

[25] These include the elimination of sunset provisions for rental rights in recordings, and additional restrictions on the registration of geographically deceptive trademarks.

products, provides more effective copyright protection for sound recording, and protects trademarks for a minimum of ten, not seven, years.

### (b) IP and competition policy

TRIPS recognizes that the use of IP rights may occasionally conflict with national competition policies.[26] Since national competition policies differ, TRIPS permits members to specify in their legislation "licensing practices or conditions that may in particular cases constitute an abuse of IP rights, having an adverse effect on competition in the relevant market".[27] For example, members may take measures to control practices such as exclusive grantback conditions, conditions preventing challenges to validity, and coercive package licensing.

Beyond this, what constitutes an abuse of intellectual property rights, an adverse effect on competition or the relevant market is not defined in TRIPS, and the list of illustrative examples is quite short. Like the interface between IP and antitrust in the US, the balance between granting exclusive IP rights and placing limitations on those rights once granted is (necessarily) not made clear in TRIPS and is likely to be an area of future dispute.

### (c) Enforcement obligations

[26] "Some licensing practices or conditions pertaining to IP rights which restrain competition, may have adverse effects on trade and may impede the transfer and dissemination of technology", (Article 40: 1).

[27] Article 40: 2.

> "The obligations defining IP protection...are the bricks and stones of TRIPS and the obligations on enforcement, its mortar."[28]

Even where IP laws are adequate, weak enforcement can render them ineffective. Unlike the Berne and Paris Conventions, the TRIPS agreement spells out detailed enforcement procedures, both to prevent and deter infringement. Members must ensure that enforcement procedures are available under their national laws that permit "effective action against any act of infringement of intellectual property rights" covered by the agreement. Moreover, enforcement procedures must be fair and equitable, and must not "be unnecessarily complicated or costly, or entail unreasonable time-limits or unwarranted delays".[29] The most detailed procedures of this kind in a worldwide IP agreement, the TRIPS agreement covers administrative procedures, civil and criminal penalties and procedures, and customs enforcement actions.

The provisions lay out minimum standards for an adequate judicial enforcement system. Processes must be transparent, judicial opinions must be written, and parties must have the ability to appeal decisions. Judicial authorities must have a combination of specified procedures and remedies to invoke in IP infringement cases. Among other things, courts must have the authority to stop an infringement or related importation, order payment of damages to the rights holder, and order the submission of evidence (subject to protection of confidential information). Judicial authorities must also have provisional remedies at their disposal to prevent the selling of allegedly infringing goods and to preserve relevant evidence.

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[28] Michael Kirk, Chief US Negotiator for TRIPS, June 22, 1994.

[29] Article 41:2.

TRIPS also lays out special requirements for border measures, although particular customs procedures may vary greatly among nations.[30] For counterfeit trademark goods or pirated copyright goods, countries must have customs procedures in place so that rights holders can petition to stop importation. The competent administrative authority must be empowered, subject to judicial review, to destroy or dispose of the infringing goods. For other forms of intellectual property, these procedures may also be available but are not mandatory.
Finally, in an attempt to make the international IP system more transparent, TRIPS requires that countries publish laws, regulations, and any final judicial or administrative rulings related to subject matter covered by the agreement. Countries must also provide information regarding such laws and regulations to the TRIPS Council, administered by the WTO, which will monitor the compliance with TRIPS commitment of member countries.

**(d) Dispute settlement**

Just as important as ensuring national enforcement of IP provisions is the resolution of IP disputes among member countries. TRIPS is covered by the WTO's integrated dispute settlement procedures. Member countries are required to consult, at another country's request, when they disagree over the interpretation or application of the agreement. If consultations do not resolve the dispute, a panel hears the two sides and makes a ruling. The panel then reports its findings and recommendations to the Dispute Settlement Body. Any party to the dispute can appeal the panel report to the Appelate Body, which must rule on the appeal within 90 days. The ruling of the Appelate Body is binding and the acceptance of the panel report as modified by the Appelate Body by the DSB is mandatory.

[30] Some countries, like the US, intercept suspicious shipments, rule on their legitimacy, dispose of the infringing goods or refuse their entry into the country. Others detain shipments while injured parties obtain court orders for disposition. Others relegate infringement matters to the court system, eliminating the option for immediate border remedies (GAO, 1987, p.36).

The WTO improves significantly on previous dispute settlement procedures. It establishes a unified dispute settlement system for all of the agreements under the WTO umbrella, thereby alleviating controversies over which procedure to use. It sets time limits to ensure that procedures are not delayed. And it reaffirms the rights of complaining governments to initiate panel investigations, and prevents blocking by other members at this stage. It also establishes an elaborate mechanism with which to resolve disputes over whether member countries are complying with the IP provisions and enforcement standards of TRIPS.[31]

### (e) Impact of TRIPS

For IP owners, TRIPS is a landmark event. It establishes minimum standards for international IP protection and specifies the exclusive rights of IP holders in traditional as well as new areas such as trade secrets and computer programs. Unlike any previous international IP treaty, it spells out in considerable detail the administrative and enforcement procedures related to IP that countries must establish, and is armed with an enforcement mechanism should disputes arise.

[31] In the past, GATT dispute settlement panels and reports could be effectively delayed or blocked by any one country, and the GATT had no authority to enforce its decisions (Morrison, 1995a; Jackson, 1994; GAO, 1994; Schrader, 1994c).

The direct effects of TRIPS will undoubtedly differ by industry. Industries explicitly covered by the treaty are the most obvious beneficiaries, such as pharmaceuticals, entertainment, computers and software, and semiconductors, similarly firms that rely on trade secrets. The agreement may stimulate trade in IP in cases where firms were reluctant to export certain goods and services, or to license technologies, for fear of losing control over their IP, and hence may stimulate innovation. This rests on the effectiveness of the IP institutions within member countries, and the extent to which this enhances the firms' ability to earn rents on their IP.[32]

The overall effectiveness of TRIPS hinges on how nations interpret and implement the agreement, and honour the rulings of the multilateral panel when IP disputes arise. This is likely to be a concern in the area of competition policy (what countries designate as an abuse of IP rights and how they apply competition law) and in compulsory licensing (whether this will continue but with different justifications). In such areas, the language of the treaty is ambiguous and may invite dispute.

## 3-6 Changes to US IP system

### (a) TRIPS and other changes

From the US standpoint, TRIPS represents an advance for owners of US intellectual property rights abroad. TRIPS itself required few changes to US IP law, since it establishes minimum standards which generally are already more than covered by US law. Yet the broader harmonization process associated with TRIPS has included significant changes to the US IP system. The most dramatic changes to US IP law were agreed as the result of bilateral agreements, primarily the 1994 US/Japan accord. Together these have significantly changed the US IP landscape. These changes have triggered a domestic debate reflecting the differences in incentives and goals among US patent holders in different industries, as well as conflicts between users and producers of IP.

In patent law, the term of protection was changed from 17 years from the grant date, to 20 years from the filing date; inventive activity in the territory of a WTO member is now treated identically to activity in the US for the purpose of establishing the date of invention; the

[32] Contentious features of TRIPS include the long transition period for developing countries (a concern for US chemical, pharmaceutical, and computer firms), the lack of protection for patents in the development pipeline (a concern for pharmaceutical firms), and some technological areas are not ensured protection at all (certain biotechnological products and processes, and medical diagnostics), (Schott, 1994, p.120).

definition of infringement was expanded to include "offers to" sell or import a patented good; and a new "provisional" patent application was created.

In copyright law, rental rights in computer programs were specified; protection was granted against the unauthorized recording or video-taping of a live performance or its broadcast; and rights were afforded to certain works that are protected in another WTO member country but not previously protected in the US. In trademark law, the definition of "abandonment" was revised and the registration of misleading geographic indications for wines and spirits was prohibited. US laws regarding the protection of industrial designs (including integrated circuits) and trade secrets remain largely unchanged.

The main changes specifically due to TRIPS are in the procedures for pursuing and enforcing IP conflicts. Whereas in the recent past this has mainly been a concern of bilateral negotiations and the use of trade sanction power, TRIPS provides for a staged arbitration process which may enable disputes to be resolved through the WTO mechanism. Even so, the US retains much of its capacity to act unilaterally. In signing TRIPS, the US agreed to bring a wide range of international IP disputes with another WTO member before the TRIPS Council. It may still initiate section 301 cases, but TRIPS requires that it submit cases involving WTO trade agreements to the multilateral forum, which will then settle the dispute.[33]

### (b) Current "hybrid" US patent system

In effect, the US has adopted a "hybrid" patent system, revising some of its key aspects in closer alignment with international norms while maintaining its unique first-to-invent system. The new 20 year patent term redefines and typically extends the effective life of a patent. The newly created provisional application may further extend patent terms by one year, and offers special advantages to small firms and private inventors. However, in a first-to-invent system, the revised

[33] The US TRIPS implementing legislation also contains provisions to revise ITC's handling of section 337 cases, placing US practices more in line with 1988 GATT rulings (Appendix A1.2). See Morrison (1995a); Schrader (1994c); *Economist,* 25 March, 1995; Jackson (1994). The dispute mechanism does not become fully effective until the year 2000.

treatment of inventive activity may significantly increase the costs of designating patent rights, since evidence of inventorship may now be based on activity that took place abroad.

***(i) 20 year patent term***

Under the revised system, the US will grant a patent term ending 20 years from the date on which the application for the patent was filed in the US. Patent terms may be extended for up to 5 years for any cumulative delay caused by a secrecy order, an interference, or a successful appeal of an examiner's rejection. A main advantage to US patent holders is that this ensures similar patent lives across countries, so that firms may follow similar IP and commercialization strategies globally.[34]

A further advantage of pegging the patent term to the original filing date is that, combined with the 5 year cap on cumulative delays, the new system effectively eliminates "submarine" patents – patent applications that are submerged in the US patent office for prolonged periods of time and protected against disclosure until issued. Under the previous system, an applicant could periodically file changes and amendments to an application under review by the US patent office and, intentionally or not, delay the application's issuance. Since patent terms were based on the date that the application was issued, not filed, a submarine patent could surface years or decades after it was originally filed and still receive its full 17 years of patent protection, during a period in which the technology has likely become more widely diffused and a more valuable source of royalties. The new rules strengthen the motivation for applicants to seek a speedy resolution of the patent examination process. An 18-month publication rule would further reduce the problem

[34] With the old 17 years from issue rule, innovations might in some cases be protected in the US after they had expired abroad, so the US customers would still be paying royalties (Larry Goffney, USPTO, in *Investors Business Daily*, May 1, 1995)

of submarine patents, since firms would have advance warning of pending patents, and make their product development and investment decisions accordingly.[35]

The move to a 20-year from filing patent term has conveyed an economic windfall to some US patent holders, since it may extend their patent rights by one to two years.[36] However, the post-TRIPS patent term remains contested in the US, with at least one Congressional bill seeking to amend it.[37]

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[35] Submarine patents are discussed more fully below, in Ch. 15.

[36] It takes an average 19.5 months in the US for an applicant to obtain a patent (USPTO, 1993, p.3).

[37] The 20-year patent term had not been viewed by the US as a contentious provision when it was part of the WIPO harmonization effort, and was considered a much safer alternative to adopting a first-to-file system. The US could have satisfied the requirements of TRIPS by adopting, as in NAFTA, an optional patent term that would be the greater of the 20 year from filing term or 17 years from grant. One Congressional initiative (the Rohrabacher bill) seeks to resurrect the 17-year from grant patent term as an option. As of mid-1995, this bill had 185 co-sponsors in the House, but met great opposition from industry groups and IP associations. If enacted, this would renege on the 1994 US patent agreement with Japan, although it would still adhere to the minimum standards of TRIPS. The Moorehead initiative would extend the 20-year term when delays in the US Patent Office were beyond the control of the applicant, but would otherwise maintain a cap on patent terms (Lewis, 1995).

### *(ii) Provisional applications*

To ensure that applicants who file originally in the US are not at a disadvantage relative to foreign applicants, a revised system of domestic priority has been set in place, with the creation of a new provisional patent application. Under the new system, a party who files a provisional patent application in the US has up to a year in which to file a formal application. This enables an applicant to claim domestic priority to the invention, with a filing which is simpler and less expensive than a standard patent application. However, it does not count towards the 20 year patent term, which is based on the subsequently filed formal application, and thereby offers a way of extending the effective life of a patent by one year.[38]

### *(iii) Accepting foreign inventive activity*

Keeping its first-to-invent rule, when two or more parties claim substantially the same invention in the US, an interference proceeding will be conducted to determine which applicant legally establishes the earliest invention date. TRIPS requires that the US no longer discriminate regarding the place of invention when determining patent rights, and WTO members are now allowed to prove a date of invention based on acts taking place outside the US.[39]

A globalized interference process, relying on overseas documents and proofs of inventive activity, may add considerable delays and costs to the already lengthy and costly US interference proceedings.[40] A first-to-file system is simpler, in which priority is granted to the first party to file an application. This illustrates the potential difficulties of operating the new "hybrid" patent system, i.e. of limited harmonization.

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[38] The fee for filing a provisional application is $150, or $75 for small entities. The provisional application must contain a specification and necessary drawings, but need not include claims.

[39] A non-US inventor can use evidence of inventorship only for inventions conceived after January 1, 1996.

[40] It is estimated that 80% of US interferences in recent years have been settled between the disputing parties, partly reflecting the length and cost of Proceedings (Calvert and Sofocleous, 1992, cited by Lerner, 1994, pp.6-7).

### 3-7 Conclusion

Recent changes are transforming the landscape within which international transactions in IP take place. As a result of bilateral measures, and multilateral agreements such as TRIPS, minimum international standards for intellectual property protection have been established, both in terms of deeming certain types of intellectual property valid for legal protection, and specifying how rights should be enforced once granted.

Most agree that TRIPS in particular has strengthened the international rights of innovators. For the first time, a large number of countries (developed and developing alike) have agreed to common underlying principles of appropriate domestic intellectual property regimes. The agreement extends patent rights to virtually all types of technologies, sets forth the exclusive rights of patent holders, expands national treatment to IP policies and practices, and explicitly lays out IP rights in new areas, including computer software, databases, and trade secrets. In these regards, the TRIPS agreement accomplishes many of the long sought-after objectives of the US.

Like the 1982 formation of the US Court of Appeals for the Federal Circuit (CAFC), the TRIPS agreement may foster a more predictable and transparent environment within which to conduct intellectual property transactions such as licensing agreements.[41] It designates clearer, more comprehensive procedures with which to administer and adjudicate intellectual property rights.

The TRIPS agreement does not establish a uniform international level of IP protection. It is not clear what mix of bilateral and multilateral efforts may be used for further harmonization. There are also questions as to how much harmonization is desirable in the medium term. As a practical matter it is likely to be hard to change national approaches to IP on a wide scale unless there are compelling reasons to do so. Further, IP laws are embedded in the industrial and institutional structure of the country, and what may be appropriate for one country may not be so for another. limit the degree of harmonization desirable. Not only does the level of rights vary, but so does the use of the rights within these national systems.

It may be that future harmonization will be the result of a continuing process of convergence as IP laws change to reflect the underlying shifts in the economy. As world trade and technology transfer increase, national changes in IP law may take harmonization into account, and changes

[41] Nies (1993).

will tend to be in the same direction. However, there is a challenge to the international system to facilitate cooperation and convergence.

# CHAPTER 4: INTERNATIONAL PATENTING BEHAVIOUR: A STATISTICAL ANALYSIS

The purpose of this section is to determine the extent to which market size, patent protection, and patent filing costs matter to international patenting. The statistical analysis here complements case study and survey work. It provides another angle from which to assess how national and PCT filings - in the aggregate - are affected by economic and business-related conditions. Can international PCT and non-PCT filing activity be explained? Can the statistical model be used to forecast the effects of global economic events on international filing activities? Or be used to evaluate the effects of policies (concerning filing fees or patent rights)?

The results in this section are *tentative*. As will be explained, better data (or measures) and different investigative techniques are needed to take into account the peculiar (or particular) features of the PCT. There is scope therefore for improving upon the statistical model before it can assist in prediction and policy evaluation. In the meantime, this interim report finds the statistical model to be relatively good at explaining non-PCT filing behavior but relatively poor at explaining PCT filings.

The first part of this section describes the statistical model; the next part discusses the data to be used to estimate the model; and the last part will present and discuss the estimation results.

## 4-1 Statistical Model

A *source* country is defined as the country from which a set of patentable inventions originate, and *destination* countries as the countries in which patent protection is sought. The following statistical model relates the patenting propensity of the source country to various destination factors, like the strength of patent protection, market size, and patent filing costs. In general, the higher the quality of inventions and the more attractive the destination is in terms of patent protection, market size, and patent filing costs, the greater the fraction of source country inventions that will be sought for protection in that destination. Thus, the "estimation equation" relates the *fraction* of source country inventions patented in a destination to the destination country's *characteristics*.

The reasoning is as follows: assume that a particular source country has q = 1, ..., Q inventions, and assume that those inventions are sorted in increasing order of quality; that is, invention 2 is of higher quality than invention 1, etc. An invention is patented if the value of patenting in a destination (in terms of an increase in the discounted present value of profits) exceeds the patent filing costs. Let q* be the quality level of that source country invention which breaks even -- i.e. the benefit of patenting that invention just equals the cost of patenting it. Then all inventions whose quality level exceeds q* will be patented, and those whose quality levels follow below q* will not be. More precisely, F = 1 - (q*/Q) is the fraction of Q inventions that will be patented in a destination. Now, holding the quality of inventions constant, this fraction will be higher the more attractive a destination is in terms of market size, patent filing costs, patent protection levels, and so forth. The reason is that the more attractive a destination is, the lower the threshold q* -- that is, even lesser quality inventions will become profitable to patent.

Thus the statistical model explains the fraction of source country inventions that are patented in a foreign destination (the *dependent* variable), using destination characteristics, such as market size, patent filing costs, and patent protection levels (as the explanatory variables). The statistical model is subject to error owing to the fact that some profitable inventions fail to be patented, while some unprofitable ones are patented. Also, substantive differences in laws across destinations result in differences in examination standards, so that even destinations similar in economic conditions receive different proportions of a source country's patent applications.

### 4-2 Data and Sample Statistics

A panel data set of 35 source countries and 27 destination countries was assembled for four time periods: 1980, 1985, 1990, and 1995.

*(A) Data*

International patent filing data are from the World Intellectual Property Office's (WIPO), *Industrial Property Statistics*, 1980-1995. The measure of market size is per capita GDP (in real 1992 PPP adjusted U.S. dollars) and is obtained from the World Bank's *World Development Indicators*, various issues. Data on patent protection levels and patent filing costs were constructed. The following briefly describes the construction of each:

(i) Patent Rights: The measure of patent rights is taken from Ginarte and Park (1997) and Mahadevan and Park (1999). Their studies provide a rating of the *strength* of patent rights in 110 countries for the period 1960-1995 (every five years). The index of patent rights (henceforth IPR) ranges from zero to five, with higher numbers reflecting stronger levels of protection. The value of the index is obtained by aggregating five sub-indices: extent of coverage, membership in international treaties, enforcement mechanisms, duration of protection, and provisions against loss of protection (against, for example, compulsory licensing or working requirements). These features

(coverage, membership, duration, enforcement, and loss of protection) were chosen as a reference point for judging the strength of patent rights because of their adoption in international standards (for example, the *Uruguay Round* Agreements).

The numerical value of each of these sub-indices (which range from zero to one) indicates the fraction of legal features in that sub-index available in the particular country. For example, a value of 1/3 for *enforcement* indicates that a country has one-third of the possible enforcement mechanisms listed under that sub-index. A value of for *duration* implies that a country grants protection for half the international standard time (of 20 years from the date of application or 17 years from the date of grant). The value for *membership in international treaties* indicates the fraction of available treaties to which the nation is a signatory. The value for *coverage* indicates the fraction of invention classes the country allows as patentable subject matter. Finally, there are several conditions or regulations under which legal authorities can revoke or reduce patent rights. The value for *provisions against loss of protection* indicates the fraction of those conditions or regulations which are not exercised in the country.

(ii) Patent Filing Costs: Patent filing cost data were derived since international patent filing cost data are sparsely available. This paper builds on Helfgott's (1993) survey of patent filing costs. These costs include translation costs, official filing fees, and agent fees Helfgott's data on filing costs refer to a particular type of invention (e.g. one which allows ten claims, twenty pages of specification, two sheets of drawing, is drafted in English, and has a corporate assignee). Most importantly, the filing costs are from a U.S. applicant's point of view. The estimated filing cost of $690 (in real 1992 U.S. dollars) in Canada need not be the filing cost faced by German or Indian applicants in Canada.

To generate patent costs for more than the sample covered in Helfgott (1993), and for applicants from countries other than the U.S., an equation is first estimated that best fits the patent filing costs data in Helfgott (1993). The fitted equation is then used to predict patent filing costs for all of the required bilateral country pairs. As determinants of filing costs, geographic distance from the U.S. (and its square) and linguistic similarity with the U.S. were used. The reason is that the bulk of filing costs is due to translation. Thus, the more similar the languages between two countries, the less expensive it would be to apply for patents in each other's markets. Filing in a foreign market is also likely to be affected by geographic distance, reflecting transportation costs and perhaps differences in economic structure (regulations, customs, and practices), which may make patenting in foreign jurisdictions costly.

Based on Helfgott's original sample of 28 countries, the following regression results were obtained:

$$\widehat{\log(\text{Patent Costs})} = -22.17 + 7.57 \log \text{Dist} - 0.47*(\log \text{Dist})^2 - 0.032 \log \text{Ling},$$
$$\qquad\qquad (7.5) \quad (1.81) \qquad (0.11) \qquad (0.015)$$

*Adj. $R^2$ = 0.51, Standard Error of the Regression = 0.51*

where standard errors are in parentheses. The two variables (Distance and the Index of Linguistic Similarity) have the expected effects on patent costs, where Dist denotes distance and Ling Linguistic Similarity. Distance, however, affects filing costs up to a point. Beyond that (at longer distances), inventors are likely to find ways to reduce global filing costs, such as multiple patent filings (to spread the costs of filing among several destinations) or (if a transnational corporation) establish a corporate patenting branch in a foreign office.

With the above fitted equation, patent costs between any pair of source and destination countries can be generated, as distance and linguistic similarity data are widely available.[42] The data thereby generated are the measure of patent filing costs. The generated costs, however, are in real 1992 U.S. dollars. To obtain time-series estimates of patent filing costs for 1975, 1980, 1985, and 1990, the GDP deflator (where 1992=100) was used for each country to infer the filing costs for those years in real 1992 U.S. dollars.[43] For example, if the 1975 deflator = 50, the 1975 filing cost figure was considered to be half the 1992 estimate. This approach, however, assumes no real changes in filing costs. To allow for them, the cost figures were adjusted upward by the real GDP per capita growth rates (that is, each cost figure was multiplied by one plus the destination s real GDP per capita growth rate in that period). The working assumption here is that the growth in demand for patenting resources (and consequent rise in real filing costs) parallels the growth in market size.

*(B) Sample Statistics*

Most of the 35 source countries in the sample consist of the OECD countries; a few of them consists of members of emerging markets (Brazil, Mexico, and the Russian Federation). Table 1 identifies the source countries, and shows how many patent applications they filed in 3 regions of interest: Asia, Eastern Europe, and Latin America. The patent filings are broken down into PCT filings and non-PCT filings (or filings made directly through the national route). Some perspective is gained on the number, or size, of filings, by comparing them to the size of the labour force in the source country: the larger the labour force, the greater the potential pool from which to draw patentable inventions. (Overall, Japan has the most patents per worker, and China the least).

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[42] Data on distance and linguistic similarity are from Boisso and Ferrantino (1996).

[43] Deflator data are from Summers et. al. (1995)

Part A of Table 1 focuses on the countries of interest for this interim report. In Japan, the increased use of PCT is quite striking. Between 1990-1995, its national filings increased 65% in Asia, while its PCT filings increased by 350%. In Latin America, Japan's national filings increased by 2.7% while its PCT filings in the region increased by 752%. Yet still, PCT filings within Asia are a third of national filings within Asia, perhaps because not as many Asian economies – particularly the smaller – have joined the PCT. Outside Asia, in 1995, Japan's PCT filings exceeded its national filings.

For other source countries (Brazil, Hungary, Poland, Romania, and Russia), by 1995, PCT is the main route for international applications – even when applying in Asia. This is so since most of their Asian filings are in Japan.

Part B of Table 4-1 shows the filing patterns of other countries. Their use of the PCT has increased geometrically over time. By 1995, their PCT filings exceed national filings in all 3 regions, except for those of South Africa. (The South African patenting strategy appears to have focused on a few national markets.)

In 1990, the U.S. filed 30,027 patent applications in Asia, 34% of which occurred through the PCT. In 1995, there was not only an absolute rise in the number of U.S. patent applications in Asia, but a major shift to the use of PCT filings, which accounted for 71% of all U.S. Asian applications. During the same period, U.S. filings in Eastern Europe also increased absolutely (from 5,048 in 1990 to 48,296 in 1995), of which 95% in 1995 were PCT filings. In Latin America, by 1995, 75% of U.S. filings were through the PCT route.

This informally illustrates that developing (emerging) economies have been the beneficiaries of the PCT system, especially Eastern Europe. They have been obtaining new foreign technologies via PCT filings. However, it is of interest to know whether the increase in patent applications in the region is due to the growing market size of those emerging regions, to membership in the PCT, or to firms taking advantage of the financial cost savings of the PCT. (The fact that most of the source country's PCT filings are in countries like Japan, Korea (pre-1997 crisis), China, Brazil, Mexico, Hungary, Czech Republic, is a cause for concern.) One advantage of the statistical analysis of international patenting behavior is that it examines the joint interplay of all these factors.[44]

[44] Indeed the IPR index includes membership in the PCT; the indexes of nations that are signatories of the PCT are higher than they would be otherwise.

Table 4-2 presents sample statistics for the destination countries of interest. Patent filing costs vary over time and across countries. They tend to be high in nations that receive a relatively large volume of patent applications (e.g. China, Japan, Korea, Brazil, Bulgaria, Hungary, and Russia (pre-1997 crisis)), thus reflecting to some degree "demand" and "supply" conditions. With the exception of Japan, Korea (in 1995), Hong Kong, and Singapore, the GDP per capita levels show that most destination countries in the sample are medium-income economies. The IPR index levels are fairly low, except in Japan, Korea (1995), and Hungary. Most OECD economies have IPR index values above 3.5. Thus, the patent regimes in this sample of destination countries are on the relatively "weak" side, as far as the protection and enforcement of patent rights are concerned. This is also a sample of countries (excluding Japan and Korea) where less than 1% of GDP is devoted to research and development. Thus, this is not a sample of research-intensive nations.

The last four columns of Table 4-2 measure the "arrival" of new technologies to the destination. There are two sources: domestic patent applications and foreign; they in turn can come from either PCT filings or the national route. In China, for example, in 1995, domestic nationals filed 10,011 national applications and an additional 55 via the PCT route, listing their own home country as one of the PCT designations. Moreover, foreigners filed 8,688 national applications in China, and an additional 23,019 via the PCT route.

What China experienced in 1995 fits in with a fairly stylized fact, that only a fraction of domestic inventions are ever patented outside the home country. Patenting abroad is costly, and only relatively high quality inventions in general are patented abroad (self-selection). Thus it is not surprising to see that domestic patent applications via the PCT to be a fraction of domestic applications via the national route.

Japan has the largest number of domestic patent applications and received the most foreign patent applications in the sample (not surprisingly since it is the largest and strongest economy within the group). However, it would be useful to adjust the number of domestic patent applications down by a factor of 5, to make them comparable to foreign patent applications, since Japanese domestic applications tend to consist of single claims whereas foreign applications lump 5 or 6 claims into one patent application.

Note also that of all the foreign patent applications received, an increasing share of that comes from the PCT route. By 1995, more foreign patent applications came via the PCT route than came via the national route – with the exception of Singapore (which only became a signatory to the PCT in 1995).

### 4-3 Empirical Results

Recall that the dependent variable in the statistical model is the fraction of source country inventions that are patented in a destination country, and that the independent (explanatory) variables in the model consist of destination factors like the destination's market size (as proxied by its GDP per capita), patent protection level, and patent filing costs.

Table 4-3 presents the regression results. In the case of Panel A, the dependent variable is the total filings (both via the national route and PCT route) divided by the source country's domestic patent applications. (The latter proxies for the universe of source country patentable inventions.) The dependent variable indicates what fraction of the source country's inventions was patented in a particular destination country in a particular year. All the variables in the regression are in logs; hence the coefficient estimates represent "elasticities." An asterisk indicates that the estimate is statistically significant at conventional levels.
First, the pooled results, where all 35 source countries were mixed in together, as if they were all identical nations. A 1% increase in a destination's GDP per capita would on average motivate a source country to increase its foreign patent applications by 1.56%. Hence an economic expansion (contraction) is associated with a more than proportionate increase (decrease) in foreign patent filings. The coefficient estimate of the IPR index suggests that a 1% strengthening of patent rights would increase foreign patent filings by 3.41%. (Joining the PCT would, for example, increase the value of the IPR index by 6.67%, as membership in the PCT has a weight of 0.33 points on a scale of 0 to 5). The coefficient estimate of Patent Filing Costs shows that the demand for patent applications is highly elastic: a decrease in fees by 1% would increase filings by 2.19%.

One criticism of the results so far is that only 27% of the data is explained. The model does not capture all the important influences or motives for patenting (for example, strategic reasons, political factors).

The remainder of Table 4-3, Panel A, shows the results country by country. In general, the IPR index does best in predicting patent filings; the patent filing cost variable has the predicted "negative" effect on filings. In Japan, these two variables are almost (but not quite) significant in conventional statistical terms. GDP per capita is a significant explanatory factor for most countries; it has the "wrong" sign for the Czech Republic, however. This is attributable to two factors: i) there are too few observations to make an accurate measurement; ii) there are also some "neighborhood" effects: patents from the Czech Republic tend to concentrate among geographic (smaller European) neighbors, rather than in places like the U.S., Canada, and Japan.

The model varies in its ability to capture the data. The worst cases are its estimates for Mexico and India, where only 2% and 8% of the data are explained respectively. For most European source countries, the model explains anywhere between 40-55% of the data; for the U.S., Canada, and Japan, less than 40% is explained.

Finally, in Table 4-3, Panel B, the regression exercises are repeated, with the previous dependent variable being replaced by PCT filings as a fraction of domestic patent applications. Here the model does not fare well at explaining the data. Only the IPR index matters; the patent filing cost variable has a significant negative effect on PCT filings for only a few countries. The results seem to suggest that filing costs exert little or no influence on the behavior of PCT filings. GDP per capita has a positive but statistically insignificant influence (perhaps not surprising, since the time plot of PCT filings shows an exponential growth pattern, but the time path of GDP per capita does not follow this track. Rather it fluctuates around a trend which grows at the rate of 2 to 5%, depending on the country. Overall, the model explains about 20% of international PCT behavior.

The results suggest that these standard "macro" factors (like market size) do not capture all the variation in the data. Thus "micro" factors (at the firm or inventor level) should warrant greater consideration. An analysis of the effects of financial crises on international patenting should therefore be linked to some of these microeconomic channels or factors.

In the interim, there is much that can be done to improve the statistical modeling of PCT filing behavior: one, introduce business cycle factors (crises variables); two, introduce better dynamics (through lagged variables); three, introduce source and destination country heterogeneities (e.g. fixed effects); and four, measure patent filing costs with less error and separately for PCT and non-PCT filings.

As extensions, it would be desirable to study international patenting at disaggregated industrial or technology levels (for example, at the level of the International Patent Classification (IPC)). It would also be useful to study international patent families, to track PCT applications to the national stage (that is, find out which national filings are previously filed PCT applications that are at the "national" stage?), and finally, to examine which patent applications, after the national stage, are granted, which "worked" (i.e. was there anything manufactured?), and which renewed and for how long. The impact of global economic crises is likely to have diverse effects on different kinds of patentable inventions and on different stages of the patent protection life cycle.

The statistical analysis undertaken here is preliminary, but it does suggest that PCT filings are determined by different factors than national filings. One plausible explanation might be that PCT filings are in a "catch-up" mode as firms and patent attorneys become more aware of the advantages of PCT filings, but we have no direct evidence to support this view.

***Table 4.1 International Patent Applications***

*goes here*

*4.1 again*

*4.1 again*

***Table 4.2 Patent Destination Characteristics***

*table 4.2 again*

***Table 4-3. Determinants of International Patenting 1980-1995***

*H. Dependent Variable:* Total Foreign Filings (National Route and PCT Filings) as a Fraction of Source Country Patents

| Source Country | Constant | GDP per capita | Patent Rights Index | Patent Filing Costs | Adj. R-sq | N |
|---|---|---|---|---|---|---|
| Pooled | -5.94* | 1.56* | 3.41* | -2.19* | 0.27 | 1909 |
| Australia | -9.11 | 2.52* | 2.83* | -2.61* | 0.42 | 59 |
| Austria | -20.6* | 2.75* | 3.23* | -1.52* | 0.54 | 59 |
| Belgium | -5.92 | 2.56* | 3.12* | -2.93* | 0.55 | 59 |
| Brazil | -4.43 | 0.72 | 3.59* | -1.69* | 0.25 | 56 |
| Bulgaria | -2.44 | 1.85* | 4.00* | -3.48* | 0.44 | 58 |
| Canada | -13.9* | 1.99* | 2.74* | -1.36* | 0.39 | 59 |
| China | 16.9 | 0.75 | 10.1* | -5.12 | 0.19 | 24 |
| Czech Rep | 29.2* | -1.92* | 12.1* | -3.98* | 0.75 | 24 |
| Denmark | -5.60 | 2.89* | 3.49* | -3.43* | 0.48 | 59 |
| Finland | -7.77 | 2.52* | 4.13* | -2.92* | 0.40 | 59 |
| France | -9.41 | 2.44* | 3.07* | -2.43* | 0.51 | 59 |
| Germany | -13.3* | 2.87* | 3.22* | -2.36* | 0.49 | 59 |
| Greece | 8.74 | 0.57 | 5.78* | -3.36* | 0.39 | 52 |
| Hungary | 13.6 | 0.73 | 4.43* | -3.90* | 0.42 | 65 |
| India | -2.95 | 0.19 | 2.52* | -1.50* | 0.08 | 59 |
| Ireland | -6.65 | 0.41 | 6.43* | -1.34 | 0.40 | 59 |
| Israel | -4.92 | 1.29 | 3.22* | -1.89* | 0.20 | 59 |
| Italy | 0.37 | 2.02* | 1.35* | -2.90* | 0.54 | 59 |
| Japan | -23.9* | 2.71* | 1.84 | -1.15 | 0.27 | 56 |
| Korea | -8.65 | 1.28 | 10.6* | -2.63 | 0.48 | 24 |
| Luxem | 0.85 | 1.97* | 3.87* | -3.29* | 0.40 | 59 |
| Mexico | -7.30 | 0.42 | 2.11 | -0.77 | 0.02 | 56 |
| Netherl | -7.69 | 3.01* | 2.89* | -3.16* | 0.46 | 59 |
| New Zeal | -1.07 | 2.15* | 3.31* | -3.42* | 0.55 | 59 |
| Norway | -11.3 | 2.84* | 3.61* | -2.71* | 0.45 | 59 |
| Poland | -4.80 | 1.54* | 4.07* | -3.05* | 0.42 | 58 |
| Portugal | -2.49 | 0.93 | 3.91* | -2.04* | 0.34 | 59 |
| Romania | -1.22 | 1.02 | 4.20* | -2.93* | 0.37 | 58 |
| Russia | 23.3 | -1.29 | 12.7* | -4.25* | 0.67 | 24 |
| S. Africa | 11.5 | -0.23 | 3.78* | -2.89* | 0.26 | 56 |
| Spain | -4.67 | 0.93 | 3.24* | -1.56 | 0.15 | 59 |
| Sweden | -6.39 | 2.63* | 4.62* | -3.15* | 0.52 | 59 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Switzerl | -8.47* | 1.94* | 1.67* | -1.70* | 0.48 | 59 |
| UK | -8.37 | 1.35* | 2.27* | -1.28* | 0.42 | 59 |
| USA | -11.3* | 1.57* | 1.39* | -1.02* | 0.35 | 59 |

*B. Dependent Variable:* PCT Filings as a Fraction of Source Country Patents

| Source | Constant | GDP pc | Pat Rights | Filing Costs | Adj R-sq | N |
|---|---|---|---|---|---|---|
| Pooled | 14.9* | 0.69* | 4.56* | -0.81* | 0.20 | 1909 |
| Australia | -15.4 | 1.39 | 5.60* | -1.61 | 0.23 | 59 |
| Austria | -8.03 | 1.47 | 4.31* | -2.42* | 0.39 | 59 |
| Belgium | -15.7 | 0.94 | 4.79* | -0.82 | 0.20 | 59 |
| Brazil | -7.83 | 0.56 | 4.03* | -1.56* | 0.28 | 56 |
| Bulgaria | -8.57 | 0.79 | 3.58* | -1.66* | 0.21 | 58 |
| Canada | -29.4* | 0.84 | 4.69* | 0.861 | 0.17 | 59 |
| China | 19.9 | -0.16 | 15.4* | -3.85 | 0.25 | 24 |
| Czech Rep | 28.1* | -1.53 | 10.7* | -4.13 | 0.66 | 24 |
| Denmark | -6.96 | 1.14 | 5.43* | -2.15 | 0.23 | 59 |
| Finland | -14.8 | 1.10 | 5.39* | -1.19 | 0.21 | 59 |
| France | -18.4 | 1.16 | 5.59* | -1.03 | 0.21 | 59 |
| Germany | -17.5 | 1.71 | 6.58* | -1.84 | 0.25 | 59 |
| Greece | -19.3 | 0.91 | 3.35* | -0.21 | 0.17 | 52 |
| Hungary | -6.50 | 1.21 | 4.95* | -2.37* | 0.32 | 65 |
| India | -12.7 | -0.02 | -0.03 | -0.14* | 0.41 | 59 |
| Ireland | -27.6 | 0.28 | 3.08* | 1.39 | 0.14 | 59 |
| Israel | -26.5 | 0.07 | 2.08 | 1.51 | 0.15 | 59 |
| Italy | -4.27 | 1.14 | 5.12* | -2.57* | 0.26 | 59 |
| Japan | -18.9 | 0.56 | 5.26* | -0.75 | 0.15 | 56 |
| Korea | -4.15 | -1.61 | 12.7* | -0.88 | 0.22 | 24 |
| Luxem | -12.8 | 0.79 | 4.23* | -0.69 | 0.23 | 59 |
| Mexico | -30.1* | 0.13 | 1.92 | 2.01* | 0.17 | 56 |
| Netherl | -17.1 | 1.07 | 5.28* | -0.93 | 0.21 | 59 |
| New Zeal | -10.9 | 0.45 | 3.53* | -0.93 | 0.12 | 59 |
| Norway | -15.1 | 0.92 | 5.04* | -0.86 | 0.20 | 59 |
| Poland | -4.04 | 0.75 | 3.47* | -2.30* | 0.25 | 58 |
| Portugal | -18.1 | 0.22 | 2.34* | 0.551 | 0.12 | 59 |
| Romania | -1.16 | 1.03 | 3.98* | -2.94* | 0.36 | 58 |
| Russia | 27.9 | -1.46 | 12.5* | -4.07* | 0.63 | 24 |
| S. Africa | -21.0* | 0.06 | 2.19* | 0.606 | 0.15 | 56 |
| Spain | -29.1* | 0.67 | 3.30* | 1.136 | 0.17 | 59 |
| Sweden | -17.6 | 1.13 | 5.70* | -0.97 | 0.20 | 59 |
| Switzerl | -11.1 | 1.42 | 5.38* | -2.08* | 0.25 | 59 |

| | | | | | | |
|---|---|---|---|---|---|---|
| UK | -27.8* | 1.05 | 5.80* | 0.187 | 0.20 | 59 |
| USA | -31.9* | 1.09 | 6.22* | 0.507 | 0.20 | 59 |

Notes: All variables are in logs, including the dependent variable. N denotes the number of observations; adjusted R-square is the percentage of the data explained. Asterisk * denotes that the estimate is considered *statistically significant* at conventional levels (i.e. there is less than 5% chance that the estimate is really zero). "Pooled" refers to the pooling of all 35 source countries. The estimates are obtained from source country patenting in 27 different patent destinations and 4 time periods (1980, 1985, 1990, and 1995). Due to missing data, the actual number of observations (per source country) is less than 108 (= 27 x 4). Estimation is by the least squares method.

**Table 4.4 Relationship between PCT Filings and National Filings, 1980-1995**

*Dependent Variable:* National Filings

| Country | Constant | PCT Filings | R-squared | N |
|---|---|---|---|---|
| Pooled | -6.89* | 0.16* | 0.04 | 2174 |
| Australia | -8.06* | -0.02 | 0.0008 | 68 |
| Austria | -4.81* | 0.24* | 0.10 | 68 |
| Belgium | -4.26* | 0.18* | 0.07 | 68 |
| Brazil | -10.1* | 0.03 | 0.0008 | 65 |
| Bulgaria | -10.2* | 0.18 | 0.05 | 64 |
| Canada | -5.61* | 0.12 | 0.04 | 68 |
| China | -12.0* | 0.02 | 0.0007 | 24 |
| Czech Rep | -9.26* | 0.27* | 0.16 | 24 |
| Denmark | -7.01* | 0.07 | 0.01 | 68 |
| Finland | -5.49* | 0.23* | 0.10 | 68 |
| France | -4.79* | 0.16* | 0.07 | 68 |
| Germany | -4.10* | 0.18* | 0.10 | 68 |
| Greece | -8.72* | 0.14 | 0.03 | 61 |
| Hungary | -6.06* | 0.25* | 0.08 | 72 |
| India | 27.0 | 2.74 | 0.02 | 67 |
| Ireland | -8.50* | 0.17 | 0.03 | 68 |
| Israel | -4.69* | 0.24* | 0.05 | 67 |
| Italy | -4.39* | 0.11 | 0.04 | 68 |
| Japan | -8.16* | 0.10 | 0.02 | 65 |
| Korea | -7.24* | 0.25 | 0.11 | 24 |
| Luxem | -4.85* | 0.29* | 0.09 | 68 |
| Mexico | -12.3* | -0.22 | 0.03 | 65 |
| Netherl | -4.51* | 0.17* | 0.05 | 68 |
| New Zeal | -10.7* | -0.13 | 0.02 | 68 |
| Norway | -7.65* | 0.05 | 0.51 | 68 |
| Poland | -12.0* | 0.13 | 0.02 | 65 |
| Portugal | -8.76* | 0.09 | 0.008 | 67 |
| Romania | -11.4* | 0.20* | 0.11 | 64 |

| | | | | |
|---|---|---|---|---|
| Russia | -9.52* | 0.33* | 0.22 | 24 |
| S. Africa | -7.95* | 0.27 | 0.03 | 64 |
| Spain | -5.65* | 0.14 | 0.04 | 68 |
| Sweden | -6.90* | 0.06 | 0.008 | 68 |
| Switzerl | -4.32* | 0.07 | 0.02 | 68 |
| UK | -6.99* | -0.02 | 0.001 | 68 |
| USA | -6.04* | 0.004 | 0.00009 | 68 |

Notes: All variables are in logs. N denotes the number of observations; R-squared is the percentage of the data explained. Asterisk * denotes that the estimate is considered *statistically significant* at conventional levels (i.e. there is less than 5% chance that the estimate is really zero).

# CHAPTER 5: SUMMARY AND FUTURE ISSUES

## 5-1 Introduction

The overall aim of this study is to provide World Intellectual Property Organisation (WIPO) and the Patent Co-operation Treaty (PCT) directorate with a better understanding of how and why organisations are using the PCT and how WIPO can continue to meet its policy objectives. The study focuses on two main areas. The first area is to provide information and analysis that will help the PCT to continue to successfully fulfil its role in international patenting, and to be able to respond to changes that may take place in the technological, economic, legal and political environment affecting international patenting in the next several years. A particular question has been how the PCT is likely to be affected by worldwide economic shocks such as the Asian financial crisis, or a general slowdown in economic growth. Equally important questions are how the PCT may be affected by technological changes such as the move to electronic filing, or by the activities of regional Patent and Trademark Offices (PTOs) and multilateral patenting agreements. The PCT appears to have distinct advantages as a means for international patent filing. It needs to understand the nature of these strengths, of the demand for its services, so as to be able to plan for the future. At a more general level these are issues of how do the corporate strategies of firms affect international patenting decisions, but these are also issues of the corporate strategy of WIPO.

The second area is the longer term role of the PCT and its relationship to policy objectives not just for the PCT but also for WIPO as a whole. This is necessarily more speculative, and is based on the better understanding of the role of the PCT, as above. In particular this includes the growing importance of intellectual property protection in developing countries (DCs), and the means by which patenting and the PCT may become a more relevant and positive element in developing economies. It might also include the response to increasing harmonisation of patenting and intellectual property policies worldwide and the role that the PCT may take in this effort.

In deciding future policies, WIPO and the PCT need as full information as possible on how the PCT is used, not just by patenting firms or organisations, but also its relationship with national and regional PTOs, and with the member organisations. The PCT s role in future policy is more than a question of revenues and fees, although these are clearly important. As a conduit for international patent filing it may be able to have a direct, if limited, influence on issues such as the impact of IP in developing countries or harmonisation mechanisms, via its influence on filing rates, IP protection costs and fees, procedural simplification, and others. To see whether this is a possibility requires broad understanding of the role of the PCT, and its relationship to national IP institutions and practice.

The current study can only be an initial step towards such an understanding. This report has limited objectives. It aims to provide a first summary of how and why the PCT is being used, of

the impact of macro-economic changes, of possible results of current trends, and the steps that the PCT might consider in response. It also discusses some of the policy issues that may need to be addressed, including the question of greater involvement of developing countries and possible links between harmonization and the PCT. The report is based on a review of the economic patenting and strategy literature, discussions with PCT personnel, and some initial questionnaire interviews with major corporate users of the PCT as well as patent attorneys. It includes a preliminary empirical analysis of the impact of macro-economic changes such as the Asian crisis.

At this stage, the report is intended primarily to establish some key issues that the PCT may need to consider further. It suggests the scope of potential investigation into the nature of demand for PCT services and the impact of external and internal policy changes. Many of these issues will need significant information gathering before they are fully understood. The analysis calls for more comprehensive and reliable knowledge of the needs of users than is currently available, mostly in a non-systematic and anecdotal way. Indeed, it appears that there is much more information that could be gleaned from the existing information sources of the PCT, but is not now exploited (or gathered) in a timely way that can be used effectively in PCT policy making. There is also scope for more systematic empirical analysis of the demand for PCT services, fees and revenues, and the sensitivity of PCT usage to variations in external conditions. The PCT has begun to make long term review of its role and possible policy changes to consider (e.g., in the "long term policy review"). This effort would benefit from greater empirical evidence and survey information to help support these deliberations.

## 5-2. Role of the PCT

### 5-2.1 Context of the study

Established by treaty over twenty five years ago, in 1970, and entered into force since 1978, the use of the PCT has grown dramatically within the last decade. A major proportion of international patent filings now take place through the medium of the PCT. To adjust to this rapid growth in the scale of PCT use, to prepare for further growth, and to ensure that the PCT continues to offer a valuable service to its users and its members, a necessary step for the PCT is to understand more fully the nature of demand for its service and ways in which it may continue to offer its users and members value. It needs to be able prepare for future changes in the environment in which the PCT operates and to be responsive to its users' and members' needs. For example, the PCT needs to be able to stay abreast of, if not lead, technological changes that are taking place in the operations of patenting systems worldwide. The introduction of electronic filing is speeding and simplifying the filing process so that from an operational viewpoint the PCT could be working in a very different technological environment in just a few years.

The current report is a scoping report to provide an initial summary of who is using the PCT and why, and what this implies for future PCT and WIPO policy. A major aspect of this analysis are the possible responses by the PCT to many changes now underway in the area of international patents. A key concern is the potential impact of macro changes in the international economic climate, such as the Asian financial crisis, now nearly two years old but the implications of which, for the PCT as well as for many other areas, are still not well understood. in addition there are many other operational and policy aims of the PCT to consider. With one hundred nations now members of the PCT, including almost all the main industrial and developing economies,

(among the main exception are some of the ASEAN countries), there is only a limited scope for growth through membership. But there is still a large proportion of international patents which are not filed via the PCT and a question is whether the PCT should be aiming to obtain a greater share of these.

In the policy area there are also many questions. One of the most immediate issues is how best to serve the needs of the developing countries. Many are now members of the PCT but whether they yet get significant benefits from membership is not known. In the longer term there will be other questions of how the PCT can better meet it policy aims. Does it have a role in harmonization of intellectual property rules, how should it prepare for future policy needs, what is the relationship between the PCT and WIPO as a whole? Central to this, to be sure, is the effective operation of the PCT, to add value to users international patenting efforts. But at this stage in its development the PCT may need to be more proactive and plan for future needs.

### 5-2.2 Brief description of the PCT operations

The PCT allows multiple filings of a patent application in various countries around the world to be achieved via a single filing made through the PCT. By filing only one application with one Receiving Office, the PCT applicant can obtain the effect of regular national filings in any of the PCT contracting states being designated without initially having to furnish a translation of the application or pay national fees. Essentially, the PCT acts as a clearing house, ensuring that the application conforms to the filing requirements in the each of the national PTOs designated for filing in the initial PCT request, and establishing an internationally accepted priority date for the application. This is performed in concert with several other functions, including a preliminary search and examination process.

PCT applications are accepted by a number of Receiving Offices (ROs), typically national or regional PTOs, and forwarded to the International Bureau of the PCT Directorate for processing. This begins the International Phase (Phase I) of the application. The application is checked for conformity to the patent requirements of the countries designated for national patenting in the application. The patentee designates a list of countries in which a patent may be sought, and to which a copy of the application will be sent at the publication date, 18 months after the priority date. For all applications the PCT subjects the application to an international patent search, citing relevant prior art, to be performed by a designated International Searching Authority (ISA), and generating an International Search Report (ISR). The report is sent to the applicant and published. The PCT also publishes the application, at 18 months after filing. The ISA is typically a national or regional PTO. The user selects the search organisation. If requested by the applicant, the PCT arranges an initial international examination, by a designated International Preliminary Examination Authority (IPEA). This will generate an International Preliminary Examination Report (IPER). The report is sent to the applicant and to the national offices concerned (i.e., the offices where the patent is filed). This report will be available as part of the application to the national PTOs, although it is the national offices decision how far to rely on it.

The application moves to the National Phase (Phase II), at a time selected by the applicant (within the overall application schedule). The applicant may file amendments to the application

with the IPEA in light of the IPER report or other considerations. The applicant decides with which national offices to file, typically far fewer than originally designated. The applicant pays the national fee and supplies the national offices with translations if needed. The application is then forwarded to the national PTOs. However, the PCT may not be directly aware of the national application. The PCT does not grant "international patents" – granting the patents is the responsibility of the national and regional PTOs.

Fees are charged for transmittal of the application (by the RO), the basic processing fee, designation fees per country designated (up to a maximum of 10 after which there is no further charges), a per page fee (applications over 30 pages long), the international search fee, the international preliminary examination fee, and the handling fee (for handling the demand for examination). There are also the national filing fees (paid directly to the national offices). The transmittal fee is for the benefit if the RO; the basic fee, designation fees, per page fee and handling fee are to the benefit of the PCT; the search fees are to the benefit of the ISA; the examination fees are for the IPEA. The national filing fees are for the national PTOs. Only those fees for the direct benefit of the PCT International Bureau are set by the PCT.

PCT fees in effect at the beginning of 1999 are: Basic fee: 650 CHF; designation fee: 150 CHF per country to a maximum 10 countries, rest free; per page fee: 30 CHF per page over 30 pages; handling fee: 233 CHF. There is a reduction in the total of the basic fee and the designation fees of 200 CHF for applications filed together with an electronic copy.

The operation of the PCT system is supported by international treaty, the PCT, which permits national filings to be handled in this way. Most importantly, the PCT allows the priority date established by the PCT filing to be used as the priority date in each of the national filings. It also allows the date of national filing to be extended beyond the usual 12 month limit from the priority date, to 20 or 30 months after according to whether an examination is requested. This gives an extra 8 to 18 months to prepare the national filing. As this very brief description shows, using the PCT adds some complexity and cost to filing, but there are several benefits, notably the extra filing time. There are three key filing dates for the application: the initial PCT filing date, the election for PCT examination, and the national filing data. There are other intermediate dates for payment of fees, etc.

The application to the national or regional PCT proceeds in a very similar way whether the application has been filed via the PCT or directly, under the Paris Convention for international filing. In some cases there may be an allowance in the search and examination fees for the prior search and examination performed for the PCT. However, this usually applies only if the organisation used for the PCT search and examination is the same national or regional PTO, i.e., if the prior search information is likely to be used in the national search. These allowances to the fees may be relatively small. Otherwise the national fees and procedures, including maintenance fees, are the same whatever the source of the application.

### 5-2.3 Description of the PCT – history, organization, size and growth

A summary history of the PCT is as follows. The PCT has its origins in an initiatives in the 1960s to simplify international patent filing. Negotiations were begun in about 1966. The Patent Cooperation Treaty was agreed 1970. It came into force in 1978, with 18 states as members. There has been major growth since, both in membership and number of applications processed. The main growth has been since about 1988. In early 1999 there were 100 member states. In 1998 the PCT received 67,007 applications (each designating multiple national applications), and 48,193 demands for international preliminary examination.

The PCT is administered by WIPO. The operation of the PCT is the responsibility of the International Bureau, a department within WIPO, located in Geneva. The activities of the PCT are ultimately directed by its council of Member States, the Assembly of the PCT Union, to which the PCT is answerable. The basis for all PCT actions is the PCT Treaty, signed in Washington in 1970, amended in 1979, and modified in 1984. The operations of the PCT are governed the PCT Regulations, which may be amended from time to time according to the governing council.

The scale and scope of PCT operations may be summarised in a few main statistics. In 1998, the International Bureau of WIPO received 67,007 international applications, filed with PCT receiving Offices worldwide, which is 12,585 (23.1%) more than in 1997. The growth in the number of applications since the PCT began its operations is shown in **Table 5-1: PCT International Applications (1978-1998)** (attached to the end of this document).

Measured by the number of states designated on each of the applications, the 67,007 international applications received in 1998 were equivalent to 2,542,343 national applications (*i.e.*, an average 39.1 national designations per application), and of 169,424 regional applications (*i.e.*, an average of 2.5 regional designations per application), which in turn would have been equivalent to 2,264,654 applications for patent protection in the member States of the regional patent systems. Thus the equivalent effect of the 67,007 PCT applications would be a total of 4,806,997 national applications. However, the very large number of average designations per application is primarily a result of the fact that many applications designate all, or least very many member states, since there are no additional designation fees for more than 10 designated countries. The actual number of filings ultimately made to the national PTOs is much lower, probably around 3-6 filings per application.

The number of demands for international preliminary examination also increased in 1998. The total received was 48,193, which represents an increase over 1997 of 19.3%. The growth in the number of demands for international preliminary examination since 1985 is shown in **Table 5-2: Demands for International Preliminary Examination** (1985-1998).

As of 31 December 1998, 100 countries had joined the PCT as Contracting States. The 100$^{th}$ state was South Africa, whose membership became effective 16 March 1999. The numbers of Contracting States has also increased rapidly since the establishment of the PCT in 1978, at which time there were 18 members. The Contracting States are listed below in **Table 5-3A** for the largest sources of filings and **Table 5-8A: PCT Contracting States and Two-Letter Codes (March 1999)**.

The distribution of applications by country of origin is shown in **Table 5-3: PCT International Applications by Country: Top 10 (1998, 1997)**. This demonstrates the concentration of applications from the major industrialized economies. These are lead by the US, with 42.3% of filings, Germany with 13.6% and Japan with 9.1%. In all, the top 10 countries account for 88.9% of applications. This concentration is further demonstrated by considering the top 30 countries, shown in **Table 5-3a: PCT International Applications by Country  Top 30 (1998, 1997)**. This indicates that just 13 countries account for more than 1% each of the total applications, and the top 30, out of 100 contracting states, account for 99.5% of applications to the PCT. This does not meant that the smaller nations are inactive regarding patenting, since this measures the source of patent applications, not the destination for patent filing. Indications are that measured by filings the developing countries as a group account for about 2-3% of international filings (based on statistics collected by WIPO, but which are not recorded directly within the PCT, which records designations rather than actual filings)

Applications may be made in 15 different languages accepted by the PCT for the initial application. However, English is by far the dominant language, accounting for 66.3% of applications in 1998, followed by German with 15.1%. The five main languages used (English, German, Japanese, French, Swedish) accounted for 96.2% of applications. This is seen in **Table 5-4: Application by Language of Filing (1998, 1997)**.

The distribution of applications to the international searching authorities (ISAs) is shown in **Table 5-5: Applications to International Searching Authorities (ISAs) (1998, 1997)**. The European Patent Office accounted for 58.4% of searches applied for in 1998, and the US PTO a further 21.8%.

The distribution of demands for international preliminary examination is shown in **Table 5-6: Demands from International Preliminary Examining Authorities (IPEAs) (1998, 1997)**. The European Patent Office accounted for 55.2% of examinations demanded in 1998, and the US PTO a further 29.3%.

It is also instructive to look at the distribution of applications ranked by the characteristics of the companies. An initial indication of who is using the PCT most frequently is shown in **Table 5-7: Most Frequent PCT Users  Top 50 Firms (applications published) (1997)**. Not surprisingly, these are major MNEs. There is significant concentration in usage amongst the top firms. The top 50 firms accounted for 20.4% of applications to the PCT in 1997. The top 279 firms who each had 10 or more applications published in 1997 accounted for 36.3% of those published. It is not surprising that these firms are in high technology areas, where there are high rates of innovation. However, there is no very obvious bias towards a particular sector. The top firms include representatives from pharmaceuticals, specialty chemicals, consumer products, electronics, telecommunications equipment, and semiconductors, as well as some representation from research institutes and universities.

The above is intended only to give an outline of the structure of demand for PCT services. Perhaps the most apparent features are the rapid growth in demand for the PCT since about 1988, the dominance of the major industrialized nations in the use of the PCT, and the significance of

large companies amongst the users. Much more detailed analysis is possible from the data available from the PCT operations, and collected as part of broader efforts within the PCT and WIPO. A full understanding of the nature of the demand for the PCT is also likely to require comparisons with other sources of patenting data, and on correlations with other types of economic activity.

## 5-3 How the PCT is used

### 5-3.1 Characteristics of users  MNEs

A full understanding of the demand for the PCT depends on the characteristics of who is using PCT and why. Attention tends to be focussed on the major users and member states. We should also consider the potential users who may be partially excluded from the PCT and do not show up in the user data. This includes major firms who prefer another route for international patenting, and equally importantly it includes the smaller inventors and the states who are only beginning to build up their patenting and innovation activity.

The brief review of the data above indicates some of the key user characteristics that should be valuable in understanding demand, but at this point require more detailed information and analysis. The types of characteristics that are relevant include:

a) Applications and examinations by national source and designation. Most applications come from the major industrialized economies. Is this likely to change, and is there anything that the PCT might do to affect this distribution? It seems to be too early to identify a trend for increased participation in the PCT by users from the new member states, although filings for some latterly developing countries such as Mexico and China are increasing.

b) Applications and examinations by company size and country of origin. Large companies account for the major share of the patent filings via the PCT. Further distinctions between application patterns are not clear at this point. For example, it is not clear whether some firms or some nations are more selective in their use of the PCT, such as by designating or filing only in specific countries. In terms of designations per application (a possible indication of the breadth of patenting by users from different nations and industries) there is some indication of more targeted patenting (i.e., fewer designations) from some countries. Japanese firms, for example, are less likely to blanket designate all countries, from which to select a few actual national filings later. Whether this may be due to a national characteristic that values positive decision making and decries indecisiveness, or to a lack of understanding of how to use the PCT to resolve inherent uncertainty with new technology, or to some characteristic of business strategy, or a number of other possibilities is not known. also, given the fee structure, the designation data may in a large number of cases be irrelevant to the decision of where to file.

c) Identification of the major users, with large numbers of applications per year. The major users of the PCT are known, and much can be learned by investigating their application patterns and their reasons for using the PCT. However, also important are the opinions of those firms who are not major users of the PCT. The major "non-users" may be making well informed decisions for limiting PCT use in their patenting strategies, and their views should be valuable. Other users, and other nations, may not be fully aware of how they can best use the PCT, and the task there is one of education as well as ensuring that the PCT matches their specific needs. There may be ways in which the PCT can be made more useful and attractive to these potential users, while ensuring that the existing users remain satisfied.

d) Identification of industrial and technological areas represented strongly in the PCT. High users may be concentrated in areas such as pharmaceuticals and specialty chemicals, electronics related industries, and innovation based consumer products. There are likely to be links between the nature of the product market, the technology, and patenting activity which in turn affect the decision to use the PCT for international patenting. Put simply, patenting is likely to be much broader internationally in areas such as pharmaceuticals and consumer products that reach wide markets and will probably need to be protected throughout the world, than in capital intensive areas such as electronics, industrial chemicals, and capital goods which are only likely to be manufactured in a few countries. More needs to be known about these links.

It is generally clear from the data that the highest volume users are large MNEs, based in the major industrialized nations, for many of whom the PCT is now a main means of applying for international patents (in cases where they wish to patent in more than a few countries worldwide). As noted above, in 1998 the largest number of applications came from the US, with 42.3% of the total 67,007 applications, followed by Germany (13.6%), Japan (9.1%) and the UK (6.5%). The top ten countries accounted for 89.1% of applications. Similarly, the top 50 users of the PCT accounted for 20.4% of applications published in 1997.

These users have adopted the PCT strongly in the past decade. The PCT activity may appear to be dominated by MNEs, because of the numbers of applications they make but also because they may be the most vocal. However, they are necessarily less dominant in terms of numbers of users, rather than number of applications.

Similarly the use of the PCT may appear to be dominated by major industrialized countries. There are the same qualifications to this, in that the largest number of member states are now likely to be developing countries, although they make very few applications. Another way to consider the distribution of membership is by the GDP of member states. This indicates that although the developing countries may account for a very small percentage of applications (around 2-3%), they account for a rather larger (still small) percentage of economic activity, and so need to be considered by applicants expecting to do business in these countries, and who may need to ensure IP protection there.

### 5-3.2 Routes for international patenting

Firms, and especially the sophisticated MNEs, may use a variety of routes for international patenting. The main choices for a company wishing to patent internationally is to use the PCT or to patent directly under the Paris Convention. Firms also face the choice of whether to just patent nationally or extend protection internationally.

Data are available on the percentage of innovations that are only patented domestically. In general, a minority, although a large minority, of innovations are also patented outside the country or origin. Further, of these a large proportion may be patented only in a handful of major manufacturing countries or major markets. Finally there is the percentage of multiple country application that are handled via the PCT. In these circumstances the PCT must be seen as highly successful. A large proportion of those patented internationally pass through the PCT.

Changing demand for international patents and the PCT. The number of patents issued to non-residents has increased at a greater rate than the total increase in patents issued, or in innovations patented. Thus there are more innovations being patented, and more innovations being patented in more countries. In addition the PCT is now more likely to be the route of choice for patenting when more than a few countries are included in the patent list.

Why this increase in PCT applications? Partly it is the number of patents being applied for. Also the PCT becomes economically attractive once more than a few countries are included in the list. A rule of thumb is that the PCT is economically attractive for more than three countries in addition to the domestic patent. It is rare for companies to file domestic patents through the PCT. However they are increasingly using the PCT rather than direct filing once they have a number of foreign patents to consider.

Thus there are levels of users. Pharmaceutical companies, who file in a very wide range of countries appear to be some of the heaviest users of the PCT. Similarly for major consumer products companies. Other major users of patents, if not of international patents, are also heavy users of the PCT for those patents which they want to patent broadly, but for others they will patent directly in their main markets or producing countries, (*e.g.*, US, Europe at the EPO, and Japan). Other companies will only use the PCT for the occasional key patent for which they want wide international coverage.

### 5-3.3 Reasons for using the PCT

There are several potential benefits of PCT for the patent applicant.

There are transactional advantages. Using the PCT involves a single application, versus a number of disparate applications in different countries. Although the national filing is ultimately the responsibility of the user and proceeds in a way little different from the direct application from that point on, there are several simplification in managing the process for the user by having a single initial application and a priority date established clearly. This includes a standardized formality check, which may be especially valuable to small users, unfamiliar with national requirements, but which also applies to any user unfamiliar with all the differences between national filings. The PCT also imposes a discipline on the filing schedules, with the focus of the applications in one place, with known deadlines, helps avoid the problem of missed deadlines and formalities when filing directly.

Another significant factor is the potentially very great value to the patentee of the extended priority period, which may postpone national filing by up to 8 to 18 months. This can be very valuable in some circumstances, by giving extra time to get the national patent filings right, to check the commercial value of the innovation, or simply to postpone various patent costs. There are three aspects. First, this gives additional time to prepare application correctly. Second, it allows the applicant to postpone the high costs of translation, attorney/agent fees, and PTO filing (and maintenance) fees. Third it allows the applicant additional time to examine the technical and commercial viability of the patent. This last may be very important, since it is estimated that as many as 20-25% of applications may be dropped before national filing, saving further application costs. This "option value" is a significant benefit of the PCT, but it does seem to be valued differently by different MNEs.

Furthermore, the additional independent search and examination allows to fine tune the filing. This may allow the applicant to amend the application, either while the application is still under examination by the IPEA or by waiting until the national filing is made.

The international search (and examination) may also be used in some cases to double check on the national search where a separate domestic filing has been made. This is most likely to be the case for US filings, where the international filing often is carried out separately from the US filing.

A more general advantage of the PCT is that it allows the user greater breadth of filing and simplifies the problems of filing in many disparate countries. This may be especially valuable for patenting in developing countries, which may have poorly developed national patent systems and may benefit from the formalisation introduced by using the PCT for the filing preparation. Also, PCT staff may be able to help in such cases from their knowledge of conditions is such cases.

Other possible benefits of using the PCT are more speculative, and it is not known how great these benefits may be in practice. There should in theory be advantages in speeding up the national filings, if the PCT search and examination helps make the national examination process faster or more certain. However, it seems that unless the international search and/or examination are performed by the same authority as the national or regional filing then the national filing does not make direct use of the information from the international search and examination.

### 5-3.4 Influence of fees

Although fees are likely to be a key determinant of how widely the PCT is used, the sensitivity of users to fee levels and the PCT price structure may be relatively low. PCT fees are a relatively low proportion of the total costs of the patent, which include translation costs, agents costs, PTO fees and maintenance fees, as well as the potential costs of litigating the patent. If the use of the PCT is likely to have a significant beneficial effect in reducing any of these more substantial costs then one would expect that demand for PCT services would be price inelastic. Determining if this is the case might rely on the collection of direct information from users, and on the empirical analysis of the effect of fee changes on PCT demand, if this can be separated from other causes of variations and growth in PCT usage. An initial econometric analysis of demand is part of the current study.

Even so, for firms with a large patent portfolio and high usage of the PCT, the absolute cost of PCT fees may be large, and become an item for attention. A sophisticated MNE user is always ready to use the most cost effective method of filing, and if the PCT does not offer services commensurate with the advantages, they will switch to other methods.

Probably more likely, is that fees may call for attention from the small user, perhaps in a developing country, for whom the fees are more significant. The PCT has addressed this issue to some extent with the 75% discount for applicants with low incomes, primarily aimed at applicants from developing countries. This is an area that may warrant further investigation.

### 5-3.5 Reasons for the rapid increase in PCT use

Use of the PCT, both from the number of applications and the number of organization s making applications have increased rapidly since about the end of the 1980s. Growth rates in applications have typically been in the 15-30% range. Applications in 1998 were 23% higher than in 1997. This has been accompanied by a rapid increase in the number of member states, particularly since TRIPS in 1994. However, most of the new members are only lightly represented in both applications and filings, and the main industrialized nations were already members in the 1980s. Thus the increase in PCT use may have been influenced by the wider national coverage, but it seems that there are other forces at work to explain this growth.

The growth appears to have affected national application rates more or less uniformly with applications from the leading nations rising at about the same rate and shares stable. The US dominates the source of applications, with 42.3% in 1998, virtually the same as 1997. The question is why have firms, apparently across a range of countries and industries, especially the large companies that account for most of the applications, started or increased their use of the PCT in the last decade? Some suggestions are the following.

One explanation may be that this is partly an effect of the establishment of a "critical mass" of users and patent lawyers familiar with the system and able to support the use of the system. This may have been coupled with an increase in general awareness of the PCT, perhaps associated with TRIPS and the wider enforceability of IP rights introduced in 1994 with TRIPS. There may have been a realisation in the late 1980s/early 1990s that multiple national patenting was going to become a key part of firms' strategies and the PCT was the natural route to be developed. This may have led to a "bandwagon" to file international patents, and to do so via the PCT.

This has been combined with general "globalization" of many markets. The result has been a growth in the demand for international filings over this period, but more importantly for the PCT, the PCT has increased its share of these applications.

In this sense, the rapid growth in PCT application has been a readjustment or "catch up" to a new equilibrium, in which the PCT has established its role with a large share of the international filings. When this growth in share will plateau is not clear. There still seems to be scope for an increase in the PCT share of international filings, as many filings do not use the PCT. On the other hand, those major users who naturally find the PCT attractive (e.g., innovation-based MNEs who typically file a large number of patents and do so in a large number of national markets to protect their products, such as pharmaceutical companies or some consumer products companies) are probably already using the PCT as intensively as they want. Those firms that only use the PCT sporadically may also have reached their equilibrium use of the PCT. Unless economic conditions, and the demand for IP protection, change, the growth rate in the use of the PCT will eventually plateau and further growth will be asymptotic to the overall growth in international patenting. As this seems likely to continue to grow, given the various conditions for increased global IP protection, the growth of the PCT may even then remain high, although not at the recent levels.

However, some of this growth might go away as quickly as it came. The MNEs are using the PCT based on straightforward economic grounds. If the PCT fails to provide for these needs, or a more attractive route were to be developed, then MNE patenting would be expected to switch to other methods. This is not to say that this is likely to happen. The PCT has many built-in advantages over other routes (e.g., the importance of the PCT treaty itself, the value of the filing extension permitted under the treaty, and the links to developing countries) that should provide it with long term advantages. However, for the high volume user, who is probably a large multinational firm, the use of the PCT is a business decision, and subject to change.

### 5-3.6 Member States participation rates

The link between the attractiveness of the PCT for the user and the number of member states are not clear, although it is likely to be a distinct advantage to the PCT to have virtually complete coverage of the world. One of the PCT's main strengths seems to be its inclusion of many developing countries in its member list.

The only main region of economic activity that is under-represented in PCT membership currently is the ASEAN countries. The PCT would probably benefit from their inclusion, so is interested in why these countries have not joined so far?

One reason may be inertia, including the personal element of the views predominant in the relevant authority in these countries and the resistance to change by the patent attorneys. Another may be that although now seeing the point of IP protection, this may still not be a major priority for these nations, who have been heavily focussed on growth in manufacturing and are only recently starting to generate significant innovation. A further possible influence is the particular importance of the body of experience and specialised knowledge of the patenting system in these countries, built up over long use, and which there is no strong pressure from users inside or outside the country to risk damaging.

Because these countries are thought of as a group, there may be a network effect, in that membership of the PCT is only of most use if it is mutual and all the ASEAN countries join together. If there is significant intra-ASEAN patent filing then there may already be a type of informal network between the countries, working in some way between the firms or between patent institutions, so that the PCT has less new to offer.

### 5-3.7 Why firms use the PCT

As part of this study we have undertaken an initial review of why firms use, or do not use, the PCT. The preliminary survey has included discussions with some major patenting firms and international patenting attorneys, review of reports in the patenting and economic literature on reasons for and against using the PCT, and discussions with WIPO personnel in frequent contact with users.

In these discussions use was made of an initial questionnaire to try to identify some main issues in how forms use the PCT. At this point the main value of the review has been to suggest directions for further research, rather than to come to any conclusions. To come to any meaningful conclusions would require a much larger and formalised survey, which not only identified qualitatively the main concerns, but was also capable of attaching weights and consequences of the different concerns.

However, even from a preliminary review it is possible to make some comments on how some users of international patents typically view the PCT. This has uncovered a range of reasons why the PCT is seen as valuable, as well as some reasons why it is not seen to answer the particular needs of some MNEs and thus, is not used extensively by these organizations. We believe that to reach a balanced view of the use of the PCT, and to be prepared for future changes, it is

important to understand both why firms use the PCT and why they do not. This seems the only basis on which to be able to make the PCT as effective as possible. Clearly this means contacting patenting organizations who are not currently heavy users of the PCT, and whose concerns may not be gleaned from contacts with current users. This may uncover issues that the PCT might not normally be aware of.

### *a) Benefits of using PCT*

The advantages of using the PCT include each of the likely advantages listed above. In general, the reasons for using this route appear fall into three main categories, although there are many individual nuances and specific points of difference in how these are appreciated by different users.

#### *i) Timing and resolution of uncertainty*

A first main reason may be described under a general heading of the resolution of technological and commercial uncertainty. The extra filing time gives firms an additional period in which to form views as to the patentability of the innovation, and of the commercial value of the innovation.

The value of a patent depends on three main features: the viability of the patent in terms of its legal strength, the enforceability of the patent in different jurisdictions, and the commercial value of the patent in different markets. These may differ by country. The additional time and information gives the user the option of amending or dropping the patent filing depending of these three key aspects.

Coupled with the information from the international search report and international preliminary examination report the user has additional time in which to decide, from a technical viewpoint, whether to file the patent, where to file, and whether to amend the filing at the national level. This depends on a technical evaluation of the likely strength of the patent, the breadth of the allowed claims, and others.

At the same time, and possibly even more important, the firm has the opportunity to decide whether the patent has sufficient commercial value to justify patenting. This will depend on the expected method the company expects to make of the patent, whether to protect products for manufacture and sale, for out-licensing, for cross-licensing with other IP holders, or for blocking competitors. In an area of fast moving technology an additional 18 months may make a big difference in performing market research and deciding what is the value of the new market, what competitors are doing, and others. It also allows time to test whether this is a technological blind alley.

There may be a limit to how long a firm may wish to postpone patenting, however. A patent is only valid from the grant date, so that for short life-cycle products firms may wish to have a patent granted as soon as possible.

It is not known the relative importance of these factors in an abandonment decision. A broad figure quoted is that 20-25% of PCT applications are abandoned before they are filed nationally. Also it is clear that users file in far fewer national offices than they designate in the original

application. Knowing more about the abandonment decision might help understand the value of the search and examination in reducing uncertainty, compared with commercial factors.

***ii) Scheduling of the patent application process***

A second main reason may be included under a general heading of the scheduling of the patent application process. Primarily this means allowing extra time to get the application right, and to prepare all the additional documentation, especially for translations, needed for the national filing. The extra filing time also allows firm to postpone the costs of the national filing, notably translation cost, agents costs and PTO filing fees.

The additional time in which to complete the filing procedures seems to be one of the main reasons that infrequent users have for using the PCT. If there is a particular problem with a patent, or there is an increase in the number of patents being handled by a patenting department, the PCT route may provide the extra time to remove a logjam or attend to a specific problem. Again, translation time appears to be a particular issue.

The PCT also standardises the patenting application schedule, with only a single application to worry about rather than many separate national filings.

***iii)Simplification of the application process***

A third general reason for using the PCT is what is perhaps the main original motivation for the PCT, namely simplifying the application for multiple country filing by handling at least the first stages within a single application. The value of standardisation of scheduling has been mentioned above. Others are that whatever the national nuances in patent filing, the basic application procedure is the same.

This may underline the advantage that the PCT has of resting on the sturdy foundation of the international PCT treaty. Also PCT procedures remain uniform even though there may be changes in individual national IP laws and institutions.

This benefit may appear obvious, the basic reason for the existence of the PCT. However, users are always concerned about the complexity of patent filing processes, and it can only help the PCT perform a valuable service to remember that simplification is one of the primary aims.

***iv) Value of the international search and examination***

Some US MNEs regard the international search and examination as conducted by the EPO to be useful in enhancing the value of their patent both internationally and in the United States where they file under the national system. Other US MNEs expressed concern that the international search and examination might create complications for the granting of the US patent. Obviously, these reflect different views about the utility of the international search and examination reports in defending the patent in subsequent litigation after the patent is granted in either the United States or other jurisdictions.

***b) Selective use of the PCT***

A firm that only uses the PCT selectively (a major multinational electronics firm) has expressed a basic view that it has not found the PCT to meet its needs in most cases. In a recent year in which the company filed more than 1,000 US patent applications it filed only about 5% PCT applications. The main situation in which it tends to use the PCT is if it is absolutely critical to have the ability to delay the selection of designated countries. However, as a sophisticated company, in most instances it knows enough about its markets and about potential prior art that the delay doesn't really provide a benefit. The main reason is that the perceived cost and complexity of the PCT application process outweighs the potential benefits that the company sees.

For this company, for the filing of counterpart applications outside of the US, it tends to select Japan in about half of cases and a number of European countries in slightly more than half of this firm's filings. If the number of European countries is 3 or more the firm usually files via the EPO. For 1-2 European countries it typically files national directly. Interestingly, the EPO's change to allowing deferred designation of countries has proven to be of only marginal use to this firm, although the firm does some minor amount of designation changes (from their original plans) in a few of its filings.

In this case, which may be typical of firms in high technology manufacturing industries such as electronics, the main areas in which IP protection is needed may be in advanced technology manufacturing countries, where there may be competitors in the same technology capable of producing the same products. There is less need to protect in the different markets that might use the products, since there are a limited number of manufacturing possibilities. These can be protected most effectively and economically by specific patenting in a few nations. The firm knows enough about the technology and competitors' capabilities that it can handle this directly through national filings. Also, this technology is changing rapidly, so that only a few nations can keep up with the rate of innovation. Similarly, if international competitors' capabilities change then this will soon become apparent and the patenting targeting can be extended to cover that area.

For a company that is well informed about its markets and the technological characteristics involved, and has clear national targets for the patents, it may be that the PCT is an unnecessary layer of complication, unless there are pressing needs to delay filing. This is a viewpoint one can only get by going outside the main PCT users.

Comments from other users have identified some other potential problem areas for the user. One is the general complexity of the PCT procedure. Although it replaces many national applications with a single PCT one, there are some complexities of scheduling the various key dates in a PCT application.

For example, in a PCT application there are three key dates, for the initial application (within 12 months of the priority date), for the filing of a demand for an international preliminary examination (19 months from priority date), and the national filing (20 or 30 months from the

priority date). Although it does not allow for the extension of the filing under the PCT, the national application has only one date to worry about, the initial filing date (12 months from priority).

In some cases the scheduling is clearly advantageous using the PCT, since there is a single schedule for all national filings, so that problems due to differences in national rules are avoided. The PCT also provides a set schedule for each step, such as providing translations, which may impose a timetable that is more easily trackable.

Again this goes to the question of the number of nations the user expects to file in, and the sophistication of its patenting strategy. For limited national filings by a knowledgeable company who regularly files hundreds or even thousands of patents a year, the direct filing may be all that is needed. For a company that expects to file broadly in a large number of markets, such as a pharmaceutical company or a consumer products company, the PCT offers advantages of consolidating the application process in a single place.

### *c) Initial questionnaire*

The initial set of questions that have been prepared for identifying some of the main reasons firms have for using or not using the PCT. The initial objective is to identify the most relevant issues for PCT users. The aim is a general view of how and why firms use the PCT, and how the PCT fits in with firms overall patent application policies. At this point the questionnaire is mainly aimed to identify the main issues that would need to be investigated in a more detailed survey.

Broad questions are as follows:

1) Do you use the PCT significantly for international filings?
- Number.
- Share of international filings.
- Share of total filings.

2) How do you use the PCT and for what type of patenting?
- Broad national coverage.
- Protection of markets or manufacturing countries.

3) Why do you use the PCT? What advantages do you see from the PCT?
- Cost savings.
- Convenience of single application.
- Extra time to:
  - Get national filing right.
  - -- Check commercial viability of innovation.
  - -- Postpone costs (e.g., translation, agents, PTO fees).
- Ensure accuracy and correct scheduling of national filing.

- Additional international search and examination, to fine-tune national filings.
- Simpler access to more countries, including developing countries.

4) What other methods do you use for international filings?
   - Direct via Paris convention, "trilateral" services, in-house preparation/search?
   - How do you choose between routes?
   - How do you combine PCT filings with national (US) filings)?

5) When and why did you start using the PCT?
   - What caused you to start using the PCT? (awareness, increased international patenting, critical mass of experience, etc.?)
   - Has your use of the PCT increased or decreased over the past 5-10 years, and why?

6) What problems, weaknesses do you see with the PCT at present?
   - Costs.
   - Complexity.
   - More demanding schedule than national filing.
   - Incompatible with your own systems.

7) How could the PCT be improved?
   - Electronic filing.
   - Longer deferral period.
   - National PTO accepted search/examinations.
   - Simpler fee structure.

## 5-4. Impact of current trends on PCT operations

### 5-4.1 Future trends

Looking towards the future of the PCT, at least three main questions arise. The first is the continued growth of the PCT. Growth rates have been exceptionally high for more than a decade. As it has become a mainstream route for international patenting, the question arises as to how long this growth can be expected to continue. At what point will it slow down to some asymptotic rate related to the overall rate of international patenting generally? There has been a similar, and probably related, rate of growth in the number of members. The PCT now accounts for almost all of the main countries generating innovations and granting patents, and includes most of the developing countries. Is much further growth possible in membership, or perhaps

more pertinently, is there scope for increasing and broadening the participation of the existing membership?

The second is how can the PCT respond to other trends and changes happening in the areas of the international economy, technology, and competition from other patent services. There have been many changes within the past decade in approaches to IP worldwide. These will continue. The PCT needs to be aware of these and how they are likely to affect its position. The PCT may need to think very broadly, to consider very significant changes in its role that could become possible.

The third is more speculative. It is the likely effect on the PCT of increased harmonization of IP. As and when patent rules become more harmonised this may increase the potential for the PCT to extend its services into an increased role in the grant of a patent, such as greater use made nationally of the international search and examination. The legal and institutional barriers to harmonization of national patent practice are clearly very great. Whether this could lead towards a role for the PCT in developing an "international patent" is an open issue. This is mainly an issue for the longer term policy agenda, and some aspects of this are noted in Section 5-7 below. In the context of the immediate trends, harmonization is best seen as one of the factors that the PCT should be aware of as a background to its more immediate responses to current issues, such as technological change and potential competition and cooperation.

### 5-4.2 Growth trends

One of the main immediate concerns for the PCT is how long the current growth in volume and revenues will continue, and whether something needs to be done to prepare for any change in growth rather than have to adjust WIPO's organizational capacity under pressure.

As discussed above in Section 3.5, the strong growth in the use of the PCT has probably been due to a combination of the growing volume of international patenting – triggered by the globalization of markets and by the international harmonization of IP protection – and the growing awareness of the PCT as an "effective means of filing foreign patents". There are really two "catch up" phenomena at work here. The first is the growth in international patenting as a whole, as the world adjusts to TRIPS and innovation-based competition. The second is the growth of the PCT share of international patent applications towards an equilibrium share (i.e., saturation of demand) depending on the various needs of users and where the PCT fits in with these needs.

Thinking of these as separate effects may help understand when and whether PCT usage will plateau. The growth rate will slow as the PCT channel reaches the share of international applications for which users find it useful, from then on growth may not stop but continue at an "asymptotic" rate equal to the overall growth in international patenting as a whole. The date at which this happens may be postponed if other changes to the PCT, such as improved cost/benefit performance, make it more attractive relative to other means of international filing.

In terms of members, the PCT now accounts for most of the major countries involved in patenting. Some of the ASEAN countries have yet to join, but as they are currently not major generators of IP, their effect on the volume of PCT applications would be limited. The main question for the PCT seems to be how increased patenting activity by the members it already has may affect the PCT, and how the PCT might work to increase the role of the PCT and the benefits it may provide for these members. Thus the PCT may be used more intensively as a mean of applying for national patents by foreigners in a country such as China, rather than filing directly. The effect of such an increase is similar to the overall question of PCT growth, i.e., the combination of the share of filings made through the PCT, and the overall increase in the volume of national applications by non-residents. There may be an initial relatively high growth rate, as channels are opened, followed by slower "asymptotic" growth.

Needless to say, collecting the information to make these analyses may be difficult, especially as it relies on data from national PTOs and users, beyond that typically available to WIPO and the PCT. However, to understand its market the PCT will need such information.

### 5-4.3 Impact of technological change

One of the main impacts that the PCT is likely to feel within the next few years is that due to the widespread introduction of electronic technology for filing and processing patent applications. This affects the PCT itself, which has already introduced electronic filing with the PCT-EASY system and has gone far to eliminate paper in its publications of applications and statistical reporting. This will also affect the national and regional PTOs, many of whom already accept electronic filing and in some cases, such as the Japanese PTO, are almost completely converted to its use. As more of the patent information is stored electronically worldwide this also extends the possibilities for automating many of the other processes in the patent system, such as searches, record keeping, data analysis, and others.

A direct effect of this technology will be to dramatically lower the costs of processing applications, including receiving applications, checking applications for formal errors, publication, handling of examination demands costs, and various statistical and operations reporting involved in the PCT. The PCT seems to have taken the rational view that such change is highly desirable, and indeed inevitable, and is taking a pro-active stance in introducing these systems into its operations.

There are several consequences of these changes which will have deep impact on the PCT in future. One is that once such systems are in wide use – which means not just by the PCT itself but also that users have begun to submit their applications electronically and accept electronic reports, and to integrate it with their own systems – they should greatly increase the capacity of PCT operations and make an increase in volume less of a problem. Automated systems are more able to handle increased activity without appreciably changing the scale of operation.

Another effect is that if costs are seen to come down as fast as appears possible, this is likely to lead to pressure to reduce fees. The pressure would be effective through the members, who in turn are intent to provide a cost effective service to the users. It would also be effective from the users directly, especially if there are competing services, also electronically based, that are able to provide some or all of the services of the PCT at a lower price.

The advent of further technological change in the patent process may also be a factor in increased competition from other commercial and national systems that may seek to duplicate some of the PCT functions. This is discussed below.

The PCT is aware of these issues, and has already taken steps to reduce fees where these are based on lower costs. The designation fees are likely to be reduced, on the basis that publication costs of applications, including the copies to the designated national offices, are much lower when they are distributed electronically, as is now the norm.

The likely effect of lower costs and lower prices on PCT revenues is not clear. Lower prices may attract more users to the PCT. With electronic systems the PCT should be able to increase volume without increasing cost or its levels of operation, or suffering bottlenecks due to insufficient capacity. The flexibility to offer new services, or improving existing services, might also attract a wider range of users. The net effect of lower costs and prices versus potentially higher volumes will depend on the elasticity of demand for PCT services, i.e., comparing the possible effects on market expansion with lower costs and improved service versus the effect of lower revenue per use.

### 5-4.4 Increased competition

A possible related consequence of technological change may be the increased competition from other services. Electronic systems are in themselves typically quite easy to duplicate. If that is the case here then it should be possible for a competing service to offer an equivalent service that checks the formal application to conform with national requirements, schedules the application, and provides the required publications and reports. Many large private firms essentially do this already with their own in-house systems.

Such a service might not have all the advantages of the PCT, in that it might be unlikely to be able to apply the terms of the PCT treaty, including the extension of the filing date and the acceptance of PCT applications and dates for the purpose of national filing. The PCT Union was created to administer the PCT, and it is not clear whether the terms of the Treaty can be applied to any other organization. However, for many aspects of the application, a competing service might be very attractive, especially if it is low cost.

However, in some circumstances electronic systems can themselves become a source of competitive advantage. For example, this may occur if a system is widely adopted by users who then face switching costs if they were to change to another system, or if the system offers distinct advantages compared with other systems. (Airline reservation systems are an example where a widely adopted system has become a source of strategic advantage; hospital management systems are another example.) The effect often depends on what are called "network effects", based on factors such as the level of integration with the user's own systems, or the costs of retraining to use an unfamiliar system, or complementary investments made by the user in this system. These issues have been studied extensively in the standards literature in economics (summarised in Grindley, 1995, and others).

In such circumstances, the introduction of systems by the PCT might help its competitive position rather than weaken it.

Independent of the technology aspects, potential competition to the PCT for handling international applications has long been in existence from regional offices such as the EPO and national PTOs, many of whom offer the capability to handle international patent applications. Cooperation between PTOs, such as the trilateral cooperation between the US PTO, EPO, and JPTO, may add to the value of services offered in this way. However, so far it seems that the specific advantages of the PCT, such as the extension of filing, have been important, and PCT use has continued to grow.

This should not be seen as competition in the usual market sense. The PCT and the national/regional offices typically work in close cooperation, as they must for the patent system to be successful. The PTOs and the PCT are each likely to benefit from a more efficient application procedure. This may be more a question of rivalry between different routes to a common goal.

### 5-4.5 Harmonization

In the longer term the PCT may want to consider the implications of increasing harmonization of intellectual property policies and what role there might be for the PCT.

This is a large area unto itself, and cannot be adequately discussed here. Some policy concerns are noted below, in Section 5-7. In the intermediate term, harmonization is one of the issues that the PCT may want to have in mind when considering its more immediate policies. There could be a role for the PCT as the embodiment of more unified rules, and by making the introduction of harmonization simpler. The PCT could become part of the mechanism for enabling more uniform patenting, and as such may want to develop its operations in a way that is at least compatible with this objective.

There are many potential benefits to the PCT from harmonization in terms of the efficiency of the patent process. It could lead to more effective sharing of responsibilities between the PCT and the PTOs, reduce duplication in the search and examination processes, and generally speed up the patenting process.

However, at the level of operational detail, the PCT would face major challenges in trying to reconcile quite different characteristics of patents in countries with very different legal and institutional bases for their patent processes.

## 5-5. Macro-economic effects

### 5-5.1 Impact of world macro-economic trends and financial shocks

It seems plausible that as the PCT matures (in the sense of capturing a share of international patent filings), that current and future trends in world economy will have more impact upon the level of filings under the PCT in line with the patenting and innovation strategies of firms.

The patenting and innovation behaviour of firms in recessions is difficult to predict from a theoretical viewpoint. Decreased economic activity may cause firms to tighten their belts and try to save cash by postponing or reducing their patenting costs. However, firms are traditionally reluctant to cut R&D, on which their long term future depends. Moreover, patenting decisions are made about whether to protect past R&D and innovations, thus any effects might exhibit long lags. Paradoxically, the PCT could benefit, in a recession, in that firms may be more ready to postpone filing costs by using the extended priority period possible through the PCT.

Similarly, firms are often more ready to consider reviewing their existing patent portfolio with a view to cutting maintenance costs for non-performing patents when under earnings pressure, rather than cut protection on their new and future products. This is the route that many major patent holders, say in the chemical industry, have pursued in recent years, largely during the past 5-10 years. Thus, as a general matter, we would expect that patent filings might not be very sensitive to cyclical factors, unless changes in business conditions are exceptionally dramatic or prolonged.

### 5-5.2 Empirical analysis of Asian and Emerging Markets Financial Crisis

*a) General concerns*

The recent Asian financial crisis is a main case in point. From a firm strategy viewpoint, as is discussed immediately above, it is not clear what the short term effects might be (lower/higher application rates, efficiency pressure [more use of PCT], attention to renewals?). It is evident that PCT filings grew strongly in 1998, so there is little evidence to support concerns that the financial crisis will have major short term implications for PCT filings. It is also true that from the viewpoint of the PCT, the crisis may be hard to detect at this point since the countries most

affected by the crisis are often either not members of the PCT or were negligible users of PCT before the crisis.

*Emerging Markets*

There is no evidence that the economic crisis in Asia and Emerging Markets has had significant affects on PCT filings as yet. This is not surprising since the origins of PCT filings are the high-income industrial countries, which apart from the special case of Japan, have continued to experience steady economic growth. The only emerging markets which had significant PCT filings in 1997 and in 1998 are Korea, Russia and China and together they account for less than 2.0 per cent of PCT filings. Among these only Russia saw its share of PCT filings decline in 1998 as compared with 1997, while in the case of both Korea and China, their share of PCT filings increased significantly in 1998.

All emerging markets taken as a group account for less than 3.0 per cent of PCT filings. Of course some of the original crisis economies in Asia, such as Malaysia, the Philippines, and Thailand are not members of the PCT, so firms in these countries are much less likely to use the PCT, (a few large firms in these economies might file through subsidiaries) and the use of the PCT by other countries is not likely to be significantly affected by developments in these markets.

Nonetheless, the issue of contagion, or the spread of Asian financial crisis to other emerging markets could have implications for the PCT. Although Brazil and other Latin American countries have experienced serious pressures in financial markets and are experiencing painful economic adjustments, so far they have avoided the real crisis scenario or financial meltdown as happened in Russia. Since one of the attractions of the PCT is the opportunity to designate many national patent authorities,

Of course, if the Emerging Markets financial crisis spreads to the major OECD economies then the implications could be quite different. A major and prolonged recession in North American and/or Europe could have significant implications for PCT filings in the future. Of course, as was noted at the outset, these macroeconomic factors likely would influence PCT filings with a lag.

*Japan*

Although it is not an emerging market, the case of Japan warrants special consideration. Japan has experienced weak economic activity for much of the 1990s with a serious recession in 1998 and no growth or further declines forecast for 1999. As the third largest country source of PCT filings, 9.1 per cent of total filings in 1998, the depressed levels of economic activity in Japan could have significant implications for filings under the PCT. Japan had a contraction of GDP of about 3 per cent in 1998 and the projections of the IMF, the OECD and others suggest a further contraction of output of about 1 per cent in 1999. The continued weakness of the Japanese economy has been a source of concern to policymakers in Japan and in other countries.

Although economic activity in Japan is extremely weak, PCT filings in Japan have been growing extremely fast, and Japan's share of total PCT filings increased from 8.9 per cent in 1997 to 9.1

per cent in 1998. Thus PCT filings have increased faster in Japan than the overall rapid increase in PCT filings in 1998. One explanation of this somewhat surprising result is that Japanese firms still tend to file a much larger proportion of their international patent filings directly at the national level under the Paris Convention instead of using the PCT (when Japan is compared with either the United States or individual European economies such as Germany). Thus Japan still seems to be in a "catch-up" mode as more Japanese firms and patent attorneys are becoming aware of the potential advantages of filing through the PCT. Indeed, since anecdotal evidence suggests that Japanese firms in the past were reluctant to use the PCT because they did not wish to take advantage of the additional priority period or the opportunity to designate more national patent authorities, the impact of the prolonged recession may in the short run, at least, increase the interest of Japanese firms in using the PCT.

However, Japanese firms that do use the PCT tend to make very few designation in comparison with PCT filings in other countries. This might reflect some reluctance to take advantage of the longer priority period to resolve technological and market uncertainties about which patents to file in which some markets, or like some of the US MNEs we contacted, it may reflect the fact that these firms perceive these uncertainties to be modest in significance and they usually know which patents they wish to file in which markets. An additional factor for Japanese PCT filings is that Japanese firms have significant trade and investment links with countries in Southeast Asia who are not members of the PCT.

*b) Empirical study*

The preliminary statistical analysis undertaken in this study finds that macroeconomic factors have only limited explanatory power for PCT filings and that structural and microeconomic factors seem to be more significant in explaining international patenting behaviour. Models that have good explanatory power for patent filings at the national level have poor explanatory power with the PCT filings. This could reflect the "catch-up" factor, but we cannot be confident that this is the only factor. More detailed analysis is required to examine these factors more carefully.

### 5-6. Policy concerns – developing countries and the PCT

One of the major policy concerns for the PCT is the role of the developing countries. This includes the questions of membership, usage by developing countries, and usage by other countries, industrialized countries, of the PCT as an avenue to obtain patents in the developing countries. Also what effects, albeit indirect, may membership of the PCT have on the economies of these countries. Although many PCT filings designate many countries, relatively few proceed to national filings in many PCT members.

Among the issues that need to be examined are:

a) What are the benefits to developing countries from membership in the PCT (eg image with investors, inward investment, increased trade, and incentives for R&D?)

b) To what extent does the value of the PCT value derive from broader membership?

c) What are the ways to increase value to DCs from participation in the PCT apart from the present fee reductions? Could the international search and examination procedure be strengthened in a manner which will allow more countries to use the PCT search and examination reports as a basis for their own patent examination while preserving their sovereignty in the granting of patents?

d) Can WIPO and the PCT assist the development of these national patent systems?

Many developing countries face serious challenges in developing their national patent systems. Patent examination requires a large number of staff with extensive technological knowledge in many different areas of technology. If better use could be made of the international search and examination process, this would reduce the demands for scarce human captital in many developing countries. Also an enhanced role for the international search and examination could give the individual national systems greater credibility with foreign investors and could also provide benefits to nationals seeking patents at the national level.

## 5-7. Long term policy influences  harmonization

### 5-7.1 Effect of harmonization on the PCT

There is obviously a large and complex agenda for further efforts to harmonize the substantive and procedural elements of patent systems. While this study cannot address these issues, standardization of PCT application procedures may be seen as first step in supporting harmonization and moving towards (more) unified patents.

Of course, efforts for harmonization, face huge barriers to the establishment of global patents due to the very different national legal and institutional environments. These are embodied in quite different characteristics of patents among countries once one delves into the details.

There are many potential benefits from incremental harmonization in terms of the efficiency of the patent process. It could lead to more effective sharing of responsibilities between the PCT and the PTOs, reduce duplication in the search and examination processes, and generally speed up, and reduce the uncertainties of the patenting process.

### 5-7.2 Possible role for the PCT in harmonization

There could be a role for the PCT in the harmonization process, mainly by providing operational support to make the introduction of harmonization simpler. The PCT system could act as the vehicle for defining more harmonized patents. As a possible conduit for international patent filing the PCT might be able to influence harmonization, via its influence on filing rates, IP protection costs, procedural simplification, and other aspects.

### 5-8 Directions for further study

The overall aims of this study are essentially to understand more about how the PCT is being used and what the PCT can do to pursue its policy objectives more effectively. This includes an analysis of who is using the PCT and why, what trends the PCT should be prepared for, and what it can do to ensure it continues to be successful. What are the potential effects of the financial crisis in Asia and emerging markets? From a policy viewpoint, how can the PCT ensure it is more relevant to the needs of the developing countries and contributes to their economic growth? The aim is not just "commercial" success but also to improve the effectiveness of international patenting for the general welfare.

The purpose of this initial study was to survey existing studies and research on these questions, to undertake some preliminary analysis on the basis of data available from the PCT or other sources, and to undertake some interviews of IP managers in Multinational Enterprises and patent attorneys.

In this respect the current report should be seen as an indicator of areas that need to be pursued in more depth. One area of future work which seems absolutely necessary as a first step to this understanding is a more complete analysis of the data on PCT use, in the context of international patenting as a whole. Some initial indications of the characteristics of the users of the PCT gathered from the available data have been examined. This analysis should be pursued to give more definite results, based on detailed data from the PCT and other private and public sources. Analysis of the characteristics and importance of different user groups, and national groups, and the trends in use by such groups within the overall growth rate, should help understand the structure of demand for PCT services.

A further crucial area of further work is a survey of users and potential users of the PCT to understand the factors affecting their use or non-use of the PCT. The limited inputs from users that was possible in this current study has shown the variety of issues that are considered important. This survey needs to be undertaken on a systematic basis covering as large a sample as possible. This should include the views of those users with whom the PCT does not normally come into contact, i.e., major participants in international patenting but who do not use the PCT. The survey should probably combine a formal questionnaire survey, aimed to quantify the main influences, with a number of in depth interviews to identify specific issues and obtain detailed views. This would lead on from the current study, as the basis for the design of the survey and detailed qualitative and quantitative analysis in an extended study.

From our interviews of IP managers in major multinational enterprises it is evident that there are significant differences among MNE"s in their perception of the utility of the PCT and in their use of the PCT. Further analysis of these issues through interviews, survey research and quantitative analysis is a priority.

Other areas where empirical analysis should be helpful to the PCT include an analysis of the sensitivity of demand to fee levels. This has been included in the macro study, as a control variable. More analysis at the micro level should help identify the current relationship between

fee structures and demand, and the possible impact of changes in this structure. Since the use of the PCT does seem to be sensitive to fee levels, and since PCT fees are an important source of revenues for WIPO, more analysis of the potential effects of fee changes on the utilization of the PCT seems warranted.

In addition, there is a particular need to understand more about how the developing countries can be involved to a greater extent in international patenting, first as recipients of patent applications and hopefully also as the generators of patentable innovations. An understanding of the decision processes for international firms investing and otherwise participating in developing countries economies, and how these are influenced by IP protection, would be an important component of this. This should also be the result of the combination of data analysis and direct survey, possibly including potential investors, trade officials, and PTO representatives.

A main component of this would be further quantitative analysis aimed at understanding the impact of the macroeconomic variables on PCT use. So the initial effects of the Asian crisis on the PCT use have been minimal. The broad (macro) statistical analysis can be extended by (i) updating the data: we will incorporate the 1997/1998 figures on international patent filings and costs sent to us (or to be sent to us) by the contacts we made at WIPO. In addition, we are also updating supplementary data like percapita GDP and the patent rights index, and constructing a 'crisis' index measuring the uncertainty of the global market: this measure is used in the literature to study balance of payments crises, such as those that led to the Asian financial crisis.

The statistical analysis can also be extended, as mentioned in Chapter 4 of our report, by (i) disaggregating the international patent filing data by technology or industry (e.g. pharmaceuticals, chemicals, machinery, consumer goods, and so forth). The proposed micro-survey of PCT users (and non-users) can itself be the subject of statistical analysis. From the survey responses, various microeconometric techniques (for example, logit, censored regression) can be used to link the behaviour of firms to the "characteristics" of firms as well as the macroeconomic conditions under which they operate (for example, market size, industry conditions, strength of the patent regime, patent filing costs).

As we have stressed in the interim report thus far, the "strategic" responses of firms should be a major focus; that is, firms (or the potential users) must be the unit of analysis. Hence a micro-statistical analysis would shed great light on why firms choose to patent internationally, and if so, why they choose (or not choose) the PCT route in particular, and how their international patenting strategies would be affected by changing global market uncertainties. Indeed, the results in our macro-statistical analysis have shown that the PCT is a special case. The conventional statistical model (of the demand for patenting) explains national filings well, but not PCT filings. There is much variation in the data that is not explained with macroeconomic variables (like market size or the strength of the patent regime).

A microeconometric (or micro-statistical) survey and analysis of international patenting will be the FIRST of its kind. As our literature review has shown, most studies and surveys have been conducted using US data or have focussed on the perspectives of US firms. The three widely cited surveys of firms' patenting behaviour, while tremendously meticulous, informative, and insightful, completely ignore the international patenting

dimension.[45] This is a serious omission in light of the trends in global patenting that we have observed.

This project thus fills a large gap not just in the research literature, but also in policy formation and debate, as there is no empirical foundation upon which to explain international patenting behaviour. Why has the ratio of international filings to national filings increased since the early 1980s? What lies behind firms' decisions to patent abroad? Having chosen to patent abroad, how do they decide which method of international filing to take? Thus far, researchers either have anecdotal evidence about international patenting or use the results of US surveys (such as those cited above) to extrapolate the behaviour of firms in other regions. In light of differences in laws, market structure, policy, customs, and levels of economic development, this does not always prove to be wise.

Another extension of our research is to investigate the consequences of increased international patenting activity, particularly as they relate to developing countries. That is, we can turn our main research question around and ask not only what are the causes of international patenting, but what have been the "effects"? Has increased global patenting improved firms' performance? If so, which type of firms or industries benefited? What have been the effects of global patenting activities on national productivity growth, on international trade, and on the diffusion of knowledge and technology? Have there been increased spillovers of knowledge and technology transfers, and if so, to what extent have they reached developing and emerging markets? To what extent have the benefits (or costs of) international patenting and innovation gone beyond firms to affecting global standards of living, product variety, and level of science and engineering education and achievement. Understanding the effects of international patenting would better help developing nation governments form policy decisions (concerning, for example, joining the PCT and/or
strengthening patent rights).

### 5-9. Summary and conclusions

[45] See, for example, Levin et. al. (1987), Mansfield (1994) "Intellectual Property Protection, Foreign Direct Investment, and Technology Transfer" World Bank Discussion Paper No. 19, and Cohen, W., Nelson, R., and Walsh, J. (1997) "Why Firms Patent in US Manufacturing"

The PCT has been remarkably successful in achieving the goals set out for it in the 1970s. After some initial hesitation by users and some necessary streamlining of operations in the early years the use of the PCT for international filings expanded rapidly after the late 1980s, and growth has continued very strongly since then.

One effort currently underway is the strategic review of the role of PCT in future, to ensure its continued success, commercially and politically. This effort needs an economic input as well as a legal and operational view.

This initial survey suggests that the PCT has benefited from a virtuous circle of increased awareness of the significance of international IP protection driven by the process of globalization, of more companies and patent attorneys becoming aware of the advantages of the PCT, of substantial changes in the international system supporting the protection of IP across international borders, (such as TRIPS)-- which is another aspect of globalization, and of more countries joining the PCT.

Since the PCT has been in a "catch-up" mode of acquiring a growing share of international patent filings, it seems so far at least to be less sensitive to macroeconomic factors than are national patent filings. This may change to some extent as the PCT matures. Especially in the case of international patent filings by US-based MNEs, the share of PCT filings in international filings has increased to the point where the growth of PCT filings will track more closely overall international patenting activity in the future.

It should be clear that various developments have all reinforced the utility of the PCT to firms seeking to protect IP internationally. At the same time it is important to guard against complacency. It is very important that the PCT be adapted to meet the needs of users on an ongoing basis. The use of the PCT for international patent filings is a matter of corporate strategy and is subject to change as the evolving institutional, legal, economic, and technological environment changes.

As a matter of its own corporate strategy, WIPO needs to have a better understanding of the factors that affect decisions by firms about whether to use the PCT. Much more analysis is required to gain some insights and accumulate some evidence on these factors, but WIPO needs to undertake this task on an ongoing basis. The legal and institutional environment for protection of IP at the national, regional and international level will continue to evolve and the implications for firm strategies of these developments in combination with economic and technological factors need to be examined, and their potential implications for PCT and WIPO need to be assessed on a regular basis. For example, regular surveys of major MNEs, both those who are, and those who are not, users of PCT should be conducted to evaluate these developments.

The PCT has been a successful instrument, but as with all successes in the marketplace, new opportunities to add value in a rapidly changing global marketplace, should not be overlooked. WIPO faces commercial challenges in the marketplace that it must continue to meet, but it also must serve the overall policy objectives of serving the interests of member states and promoting global economic welfare through promoting cooperation in the protection of intellectual property.

Tables

**Table 5-1: PCT International Applications (1978-1998)**

| Year | Applications | Growth % |
|---|---|---|
| 1978 | 459 | |
| 1979 | 2,625 | 471.9% |
| 1980 | 3,539 | 34.8% |
| 1981 | 4,606 | 30.1% |
| 1982 | 4,675 | 1.5% |
| 1983 | 4,971 | 6.3% |
| 1984 | 5,719 | 15.0% |
| 1985 | 7,095 | 24.1% |
| 1986 | 7,652 | 7.9% |
| 1987 | 9,201 | 20.2% |
| 1988 | 11,996 | 30.4% |
| 1989 | 14,874 | 24.0% |
| 1990 | 19,159 | 28.8% |
| 1991 | 22,247 | 16.1% |
| 1992 | 25,917 | 16.5% |
| 1993 | 28,577 | 10.3% |
| 1994 | 34,104 | 19.3% |
| 1995 | 38,906 | 14.1% |
| 1996 | 47,291 | 21.6% |
| 1997 | 54,422 | 15.1% |
| 1998 | 67,007 | 23.1% |

(Source: WIPO (1998), *The Patent Cooperation Treaty in 1998*)

**Table 5-2: Demands for International Preliminary Examination (1985-1998)**

| Year | Applications | Growth % |
|---|---|---|
| 1985 | 444 | |
| 1986 | 831 | 87.2% |
| 1987 | 1,327 | 59.7% |
| 1988 | 3,594 | 170.8% |
| 1989 | 6,548 | 82.2% |
| 1990 | 8,769 | 33.9% |
| 1991 | 13,207 | 50.6% |
| 1992 | 15,051 | 14.0% |
| 1993 | 19,995 | 32.8% |
| 1994 | 23,133 | 15.7% |
| 1995 | 26,894 | 16.3% |
| 1996 | 33,046 | 22.9% |
| 1997 | 40,382 | 22.2% |
| 1998 | 48,193 | 19.3% |

(Source: WIPO (1998), *The Patent Cooperation Treaty in 1998*)

**Table 5-3: PCT International Applications by Country  Top 10 (1998, 1997)**

| | Code | Country | Applications | | % | % | Cumulative % | |
|---|---|---|---|---|---|---|---|---|
| | | | 1998 | 1997 | 1998 | 1997 | 1998 | 1997 |
| 1 | US | USA | 28,356 | 22,736 | 42.3% | 41.8% | 42.3% | 41.8% |
| 2 | DE | Germany | 9,112 | 7,436 | 13.6% | 13.7% | 55.9% | 55.4% |
| 3 | JP | Japan | 6,098 | 4,845 | 9.1% | 8.9% | 65.0% | 64.3% |
| 4 | GB | United Kingdom | 4,383 | 3,939 | 6.5% | 7.2% | 71.6% | 71.6% |
| 5 | FR | France | 3,322 | 2,496 | 5.0% | 4.6% | 76.5% | 76.2% |
| 6 | SE | Sweden | 2,554 | 2,188 | 3.8% | 4.0% | 80.3% | 80.2% |
| 7 | NL | Netherlands | 2,065 | 1,749 | 3.1% | 3.2% | 83.4% | 83.4% |
| 8 | CA | Canada | 1,315 | 1,075 | 2.0% | 2.0% | 85.4% | 85.4% |
| 9 | CH&LI | Switzerland | 1,293 | 1,101 | 1.9% | 2.0% | 87.3% | 87.4% |
| 10 | FI | Finland | 1,092 | 873 | 1.6% | 1.6% | 88.9% | 89.0% |
| | | Other | 7,417 | 5,984 | 11.1% | 11.0% | 100.0% | 100.0% |
| | | Total | 67,007 | 54,422 | 100.0% | 100.0% | | |

(Source: WIPO (1998), *The Patent Cooperation Treaty in 1998*)

**e 5-3a: PCT International Applications by Country  Top 30 (1998, 1997)**

| | | | Applications | | % | | Cumulative % | |
|---|---|---|---|---|---|---|---|---|
| | Code | Country | 1998 | 1997 | 1998 | 1997 | 1998 | 1997 |
| 1 | US | USA | 28,356 | 22,736 | 42.3% | 41.8% | 42.3% | 41.8% |
| 2 | DE | Germany | 9,112 | 7,436 | 13.6% | 13.7% | 55.9% | 55.4% |
| 3 | JP | Japan | 6,098 | 4,845 | 9.1% | 8.9% | 65.0% | 64.3% |
| 4 | GB | United Kingdom | 4,383 | 3,939 | 6.5% | 7.2% | 71.6% | 71.6% |
| 5 | FR | France | 3,322 | 2,496 | 5.0% | 4.6% | 76.5% | 76.2% |
| 6 | SE | Sweden | 2,554 | 2,188 | 3.8% | 4.0% | 80.3% | 80.2% |
| 7 | NL | Netherlands | 2,065 | 1,749 | 3.1% | 3.2% | 83.4% | 83.4% |
| 8 | CA | Canada | 1,315 | 1,075 | 2.0% | 2.0% | 85.4% | 85.4% |
| 9 | CH&LI | Switzerland | 1,293 | 1,101 | 1.9% | 2.0% | 87.3% | 87.4% |
| 10 | FI | Finland | 1,092 | 873 | 1.6% | 1.6% | 88.9% | 89.0% |
| 11 | AU | Australia | 1,048 | 881 | 1.6% | 1.6% | 90.5% | 90.6% |
| 12 | IT | Italy | 925 | 797 | 1.4% | 1.5% | 91.9% | 92.1% |
| 13 | IL | Israel | 672 | 445 | 1.0% | 0.8% | 92.9% | 92.9% |
| 14 | DK | Denmark | 624 | 642 | 0.9% | 1.2% | 93.8% | 94.1% |
| 15 | KR | Republic of Korea | 485 | 304 | 0.7% | 0.6% | 94.5% | 94.6% |
| 16 | RU | Russian Federation | 429 | 419 | 0.6% | 0.8% | 95.2% | 95.4% |
| 17 | BE | Belgium | 428 | 294 | 0.6% | 0.5% | 95.8% | 96.0% |
| 18 | AT | Austria | 421 | 373 | 0.6% | 0.7% | 96.4% | 96.6% |
| 19 | NO | Norway | 394 | 367 | 0.6% | 0.7% | 97.0% | 97.3% |
| 20 | ES | Spain | 378 | 340 | 0.6% | 0.6% | 97.6% | 97.9% |
| 21 | CN | China | 322 | 157 | 0.5% | 0.3% | 98.1% | 98.2% |
| 22 | NZ | New Zealand | 178 | 166 | 0.3% | 0.3% | 98.3% | 98.5% |
| 23 | IE | Ireland | 150 | 115 | 0.2% | 0.2% | 98.6% | 98.7% |
| 24 | SG | Singapore | 127 | 71 | 0.2% | 0.1% | 98.8% | 98.9% |
| 25 | HU | Hungary | 122 | 93 | 0.2% | 0.2% | 98.9% | 99.0% |
| 26 | BR | Brazil | 114 | 91 | 0.2% | 0.2% | 99.1% | 99.2% |
| 27 | LU | Luxembourg | 81 | 48 | 0.1% | 0.1% | 99.2% | 99.3% |
| 28 | MX | Mexico | 67 | 44 | 0.1% | 0.1% | 99.3% | 99.4% |
| 29 | CZ | Czech Republic | 55 | 50 | 0.1% | 0.1% | 99.4% | 99.5% |
| 30 | PL | Poland | 48 | 35 | 0.1% | 0.1% | 99.5% | 99.5% |
| | | Other | 349 | 252 | 0.5% | 0.5% | 100.0% | 100.0% |
| | | Total | 67,007 | 54,422 | 100.0% | 100.0% | | |

**Table 5-4: Application by Language of Filing (1998, 1997)**

| | Applications | | Percentage | |
|---|---|---|---|---|
| | **1998** | **1997** | **1998** | **1997** |
| English | 44,458 | 35,953 | 66.3% | 66.1% |
| German | 10,086 | 8,304 | 15.1% | 15.3% |
| Japanese | 5,689 | 4,521 | 8.5% | 8.3% |
| French | 3,392 | 2,618 | 5.1% | 4.8% |
| Swedish | 899 | 968 | 1.3% | 1.8% |
| Finnish | 523 | 419 | 0.8% | 0.8% |
| Dutch | 476 | 349 | 0.7% | 0.6% |
| Russian | 434 | 404 | 0.6% | 0.7% |
| Spanish | 422 | 370 | 0.6% | 0.7% |
| Norwegian | 236 | 209 | 0.4% | 0.4% |
| Danish | 178 | 173 | 0.3% | 0.3% |
| Chinese | 177 | 134 | 0.3% | 0.2% |
| Other languages | 37 | - | 0.1% | |
| Total | 67,007 | 54,422 | 100.0% | 100.0% |

(Source: WIPO (1998), *The Patent Cooperation Treaty in 1998*)

**Table 5-5: Applications to International Searching Authorities (ISAs) (1998, 1997)**

| ISA | Applications | | Percentage | |
|---|---|---|---|---|
| | **1998** | **1997** | **1998** | **1997** |
| EPO | 39,136 | 30,604 | 58.4% | 56.2% |
| USA | 14,597 | 12,717 | 21.8% | 23.4% |
| Japan | 5,690 | 4,522 | 8.5% | 8.3% |
| Sweden | 4,702 | 4,341 | 7.0% | 8.0% |
| Australia | 1,209 | 1,003 | 1.8% | 1.8% |
| Austria | 591 | 363 | 0.9% | 0.7% |
| Russian Federation | 433 | 410 | 0.6% | 0.8% |
| Spain | 329 | 305 | 0.5% | 0.6% |
| China | 320 | 157 | 0.5% | 0.3% |
| Total | 67,007 | 54,422 | 100.0% | 100.0% |

(Source: WIPO (1998), *The Patent Cooperation Treaty in 1998*)

**Table 5-6: Demands from International Preliminary Examining Authorities (IPEAs) (1998, 1997)**

| | **Demands** | | **Percentage** | |
|---|---|---|---|---|
| **IPEA** | **1998** | **1997** | **1998** | **1997** |
| EPO | 26,592 | 22,103 | 55.2% | 54.7% |
| USA | 14,130 | 12,412 | 29.3% | 30.7% |
| Sweden | 3,088 | 2,447 | 6.4% | 6.1% |
| Japan | 2,776 | 2,046 | 5.8% | 5.1% |
| Australia | 1,009 | 896 | 2.1% | 2.2% |
| Russian Federation | 259 | 183 | 0.5% | 0.5% |
| Austria | 219 | 173 | 0.5% | 0.4% |
| China | 120 | 122 | 0.2% | 0.3% |
| Total | 48,193 | 40,382 | 100.0% | 100.0% |

(Source: WIPO (1998), *The Patent Cooperation Treaty in 1998*)

**Table 5-7: Most Frequent PCT Users -- Top 50 Firms (applications published) (1997)**

| Rank | Applicant | No. published |
|---|---|---|
| 1 | Siemens Aktiengesellschaft (DE) | 841 |
| 2 | Philips (NL) | 760 |
| 3 | Procter & Gamble Company (US) | 684 |
| 4 | 3M Company (US) | 525 |
| 5 | BASF Aktiengesellschaft (DE) | 431 |
| 6 | Robert Bosch GmbH (DE) | 412 |
| 7 | Motorola Inc. (US) | 366 |
| 8 | Telefonaktiebolaget LM Ericsson (SE) | 342 |
| 9 | E.I. Du Pont de Nemours and Company (US) | 314 |
| 10 | Matsushita Electric Industrial Co., Ltd. (JP) | 236 |
| 11 | Novartis AG (CH) | 218 |
| 12 | Bayer Aktiengesellschaft (DE) | 216 |
| 13 | Hitachi, Ltd. (JP) | 204 |
| 14 | The Regents of the University of California (US) | 203 |
| 15 | Henkel Kommanditgesellschaft auf Aktien (DE) | 200 |
| 16 | Advanced Micro Devices, Inc. (US) | 198 |
| 17 | Merck & Co., Inc. (US) | 190 |
| 18 | Unilever (GB and/or NL) | 169 |
| 19 | The Whitaker Corp. (US) | 163 |
| 20 | Ericsson Inc. (US) | 161 |
| 21 | Novo Nordisk A/S (DK) | 157 |
| 22 | Kimberly-Clark Worldwide, Inc. (US) | 147 |
| 23 | Nokia Telecommunications Oy (FI) | 143 |
| 24 | Eli Lilly and Company (US) | 142 |
| 25 | SmithKline Beecham Corp. (US) | 141 |
| 26 | SmithKline Beecham plc (GB) | 140 |
| 27 | Alliedsignal Inc. (US) | 139 |
| 28 | Intel Corp.(US) | 139 |
| 29 | The Dow Chemical Company (US) | 135 |
| 30 | Zeneca Limited (GB) | 129 |
| 31 | Komatsu Ltd. (JP) | 126 |
| 32 | Fraunhofer-Gesellschaft zur FdaF.e.V. (DE) | 114 |
| 33 | British Telecommunications Plc (GB) | 113 |
| 34 | Exxon Chemical Patents Inc. (US) | 112 |
| 35 | Medtronic, Inc. (US) | 112 |
| 36 | Abbott Laboratories (US) | 111 |
| 37 | ITT Automotive Europe GmbH (DE) | 108 |
| 38 | DSM N.V. (NL) | 104 |
| 39 | Sony Corp.(JP) | 102 |
| 40 | Seiko Epson Corp. (JP) | 100 |
| 41 | Shell Internationale Research Mj B.V. (NL) | 100 |
| 42 | MCI Communications Corp. (US) | 99 |
| 43 | IBM Corp. (US) | 93 |
| 44 | Rhône-Poulenc Chimie (FR) | 93 |
| 45 | Eastman Chemical Company (US) | 91 |
| 46 | L'Oréal (FR) | 91 |
| 47 | Akzo Nobel N.V. (NL) | 90 |
| 48 | Tetra Laval Holdings & Finance S.A. (CH) | 88 |
| 49 | Henkel Corp. (US) | 86 |

| | | |
|---|---|---|
| 50 | Northern Telecom Limited (CA) | 83 |
| | Total for Top 50 | 10,261 |
| | Total applications published (1997) | 50,282 |
| | % Top 50 of total applications published (1997) | 20.4% |

**e 5-8: PCT Contracting States and Two-Letter Codes (March 1999)**

| | Code | Contracting State | Region | Original Member |
|---|---|---|---|---|
| 1 | *AE* | United Arab Emirates | | |
| 2 | AL | Albania | | |
| 3 | AM | Armenia | (EA) | |
| 4 | AT | Austria | (EP) | |
| 5 | AU | Australia | | |
| 6 | AZ | Azerbaijan | (EA) | |
| 7 | BA | Bosnia and Herzegovina | | |
| 8 | BB | Barbados | | |
| 9 | BE | Belgium | (EP) | |
| 10 | BF | Burkina Faso | (OA) | |
| 11 | BG | Bulgaria | | |
| 12 | BJ | Benin | (OA) | |
| 13 | BR | Brazil | | ** |
| 14 | BY | Belarus | (EA) | |
| 15 | CA | Canada | | |
| 16 | CF | Central African Republic | (OA) | ** |
| 17 | CG | Congo | (OA) | ** |
| 18 | CH | Switzerland | (EP) | ** |
| 19 | CI | Côte d'Ivoire | (OA) | |
| 20 | CM | Cameroon | (OA) | ** |
| 21 | CN | China | | |
| 22 | CU | Cuba | | |
| 23 | CY | Cyprus | (EP) | |
| 24 | CZ | Czech Republic | | |
| 25 | DE | Germany | (EP) | ** |
| 26 | DK | Denmark | (EP) | |
| 27 | EE | Estonia | | |
| 28 | ES | Spain | (EP) | |
| 29 | FI | Finland | (EP) | |
| 30 | FR | France | (EP) | ** |
| 31 | GA | Gabon | (OA) | ** |
| 32 | GB | United Kingdom | (EP) | ** |
| 33 | GD | Grenada | | |
| 34 | GE | Georgia | | |
| 35 | GH | Ghana | (AP) | |
| 36 | GM | Gambia | (AP) | |
| 37 | GN | Guinea | (OA) | |
| 38 | GR | Greece | (EP) | |
| 39 | GW | Guinea-Bissau | (OA) | |
| 40 | HR | Croatia | | |
| 41 | HU | Hungary | | |
| 42 | ID | Indonesia | | |
| 43 | IE | Ireland | (EP) | |
| 44 | IL | Israel | | |
| 45 | IN | India | | |

| | | | |
|---|---|---|---|
| 46 IS | Iceland | | |
| 47 IT | Italy | (EP) | |
| 48 JP | Japan | | |
| 49 KE | Kenya | (AP) | |
| 50 KG | Kyrgyzstan | (EA) | |
| 51 KP | Democratic People's Republic of Korea | | |
| 52 KR | Republic of Korea | | |
| 53 KZ | Kazakhstan | (EA) | |
| 54 LC | Saint Lucia | | |
| 55 LI | Liechtenstein | (EP) | |
| 56 LK | Sri Lanka | | |
| 57 LR | Liberia | | |
| 58 LS | Lesotho | (AP) | |
| 59 LT | Lithuania | | |
| 60 LU | Luxembourg | (EP) | ** |
| 61 LV | Latvia | | |
| 62 MC | Monaco | (EP) | |
| 63 MD | Republic of Moldova | (EA) | |
| 64 MG | Madagascar | | ** |
| 65 MK | former Yugoslav Republic of Macedonia | | |
| 66 ML | Mali | (OA) | |
| 67 MN | Mongolia | | |
| 68 MR | Mauritania | (OA) | |
| 69 MW | Malawi | (AP) | ** |
| 70 MX | Mexico | | |
| 71 NE | Niger | (OA) | |
| 72 NL | Netherlands (EP) | | |
| 73 NO | Norway | | |
| 74 NZ | New Zealand | | |
| 75 PL | Poland | | |
| 76 PT | Portugal | (EP) | |
| 77 RO | Romania | | |
| 78 RU | Russian Federation | (EA) | ** |
| 79 SD | Sudan | (AP) | |
| 80 SE | Sweden | (EP) | ** |
| 81 SG | Singapore | | |
| 82 SI | Slovenia | | |
| 83 SK | Slovakia | | |
| 84 SL | Sierra Leone | | |
| 85 SN | Senegal | (OA) | ** |
| 86 SZ | Swaziland | (AP) | ** |
| 87 TD | Chad | (OA) | |
| 88 TG | Togo | (OA) | ** |
| 89 TJ | Tajikistan | (EA) | |
| 90 TM | Turkmenistan | (EA) | |
| 91 TR | Turkey | | |
| 92 TT | Trinidad and Tobago | | |
| 93 UA | Ukraine | | |
| 94 UG | Uganda | (AP) | |

| | | | |
|---|---|---|---|
| 95 US | USA | | ** |
| 96 UZ | Uzbekistan | | |
| 97 VN | Viet Nam | | |
| 98 YU | Yugoslavia | | |
| 99 *ZA* | South Africa | | |
| 100 ZW | Zimbabwe | (AP) | |

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