Patents, Innovation and Economic Performance

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Patents, Innovation and Economic Performance



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FOREWORD

This publication presents a collection of papers prepared for the OECD Conference on Intellectual Property Rights (IPR), Innovation and Economic Performance held in Paris on 28-29 August 2003, organised by the OECD Directorate for Science, Technology and Industry under the aegis of the Committee for Science and Technology Policy (CSTP). The conference brought together economists, legal experts, patent office officials, policymakers, business executives and other interested parties.

CSTP work to date has tackled various aspects of intellectual property rights and patent policy, notably biotechnology and public research organisations. It has resulted in several conferences and publications: *Genetic Inventions, IPR and Licensing Practices* (OECD, 2002) and *Turning Science into Business: Patenting and Licensing at Public Research Organisations* (OECD, 2003). The August 2003 conference was also part of this work and addressed the broader issue of the relationship of the economy and innovation with the patent system. Although there is ample evidence of the greater importance of patents in patterns of innovation and economic growth, and although the patent system has experienced in-depth changes over the past years, to date there has been little systematic evaluation to better inform policy choices. It is the aim of the CSTP project to contribute to such evaluation.

This publication is organised in five parts, which broadly correspond to the thematic sessions of the conference:

- Patents and economic performance: establishing the links.
- Changes in patent regimes.
- Patents, entrepreneurship and diffusion of technology.
- IPR for software and services.
- Current and future policy challenges.

These proceedings were prepared by Catalina Martinez, Jerry Sheehan and Dominique Guellec, with the editorial assistance of Joseph Loux. They are published on the responsibility of the Secretary-General of the OECD.

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EXECUTIVE SUMMARY

Patented inventions are increasingly present throughout the economy and their influence on innovation and economic performance is pervasive. Over the past two decades, the number of patent applications filed each year in major patent offices has grown at a rapid pace, especially in new areas such as information and communications technologies (ICT) and biotechnology. Increased inventiveness and growing investment in research explain part of the growth in patenting, but changes in patent regimes that have expanded the realm of patent protection and strengthened rights of patent holders, together with a more strategic behaviour of patentees, have also played a role. Ensuring that the patent system continues to serve its dual role of providing incentives to invention and facilitating diffusion of technology in this new environment will require increased vigilance by policy makers and robust empirical evidence for measuring the effects of patents on innovation and economic performance.

Ministers in charge of science and technology policy from all OECD countries concluded at the January 2004 meeting of the OECD Committee for Scientific and Technological Policy at Ministerial level that *"patent regimes play an increasingly complex role in encouraging innovation, diffusing scientific and technical knowledge, and enhancing market entry and firm creation. As such, they should be subject to closer scrutiny by science, technology and innovation policy makers."*[1]

The OECD Conference on Intellectual Property Rights (IPR), Innovation and Economic Performance, held in Paris on 28-29 August 2003, foreshadowed this need by providing policy makers with factual evidence and analysis that shed light on the policy debate about patents and by setting out implications for the development of IPR regimes that contribute more efficiently to innovation and economic performance. Organised at the initiative of the OECD Directorate of Science, Technology and Industry, as part of a broader project on IPR, the conference was designed as a forum for discussion among researchers, stakeholders and policy makers. A number of policy-oriented empirical studies undertaken by economists and legal experts, in most part especially prepared for the project, were presented and discussed at the conference. Results and conclusions from those studies were tested against the views of policy makers and practitioners from the business community and patent offices. Discussions were organised around a number of themes, including the link between patents and economic performance, recent changes in patent regimes, the impact of patents on entrepreneurship and technology diffusion, and the protection of intellectual property in software and services.

The presentations and discussions led to the conclusion that the strengthening and extension of the patent system correspond to broader changes in the economy, notably the transition to increasingly global knowledge-based economies characterised by growing innovation and heightened dependence on intellectual assets as a key source of economic value and competitive advantage. Broad generalisations about the effects of patenting on innovation and economic performance are difficult to make, as the effectiveness of patents seems to vary considerably by industry sector and technological field. For example, whereas most participants agreed that patents provide incentives to innovate in the pharmaceuticals sector, opinions were divided as regards software. Nevertheless, discussions reflected that the expansion of patent protection has certainly influenced industrial structure by, for example, facili-

1. Final Ministerial communiqué available at *www.oecd.org/sti/innovation*

tating the breakdown of vertically integrated industries (*e.g.* semiconductors and pharmaceuticals) and creating opportunities for small firms that by virtue of their intellectual property can attract capital and integrate themselves into global value chains (*e.g.* biotechnology). At the same time, participants identified several areas for which additional attention is needed in order to ensure that patents continue to both protect inventions and encourage disclosure: *1)* enhancing the diffusion of patented technology; *2)* ensuring thorough examination and high-quality of issued patents; and *3)* improving international co-ordination.

Participants raised concerns about the possible effects of patenting on diffusion of knowledge and on access to patented knowledge for follow-on research, especially in new technological fields. Two main areas of interest were identified regarding policy directions to improve the diffusion of knowledge and follow-on innovation:

- *Exemptions for research use of patented inventions.* Participants indicated a need for better monitoring the evolution of exceptions for research use of patented inventions. Research exemptions allow research institutions, such as universities, to use freely patented research results from other institutions when the purpose is non-commercial. Recent court decisions in the United States have narrowed the scope of application of the exception and the definition and status of research exemptions in other regions is heterogeneous and sometimes uncertain.

- *Markets for technology*, notably patent licensing agreements, play an increasingly important role in the economy, especially as innovation becomes more co-operative. They contribute to the diffusion of technology in an era characterised by greater patent protection and favour the creation of science-based SMEs. On the basis of improved understanding of such markets, governments might consider policy measures to remove obstacles to their development.

Key to an effective patent system is ensuring the quality of patents. Low-quality patents include those that are overly broad, or for which inventiveness is weak. Such patents contribute to congestion in the patent system and give patent holders more protection than might be warranted, reducing the net benefit of patents to society. However, ensuring high-quality standards for patents can be costly. Participants identified two areas in need of attention.

- *New areas of patent protection*, notably biotechnology, software and business methods, have raised new issues that the patent system have had difficulties in addressing. There is need for developing the capability to rapidly build up expertise in new areas and learn how best to apply basic patenting principles and ensure the granting of high quality patents. More policy-oriented studies based on empirical evidence have to be undertaken to face future challenges as further new areas emerge.

- *Patent administration.* Concerns regarding the quality of patents are not limited to new areas. Growing workloads at patent offices make it more difficult to maintain the quality of all issued patents. Participants noted that post-grant measures, such as opposition systems, can help offset such problems. They also identified a need for a better assessment of the issue of patent quality, including definitions and measurement, and for improving existing solutions.

International issues were also high on the conference participants' agenda. The question of patent administration and enforcement in developing countries was hotly debated. Even among OECD countries, business representatives highlighted the challenges of protecting inventions across multiple jurisdictions, and patent officials identified a need for greater co-operation.

- *Developing countries* are currently strengthening their patent systems, mainly under pressure from developed countries but also with the view of encouraging indigenous inventions. The level of development of a country, notably its innovative capability, determines its ability to use efficiently a patent system. As a result, it might not be in the interest of all developing countries to adopt patent systems as strong as in developed countries in all aspects. More economic analysis distinguishing between the poorest and middle income among the less developed countries is needed in this domain.

- Reinforced *international co-operation* among patent authorities was seen as a priority by many participants, especially as relates to patentability criteria and prior-art searches. This could not only reduce the administrative burden on patent offices, but provide a more consistent IPR framework for firms and other inventors that exploit their IP globally.

These proceedings summarise the presentations and discussions held at the conference and include a compilation of written contributions prepared by a number of participants. The publication is organised into five parts that roughly follow the conference structure. The first part explores the links between patenting, innovation and economic performance. The second describes recent changes in patent regimes. The third analyses the impact of patents on entrepreneurship and diffusion of technology. The fourth part looks at the protection of intellectual property in software and services and the impact of patents on diffusion of knowledge in this area. The last part concludes with the views of patent officials, policy makers and experts on current and future challenges for patent policy, including issues related to adapting patent systems to developing countries.

INTRODUCTION

The number of patent applications submitted to major patent offices has grown rapidly in the past two decades. Patented inventions are increasingly present throughout the economy, and their influence on innovation and economic performance is becoming more important and pervasive. The growth in patenting reflects increased investments in research, development and innovation, more strategic behaviour of patentees and changes in patent regimes that have led to an expanding realm of patent protection and stronger rights for patent holders. Patents provide incentives to innovate and contribute to technology diffusion, in particular by requiring disclosure of the functioning of a new invention and facilitating exchanges via licensing agreements. Nevertheless, a number of questions must be re-assessed regarding the determinants of patenting and the impact of patenting on innovation and economic performance. In particular, as innovation processes have changed and new types of inventions have been introduced, there is a need to ensure that the patent system continues to strike the right balance between the appropriation of the fruits of innovation by patent holders and the diffusion of technology for the society as a whole. Policy oriented research based on empirical evidence to address these questions is scarce and an open dialogue among policy makers and other interested parties is in high demand.

The Conference on IPR, Innovation and Economic Performance organised at the end of August 2003 by the OECD Directorate for Science, Technology and Industry was designed as a forum for experts, policy makers and stakeholders to exchange views on these issues. The conference showed that the relationship between patents and innovation is complex and varies across industry sectors, technological fields and types of firms. Increased patenting seems to be a mix of growing innovation, internationalisation and strategic patenting by firms and new ways of organising research and innovation. Teasing out the relative contributions of each of these factors is a difficult task. Participants identified a certain number of areas deserving attention from policy makers to ensure that patents continue to both protect inventions and encourage diffusion. These included enhancing the access to patented technology, ensuring the quality of issued patents, especially in emerging areas, improving international co-ordination and finding the best way of implementing IP protection in developing countries.

This introduction summarises the conference presentations and discussions. It is followed by a compilation of written contributions prepared by a number of participants, organised into five parts that roughly follow the conference structure. The first part explores the link between patenting, innovation and economic performance. The second describes recent changes in patent regimes in major OECD regions. The third analyses the impact of patents on entrepreneurship and diffusion of technology. The fourth part looks at the protection of intellectual property in software and services, with a particular focus on the impact of patents on diffusion of knowledge in this area. The last part concludes with the views of patent officials, policy makers and experts on current and future challenges for patent policy, including issues related to the implementation of patent systems in developing countries.

Patents and economic performance: Establishing the links

The focus of the first session was on trends, determinants and obstacles to patenting. Participants tried to answer questions such as whether the surge in patenting has been a generalised phenomenon across sectors and countries and attempted to identify the determinants and impacts of the increasing importance of patents.

Many interpretations were offered for the factors driving growth in patenting. Participants agreed on the need to do further research on the determinants and impacts of patents on the economy in order to be better prepared to face future challenges and implement policy changes, but recognised the difficulties to draw causalities in this field.

The econometric analysis of EPO patents presented by **Samuel Kortum** from the University of Minnesota suggests that half the growth in filings at the European Patent Office (EPO) during the 1990s can be attributed to a decrease in fees (see Chapter 1, *International Patenting at the EPO: A Quantitative Assessment*). According to the model developed in his work, which is restricted to the early stages of EPO filing, about 60% of the nearly 6% annual increase in European patents between 1991 and 2000 can be attributed to the decline in EPO application fees. He attributes the remaining growth to an increase in innovative output of around 2.3%. However, better data on patent counts and patenting costs (*e.g.* translation costs, national agent fees, renewal costs), discussants noted, would be needed to further elaborate an econometric model on the determinants of patenting in Europe.

Statistical analysis and information from industry surveys in different countries offered other interpretations to the determinants of patenting. For example, the work presented by **Jakob Elder,** from the Fraunhofer Institute for Systems and Innovation Research, is based on a study of EPO patents filed by German firms and a survey of more than 500 German patentees. Edler finds that German patent applications at the European Patent Office more than doubled during the 1990s, whereas R&D expenditures grew at a much lower rate (see Chapter 3, *Scope and Nature of the Patent Surge: A View from Germany*). Respondents to Edler's survey reported that pressure to compete and co-operate, rather than decreasing filing costs, or increased inventiveness, had been the main drivers of increased patenting in Germany during the 1990s. Edler suggests that this factor led to a breaking up of the direct relationship between R&D expenditures and patent applications during the period.

The results of an international survey conducted by OECD and the Business and Industry Advisory Committee to the OECD (BIAC), presented by **Jerry Sheehan** of the OECD (see Chapter 4, *Understanding Business Patenting and Licensing: Results of a Survey*), also confirmed the increased importance of patents in business strategy over the past ten years. Respondents attributed this change to a combination of increased innovation, more intensive competition and patent reform (notably expanded subject matter). Most firms reported that patents had become a more valuable means of protecting their inventions in recent years. They noted that an increase in the number of inventions had been a very important driver of their increased patenting, especially in the ICT and pharmaceutical sectors. More than half of responding firms recognised that they are now patenting inventions they would not have sought to patent ten years ago, even if they were patentable then. Indeed, as indicated by Edler's study and corroborated by the OECD/BIAC survey, patents and other protection strategies seem to have become more important in the last few years, especially for very large firms. In contrast to Kortum's results, however, the survey indicated that changes in the cost or administrative procedures for patenting had only played a moderately important role in the patenting strategies of respondants, which were essentially large firms.

Opinions were divided as to whether pro-patent policies have had any visible effects on business innovation. Arguments in favour of pro-patent policies had largely relied on the conventional wisdom that patents have a positive effect on innovation and economic performance. However, participants noted that concerns about the effectiveness of the patent system have started to be raised and empirical studies available to date show that impacts tend to vary across sectors and countries.

Recent changes in the US patent system have coincided with rapid technological advance, revival of productivity growth and restoration of US competitiveness, and prompted other countries to emulate the US patent policy model, noted **Stephen Merrill,** of the National Academies (NAS), (see Chapter 5, *Improving Patent Quality: Connecting Economic Research and Policy*). However, the US patent model is increasingly under scrutiny, and concerns have been raised about patent quality, strategic patenting or incursions of patent protection into the domain of ideas. Proposals for reform have been expressed in a number of US fora during 2003.[1] Although progress has been made in understanding the patent system, Merrill concluded, there is still need to better communicate the results of economic research to policy makers. The design of a framework for evaluating the patent system should take into account factors such as patent quality, timeliness of decisions and transaction costs.

Kazuyuki Motohashi, from Hitotsubashi University, insisted on the difficulty of discerning the effects of pro-patent policies on business innovation and diffusion of technology, especially in the presence of increased technological opportunities. Patent strategies vary across firms and sectors and over time. Based on statistical analysis and interviews with large companies of the IT and biopharmaceutical sectors, Motohashi showed that large part of the growth in patent applications in the late 1990s was due to a surge in IT and pharmaceutical patents, which coincided with increased R&D and expanded patentability in those areas. He also noted that the growing importance of patents have led IP sections within firms to play a more active role in R&D and product development strategies, particularly in the pharmaceuticals sector. The role of patents for technology diffusion is also reflected in his study, where he notes that IT and biotechnology firms tend to increasingly rely on external knowledge via licensing (see Chapter 2, *Japan's Patent System and Business Innovation: Reassessing Pro-patent Policies*). He concluded that patent policy making should take a balanced approach and consider impacts on both technology diffusion and expansion of protection. Initiatives such as those included in the Japanese Framework for Intellectual Property Strategy launched in June 2002, he suggested, should take into account characteristics of different sectors.

The important role of patents for the diffusion of technology was stressed by **Thierry Sueur,** Air Liquide Vice President of Intellectual Property. Sueur noted that a systematic analysis of patents from third parties represents a very important source of technical information for firms and provides inspiration for new inventions (see Chapter 6, *How Do Third Party Patents Foster Innovation?*). Third party patents facilitate information on competitors' strategies, and motivate in-house inventors by challenging them to find alternative solutions. Among the necessary conditions for the net effect of patents on economic performance to be positive, Sueur mentioned predictability and high quality standards for patents, along the same lines of previous speakers.

The need to monitor and improve patent quality in order to be better prepared for new challenges in the future was again stressed during the open discussion at the end of the session. Participants also recognised the difficulties involved in extracting meaningful conclusions from patent statistics and surveys and recommended caution in the interpretation of results in this complex area.

1. NAS Committee on IPR in the Knowledge-Based Economy at *www.nationalacademies.org*
   FTC/DOJ Hearings on Competition and Intellectual Property in the Knowledge-Based Economy at *www.ftc.gov/opp/intellect*

Changes in patent regimes

Speakers and discussants in this session observed that most changes to patent regimes experienced in the past two decades have gone in the direction of expanding and strengthening patent protection.

The United States, Europe and Japan have experienced similar patterns of expanding and strengthening patent protection in recent years, as reflected in a study of recent changes in patent regimes presented by **Catalina Martínez** of the OECD (see Chapter 7, *Overview of Recent Changes and Comparison of Patent Regimes in the United States, Japan and Europe*). Changes have included the expansion of subject matter, a broadening of patent scope, a substantial increase of damage claims in patent litigations and growing flexibility and simplicity of patent procedures. International harmonisation has been an important factor in the recent developments of patent regimes across countries, marked in the first place by the TRIPs agreement setting minimum standards for IP protection within WTO countries. Nevertheless, country differences and unsettled questions remain along a number of dimensions. For example, as regards the patentability of software (currently under discussion in Europe), the patentability of business methods and the status of research exemptions. As noted in the previous session, the rationale behind most reforms seems to have been that strong patent regimes bring high economic benefits to nations in terms of foreign direct investment, incentives to invest in R&D and innovate. However, pro-patent policies have been put in place without much regard to their effects on competition or the diffusion of knowledge, which are important questions and deserve further research.

Along the same lines, **Akira Goto**, from the University of Tokyo, noted that there has not been much discussion to date on the impact of recent changes in the Japanese patent regime. Japan's pro-patent policies have been driven mainly by foreign pressure due to international trade disputes and US pro-patent policies and domestic factors such as rising levels of high technology. Technological progress had enhanced the competitiveness of the Japanese industry, which in turn triggered foreign and domestic pressure to strengthen the patent system. Pro-patent policies initiated in the late 1980s in Japan included the expansion of subject matter, an increase in the number of claims allowed per patent, limits on compulsory licensing, higher incentives for university patenting and licensing, and growth in damages awarded in litigation cases. Following these changes, R&D and patent applications slowed down, although the number of claims per application and the number of grants grew considerably in the 1990s. Further research, Goto concluded, will be needed to assess the impact of stronger patent protection on innovation in Japan based on this evidence.

The design of mechanisms to control patent quality is particularly important insofar as patent offices sometimes may grant patents to inventions that are not really new or too broad, as noted by **Dietmar Harhoff** from the University of Munich. Such low-quality patents give patent holders more protection than they merit and increase congestion in the patent system. However, they are also costly to avoid or correct. Based on his empirical work on the matter, Harhoff concluded that post-grant opposition proceedings, enabling third parties to oppose patent grants, appear to be an efficient remedy to control the quality of patents issued at EPO.[2] He also noted that although re-examination proceedings at USPTO could in principle serve similar purposes, in practice, they do not. Between 1981 and 1998, 8.6% of EPO grants were opposed, with one-third of them resulting in revocation and another third in amendment. In contrast, only 0.3% of USPTO grants were re-examined between 1981 and 1998, and only a minor fraction of them was revoked and proceedings were initiated by patent

2. B. Hall, S.J. Graham, D. Harhoff, and D. Mowery (2003), "Prospects for Improving US Patent Quality via Post-grant Opposition", Competition Policy Center Working Paper No. CPC 03-38, University of California, Berkeley.

owners in as many as 40% of those cases. Harhoff recommended USPTO to adopt an opposition system similar to the one in place at EPO, for which, he suggested, there is also some room for improvement.

As noted by **Ulrich Schatz**, former Principal Director for International Affairs at EPO (see Chapter 8, *Recent Changes and Expected Developments in Patent Regimes: A European Perspective*), the priority in the political agenda for patent reform in Europe seems to be the integration of different national systems and, ultimately, setting up a European patent system. Ongoing projects comprise intergovernmental initiatives such as the 2000 revision of the European Patent Convention, the 2000 London Agreement on translation requirements and the draft European Patent Litigation Agreement (EPLA) aiming to reduce the uncertainty caused by multiplicity of jurisprudences within EPC countries, still under discussion. Negotiations on the Community Patent pursued by the European Commission have put on hold discussions on these last two intergovernmental initiatives. However, the implementation of the Community Patent is not straightforward either and mainly due to different positions of Member countries on translation requirements and the implementation of a centralised patent court in Europe.

The complexity of international negotiations was confirmed by **Francis Gurry**, Deputy Director General at WIPO in charge of PCT and Patents, Arbitration and Mediation Center, and Global Intellectual Property Issues. He noted broadened participation in both formal and informal policy discussions and enhanced appreciation of the value of IP and consequent demand growth. He also recognised the increasing difficulties involved in the international harmonisation of patent regimes, especially at the multilateral level. Current WIPO projects include the reform of the Patent Co-operation Treaty (PCT); negotiations on the Substantive Patent Law Treaty (SPLT), whose objective is to harmonise substantive issues such as the definition of prior art, novelty, inventive step/non-obviousness, industrial applicability/utility, the drafting and interpretation of claims and the requirement of sufficient disclosure of the invention; and the protection of folklore and traditional knowledge. Gurry drew attention to a changing multilateral environment for the development of IP protection where the policy dialogue is becoming more difficult to manage as it becomes more closely connected to broader issues such as health policy, economic development and territoriality of rights. Some actors have responded by pursuing bilateral negotiations outside the multilateral arena, he noted. To conclude, Gurry insisted on the need for more empirical data to feed into the international negotiations.

Despite the problems related to multilateral negotiations, **Bruce Lehman**, president of the International Intellectual Property Institute and former USPTO Commissioner, emphasised the need to strengthen international co-operation, especially with developing countries, in order to help them in setting up patent systems that benefit inventors, local as well as foreign. He also stressed the need for moving beyond harmonisation, promoting greater capacity and efficiency in patent examination and sharing of resources and information for prior art search among the major patent offices. To conclude, he noted that examining and enforcing patents is a very expensive business, and developing countries cannot always afford it. They need financial assistance to upgrade their systems in order to protect their indigenous inventions and attract foreign ones. It is neither desirable nor possible for developing countries to develop large patent offices. He suggested that they should instead have improved access to the expertise and capacity of the patent offices of developed countries.

A large part of the open discussion at the end of the session centred on the need to increase co-operation among OECD countries and the question of whether enforcing patent rights in developing countries is beneficial to their own development. Some directions for policy were suggested to help countries improve the efficiency of their patent systems, notably fostering greater co-operation among major patent offices in a number of areas, including prior art search.

Patents and entrepreneurship

Participants in this session noted that the impact of patents on competition, and entrepreneurship largely depends on the likelihood of patent holders to successfully enforce the exclusive rights conferred by patents, which is in turn affected by market conditions and differs across technology areas.

The question of whether the patent system increases innovative activity is very old and has not yet been completely answered, as pointed out by **Bronwyn Hall,** from the University of California at Berkeley. Hall noted that the growth in patent applications observed in the United States since the creation of the Court of Appeals for the Federal Circuit in 1982 has been largely due to increased patenting by US corporations from electronics, computing and communication industries. Empirical evidence shows that although strengthening patent protection does not generally result in an increase in innovative activity (except probably in pharmaceutical and chemicals), it does increase the strategic use of patents. It also affects the structure of industries by allowing trade in disembodied knowledge, facilitating the vertical disintegration of knowledge-based industries, and enabling the entry of new firms that only possess intangible assets. Changes in patent regimes also seem to redirect innovation towards patentable inventions, when patent protection is relatively more effective than trade secret law.[3] Hall stressed the importance of granting high-quality patents, as the benefits of patents tend to increase with quality (more novel, less obvious, better disclosure) but the costs remain about the same. Congestion costs, however, increase proportionally to the number of patents, she concluded, so that "more is not better".

One of the consequences of the recent proliferation of patents, adding to those congestion costs, has been an increase in the number of litigation cases. However, **Mark Schankerman** from the London School of Economics, noted that despite the increase in overall litigation, the rate of litigation per patent has not risen. Empirical evidence on US patent suits indicates that there is substantial heterogeneity of litigation rates across patents and patent holders[4]. Patents are more likely to be litigated the more valuable they are, in other words, the larger their scope, in terms of number of claims, and the higher the number of inventions building on them, in terms of future citations by claim. Also, Schankerman showed that patent holders tend to have a higher probability of filing suits the less concentrated their technology area and the smaller their patent portfolio.

Participants suggested that the cost of patent enforcement is higher for small firms than for large firms, notably because small firms do not have access to the same amount of mechanisms large firms use to resolve litigation threats (risk-pooling across large patent portfolios, access to legal experts, etc). They also noted that although some countries have implemented a number of measures to reduce the burden of small firms in patent enforcement, none of them is frequently used. These measures include patent litigation insurance schemes, patent pools and licensing agents, alternative dispute resolution mechanisms and competition policy remedies such as compulsory licensing. Some of these solutions are being considered or have been already implemented by the European Commission, as noted by **David Ellard,** of the Directorate General on Internal Market.[5] In particular, he mentioned the project to implement a European system of patent litigation insurance and discussed some issues at the

3. P. Moser (2003), "How Do Patent Laws Influence Innovation ? Evidence from Nineteenth Century World Fairs", NBER Working Paper No. 9909, *www.nber.org/papers/w9909.*

4. J. Lanjouw and M. Schankerman (2003), "An Empirical Analysis of the Enforcement of Patent Rights in the United States," in *Patents in the Knowledge-Based Economy*, Wesley Cohen and Steven Merrill, eds. (National Academy Press: Washington, DC), 145-179.

5. Further information on the work of the Internal Market DG at the European Commission on patents and entrepreneurship available at *http://europa.eu.int/comm/internal_matrket/en/indprop/index.htm*.

interface between competition and IP law, such as the potential effects of compulsory licensing on market competition.

The risk of litigation also affects the likelihood to obtain support from a venture capitalist in the early stages of firm creation. Venture capitalists spend a large amount of time evaluating the intellectual property of start-ups and their litigation risks. They do not want to add an additional risk to those already inherent in creating a new firm. The higher is the risk of litigation, the lower the probability of raising venture capital. **Jean-Bernard Schmidt**, Chairman of the European Private Equity and Venture Capital Association, stressed the fact that one of the key ingredients for a start-up to be successful is a strong differentiating factor that may later give it a competitive advantage in the market (apart from good management and target market). This factor may be related to technical know-how, specific knowledge of an industry, marketing skills, patents and other forms of intellectual property. The effectiveness of patents as a differentiating factor varies across markets and technology areas, and appears to be higher, for instance, in life sciences, microelectronics or hardware than in software or healthcare services. As regards life sciences, **Thane Kreiner**, made clear in his presentation that patents had been critical to the success of his company, Affymetrix (see Chapter 9, *Enabling Innovation, Encouraging Investment: Intellectual Property and Genomic Entrepreneurship*).

Discussions at the end of the session centred around the impact of patent quality and enforcement mechanisms on market entry and competition. Discussants identified the need to devote more resources to the analysis of patent quality and its improvement, and identified a number of factors contributing to an increase of patent quality: strict patentability requirements, sufficient information disclosure and legal certainty about validity.

Patents and technology diffusion

The focus of the fourth session of the conference was on the impact of patents on technology diffusion. Participants were asked whether patents facilitate the diffusion of technology and whether transaction costs were higher in some sectors or for some types of firms than for others.

Patent licensing agreements are one of the mechanisms whereby inventions are diffused into the economy. However it is difficult to analyse recent trends in licensing as agreements are based on private contracts among firms. Nevertheless, information from most available databases, which are mainly based on public announcements, indicates that licensing agreements significantly increased from the mid-1980s to the mid-1990s and reached a peak around 1995. **Nicholas Vonortas**, from George Washington University, finds that three factors increase companies' likelihood to engage more often in licensing agreements: similarity in technology and market profile; existence of previous licensing agreements (to each other or independently); and importance of IP protection to their industrial sector (see Chapter 10, *Technology Licensing*). A key finding of his study is that reducing transaction cost is most important when licensing across sectors, whereas strategic and competition-related factors are most important when licensing within an industry.

The access to knowledge for follow-on innovation, an important aspect of technology diffusion, was examined by **Wesley Cohen,** from Duke University. He presented a study on the effects of patents on research tools on biomedical innovation and diffusion based on interviews with private and public sector personnel involved in biopharmaceutical research. [6] Almost all interviews showed that the recent proliferation of IP claims had been manageable and that there had been almost no break-

6. J.P. Walsh, W.M. Cohen and A. Arora (2003), "Patenting and Licensing of Research Tools and Biomedical Innovation", Pp. 285-340 in S. Merrill, R. Levin and M. Meyers, eds., *Patents in the Knowledge-Based Economy* (Washington, DC: NAP).

downs in licensing negotiations for commercially worthwhile projects. They revealed that firms and universities tend to adopt "working solutions" when they face IP access problems. These solutions include licensing, inventing around patents, going offshore, court challenges, infringement (use of the patented technology without a license, often invoking research exemptions), and alternative solutions such as the creation of public or quasi-public databases to make research tools and other foundational inventions widely available (*e.g.* GenBank, SNPs Consortium, Merck Gene Index). Nevertheless, Cohen noted, new technologies, new entrants and legal decisions may yet upset the delicate balance between protection and diffusion in the biotechnology sector, and policy makers should remain vigilant.

In contrast to the practical approach taken by Cohen, **Sandra Thomas** from the Nuffield Council on Bioethics, and **Thane Kreiner,** from Affymetrix, questioned the overall legitimacy of patenting genetic inventions, and recommended reforms to dramatically limit the number and scope of gene patents.

Thomas presented the conclusions and recommendations of the Nuffield Council's recent report on *The Ethics of Patenting DNA*, which are based on the principle that the patent system should promote the public interest, providing incentives for research, diffusing new technologies and making available medicines and diagnostics.[7] She identified two trends characterising the current situation of the patent system: protection of investments and protection of information, noting that protection of inventions should be the rule instead. Recommendations from the Nuffield Council to alleviate the tension created by increasing patent protection in biomedicine included: *1)* re-examination of the grounds for eligibility of patents for genetic inventions; *2)* rigorous application of patenting criteria by patent examiners, in particular the inventive step requirement; *3)* restriction of the scope of claims to specific defined uses and elimination of *per se* claims; *4)* clarification of research exemptions; and 5*)* compulsory license legislation when public interest is at stake.

In addition, Kreiner noted that gene patents create incentives to patent basic information instead of products and may lead to less follow-on innovation, create patent thickets and limit access to clinical tests. To avoid these problems he proposed a framework where only biotechnology inventions with proven functionality would be patented, and simple catalogues of information, such as genes, proteins or expressed sequence tags would not. He stressed the need to codify research exemptions and create pools of existing gene patents, especially those derived from publicly funded research, in order to guarantee sufficient access to fundamental genetic discoveries by researchers working in the field, both in the public and private sector.

Richard Johnson, senior partner of the US law firm Arnold & Porter, returned to the broader topic of how to get the policy framework right in order to respect the social contract inherent in the grant of intellectual property rights (see Chapter 11, *Comments on Patents, Entrepreneurship and Technology Diffusion*). Private and public sectors are both keenly interested in promoting technology diffusion; however, he noted that three recent trends are making the balance between creating incentives to research and facilitating diffusion increasingly difficult. First, new products and markets draw on a variety of technologies and bundles of IP rights; second, actors involved in R&D have no longer clearly delineated roles, universities may do development work and firms basic research, blurring the line between basic and applied research; and third, the IP landscape is increasingly complex. In some sectors, the intersection of patents, copyright, and database protection rights is likely to create new access problems and high transaction costs to which there are no simple solutions. One interesting challenge to the economics of IP will be the development of new institutional and market mechanisms

7. *www.nuffieldbioethics.org/publications/pp_0000000014.asp*

to facilitate innovation and diffusion. It is essential, he also warned, to prepare policy makers for new challenges.

The discussion at the end of the session further elaborated the issue of research exemptions and access to foundational discoveries. Speakers and discussants were largely in favour of defining a space in which basic research could be free of overly burdensome IP restrictions. Participants worried that the present patchwork of national research exemptions may be breaking down. However, it was recognised that defining a research exemption that would allow those who create research tools adequate protection is a difficult challenge and recommended further research and discussions on the issue. Participants also noted that researchers in biotechnology and software are increasingly using the public domain as an alternative means of protection, which not only involves a high degree of diffusion but also invalidates the novelty requirement preventing others from patenting. This trend raises new issues and represents another challenge for policymakers that participants though needed to be addressed.

Patents for software and services

The fifth session of the conference focused on issues related to patents for software and service-related inventions. Participants addressed questions such as whether patenting plays a different role in protecting IP or in enhancing competitive advantage in services and manufacturing sectors. They also looked at whether alternative means of protection for software and services are more effective than patents. As regards software-related inventions in particular, they discussed the effect of patents on diffusion and further innovation and how the emergence of open source software has affected the role of patents in the sector.

The distinction between service and manufacturing sectors does not appear to be appropriate nor meaningful as regards the analysis of IPR. The large heterogeneity within different types of services and manufacturing sectors as regards innovation and use of IPRs calls for analysis based on more detailed industry characteristics, as shown in the work presented by **Pierre Mohnen** from MERIT (see Chapter 13, *Intellectual Property in Services: What Do We Learn From Innovation Surveys?*). Based on data from the Third Community Innovation Survey in France, Mohnen observed that innovative firms in high-tech manufacturing use all types of IP mechanisms (except design registrations) more than innovating firms in low-tech manufacturing, and also more than innovating firms in services. In turn, innovative firms in services use lead-time, copyrights, complexity and trademarks more than innovative firms in low-tech manufacturing and non-innovating firms in services tend to use IP mechanisms (except patents) more than non-innovating firms in manufacturing. The split between innovating and non-innovating firms seems to be much more striking than the split between services and manufacturing. Moreover, within the manufacturing/services split, low-tech manufacturing sectors appear closer to services than to high-tech manufacturing sectors.

Software and business methods raise very different issues and should also be treated separately, even though they tend to be coupled together in patent policy discussions, argued **Brian Kahin**, from the School of Information, Gerald R. Ford School of Public Policy, and the Department of Communication Studies, University of Michigan (see Chapter 12, *Through the Lens of Intangibles: What Patents on Software and Services Reveal about the System*). Patenting software increases the complexity of knowledge management and raises transaction costs as each software product may comprise many patentable components. Moreover, Kahin claimed, the software industry has experienced very rapid growth in the past in the absence of patent protection. On the other hand, patenting business methods may confer exclusive rights over abstract ideas, as a patent that simply articulates a general business problem might cover all its possible solutions. As a result, Kahin proposed to exclude business methods and software ‘as such’ from patentability, as well as algorithms, abstract ideas and basic science, and questioned the one-size-fits-all model of patent protection.

The open source community is also against the patentability of abstract ideas and algorithms, as pointed out by **Hartmut Pilch** of the Foundation for a Free Information Infrastructure and Eurolinux Alliance. He argued that ideas should be in the public domain as there is no intervention of laws of nature in the production of ideas and no investment needs to be recovered, in contrast to inventions (see Chapter 16, *Why Are Software Patents So Trivial?*). Pilch also claimed that most software patents granted so far tend to be trivial and broad and insisted on the need to do more economic analysis on the impact of software patents on innovation. This research would be especially important to assess the proposal for a directive on the patentability of software currently under discussion in Europe. He concluded by wishing that the final directive, following amendments suggested by his group, ensures that patents are granted for inventions, not for abstract ideas.

Participants agreed that even if the conventional wisdom is that more and stronger patents stimulate innovation in all fields, including software, very few empirical studies have investigated the impact of patents on software innovation and little evidence in either direction has been found to date.

One exception is the work by **Robert Hunt**, of the Federal Reserve Bank of Philadelphia (see Chapter 14, *The Software Patent Experiment*). Hunt presented some empirical evidence showing that those firms that increased their software patents portfolio over the 1990s had also reduced their R&D spending as a share of sales. This evidence, Hunt suggested, invalidates the incentive hypothesis for software patenting, which is the basis for the current conventional wisdom. According to Hunt's estimates, software patents are mainly granted in the United States to large, established manufacturing firms, which also rank high as patentees in other technology fields. Recent legal changes in the United States might have encouraged strategic patenting and led to lower R&D intensity by these firms. However, as pointed out in the discussion, a correlation does not necessarily imply causality and additional research may be needed.

The analysis of software-related litigation cases presented by **Stuart Graham,** from the Georgia Institute of Technology, was consistent with Hunt's description of software patent holders (see Chapter 15, *The Use of Patents, Copyrights and Trademarks in Software: Evidence From Litigation*). The recent rise in software patenting has been accompanied by significant growth in patent litigation in software patents that has outpaced growth in patent litigation generally. Firms within the software sector have been involved in a small fraction of suits involving software patents, and most of the litigation related to software patents has involved either firms producing hardware or firms from a wide range of industries that employ software in their products or processes. Moreover, Graham finds that patent litigation suits involving firms in the software industry tend to be initiated by small firms, individuals and industry outsiders, with incumbents often being on the defensive side.

Graham's analysis also shows a high reliance of software firms on copyright enforcement, which indicates that copyright continues to play an important role in the software industry, although the evidence also indicates that firms do not see copyright as a substitute but as a complement to software patent protection. Indeed, software firms increasingly rely on patents to protect their competitive advantages, as noted by **Harald Hagedorn,** SAP Patent Attorney. Software companies apply for patents in order to control market shares, to get revenues from licensing or alliances, for defensive reasons, to avoid blocking patents or to avert litigation. Despite some limitations such as prohibition of patenting 'software as such' included in the European Patent Convention and the lack of good databases of prior art for software, Hagedorn noted, patents have become a reality for software firms in recent years.

Until the 1980s, trade secret protection and contract law were the main means of protection for software, with copyright gaining popularity since then. Patents are now becoming increasingly important. IPR protection for software has evolved over time, together with the evolution of the software industry, as noted by **Marie-Thérèse Huppertz** from Microsoft (see Chapter 17, *The Role of IPR for the Software Industry: A Changing Landscape?*). The pressure from users to make source code available and the success of open source software have imposed new challenges to software developers who now need stronger protection means, such as patents. Patent law requires information disclosure, but protects the invention itself, not just a specific implementation or its expression, which is protected by copyright. Moreover, patent prosecution ensures that enforcement applies to innovative features of products, rather than to simply incremental features. Patents may not affect the fundamentals of innovation and competition in the software industry, Huppertz argued, but affect the behaviour of users and developers, as shown by the US experience, and will lead towards the adoption of more open and interoperable systems in the software industry.

Discussants concluded that any legislation defining the patentability of software should be based on results from economic analysis on the impacts of software patents on innovation. However, measuring the impact of patenting on R&D is a difficult task since both variables may be driven by the same factors and any study must thus control for mutual causality.

A final point was also made on the role of patent offices to increase patent quality. Patent offices may provide training and funding to ensure the quality of examinations, improve databases of prior art, and get better documentation concerning patents of new technologies. In addition, they should guarantee that the inventive step or non-obviousness requirement is fulfilled. A recommendation to patent offices, based on theoretical results, would be to maintain a high standard of inventiveness, especially for software and service-related inventions, discussants noted. They also suggested that industries should give feedback on the quality of patents granted by patent offices and agreed on the importance to undertake empirical research on patent quality.

Current and future policy challenges

The last session of the conference was intended as a forum of discussion among high-level officials, policy makers and experts on the main challenges currently faced by the patent system and directions for future reform. It was chaired by **Francis Gurry**, WIPO Deputy Director General, and speakers included **Ichiro Nakayama,** Intellectual Property Strategy Headquarters, Japan; **Manuel Desantes**, EPO Vice President, International Affairs; **Lois Boland**, USPTO Acting Director, Office of International Relations; and **John Barton**, George E. Osborne Professor of Law at Stanford Law School and chair of the UK Commission on IPR (see their written contributions in Chapters 18-22).

The presentations and discussions reflected considerable similarity among the overall missions of the three major patent offices, their will to further harmonize patent regimes across countries and develop a global patent system, and the steps for addressing them. Their perceived future challenges comprised notably improving efficiency, reducing the burden on applicants and improving patent quality. Some discrepancies were raised, though, when the questions related to patents and developing countries were addressed at the end of the session. The main challenges identified during the presentations and further discussions were as follows:

- *Promoting innovation and economic performance*. Patent policy in all three regions is explicitly aimed at promoting innovation, competitiveness and economic growth. This is the stated policy of the EPO, and USPTO has the objective of strengthening and expanding IPR globally, which is seen as a way of improving US competitiveness in a global knowledge-based economy. Japan, too, has pursued a "pro-patent" policy to strengthen the invention and knowledge creation, as well as to encourage greater transfer of technology from its universities.

- *Making the patent system more efficient*. The need for greater efficiency is driven in part by the growing workload faced by patent examiners. EPO expects patent applications to rise quickly as the number of member states rises and innovative activity continues to grow. Japan already faces a large backlog, that will grow as the number of applications and international filings increase. Both JPO and EPO plan to hire additional examiners, as USPTO has done in recent years. Several participants called for greater co-operation among the three major offices to seek efficiency gains through greater harmonization and perhaps through unified searches, although considerable work would be needed to ensure that searches follow similar practices across countries. It was noted that current search capabilities under-represent the state-of-the-art in foreign countries.

- *Easing administrative burdens on patent applicants*. Patent offices see the necessity of responding to user needs and making patent filings simpler and less expensive. The USPTO, for example, is adopting uniform electronic filing and processing solutions and would like to see applicants be able to prepare a simplified application in a single format for submission to all three major offices. Japan is creating an IP High Court that hopes will speed decisions regarding patent claims (*e.g.* infringement) and improve predictability. EPO has taken steps to reduce filing fees and limit the number of translations needed, but additional work is needed to reduce pendency. Greater work-sharing among patent offices and mutual exploitation of work results (*e.g.* patent searches) could also serve to reduce time delays and filing costs.

- *Improving patent quality*. All three offices see quality as a key to effective patents, although the discussion indicates that there is not a clear sense of how to define, measure or ensure quality. Reducing the workload on examiners, providing improved search tools and prior-art databases, and clarifying rules in patent regimes may help improve the quality of examination. One discussant questioned whether patents that meet certain established criteria would be by definition quality patents, arguing that some test of the amount of effort required to devise the invention might also be applicable.

- *Trilateral and multilateral co-operation.* WIPO was seen as playing a key role in advancing harmonization and creating synergies. Several participants proposed that WIPO play a lead role in moving towards a global patent system. In the meantime, trilateral efforts will be necessary to make immediate progress on a number of these issues. The representative from USPTO, in particular, saw trilateral co-operation as a key step.

While considerable agreement exists as to the challenges facing the major patent offices, differences of opinion remain as to the degree to which developing countries should adopt a patent system similar to that of the developed world. **John Barton** stressed the need to distinguish between least developed countries and transition economies, as they face very different problems in relation to patent protection. For issues related to the poorest, least developed countries, he referred to the work undertaken by the UK Commission on IPR he chaired, which was set up by the British government in

2001 with the objective to find better ways to integrate IPR and development policy.[8] The final report released by the Commission in 2002 recognised that although the patent system is needed in the developed world, especially for pharmaceuticals, it does not work for the poorest, as they lack the resources and incentives to fully participate in the system.

The case of transition economies with a significant scientific and technological capability is different, Barton argued, as they are now entering global markets and are increasingly confront the stronger patent systems of developed countries. However, although strengthening IPR regimes could be helpful to attract foreign direct investment to some sectors in those countries, strong patents are not as necessary to attract investors as high educational levels and a good business climate. Strengthening their patent systems will likely lock-in the competitive advantage of global leaders at the expense of indigenous firms, who will not be able to imitate, may not benefit from licensing and might be acquired by multinationals investing in their countries. Careful qualitative and quantitative analysis needs to be produced to assess whether strengthening IP regimes in developing countries is relatively more beneficial to leading multinationals than to indigenous firms.

One discussant suggested that additional technical assistance could help developing countries take better advantage of the developed world's patent system and indicated that international organisations could provide financial support in that direction. However, it was noted that funds available for IP technical assistance at international organisations, WIPO in particular, are too small for that mission. Moreover, Barton argued, it is not clear to what extent developing agencies should spend money on strengthening the IP systems of developing countries, rather than on providing them with medicines and food. There is need to think of better IP systems for developing countries, Barton followed, and to avoid a duplication of the profit-center model for patent offices in developing countries. One solution, he suggested, could be to create regional offices and explore a better application of measures such as compulsory licenses and research exemptions.

The discussion concluded with a recommendation to take a balanced approach for finding the best implementation of IP protection in developing countries, considering the interests of both the developed and the developing world.

Conclusion

Most participants agreed that patents play an increasingly important role in innovation and economic performance. They recognised that the relationship between patents and innovation is complex and varies across industry sector, technological field and type of firm. Although there is general agreement on the effectiveness of patents as a means to provide incentives to innovate in some sectors (*e.g.* pharmaceuticals), conclusive evidence is scarce in others (*e.g.* software). Nevertheless, participants noted the expansion of patent protection has affected firm behaviour and industry structure in most sectors. In a context of increased technological opportunities, patents have created market opportunities for science-based firms and facilitated access to external pools of technical knowledge via licensing. Ensuring the high quality of issued patents is necessary to reinforce the dual role of patents in fostering innovation and technology diffusion. Policy makers should remain vigilant and ensure that the patent system has the tools it needs to avoid the grant of low quality patents, characterised by extremely broad claims, weak inventiveness and insufficient disclosure, which may lead to congestion in the patent system and induce anticompetitive strategic behaviours.

8. *www.iprcommission.org*

A unanimous call was raised by participants to improve existing empirical evidence related to patents and increase policy-oriented research on the relationship between patents, innovation and economic performance. Some directions for research were identified based on a number of unanswered questions raised at the conference. These included issues such as the impact of patents on the development of technology markets, the role of research exemptions on the diffusion of technology for follow-on innovation, the impact of patents on software innovation, the definition and control of patent quality and IP protection in developing countries.

With the objective to address these questions and serve as a forum for further discussion on the economics of patent policy, participants strongly encouraged the OECD to continue its work on IPR.

PART 1

PATENTS AND ECONOMIC PERFORMANCE: ESTABLISHING THE LINKS

Chapter 1

INTERNATIONAL PATENTING AND THE EUROPEAN PATENT OFFICE: A QUANTITATIVE ASSESSMENT

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Standard sources of data on international patenting suggest a surge in international patent activity in the last decade of the twentieth century. The World Intellectual Property Organization (WIPO) reports a five-fold increase in non-resident patent applications in Denmark and nearly a tripling in Germany, for example. During this period the European Patent Office (EPO) evolved to provide a simpler and cheaper means of seeking patent protection in most European countries. We find that some of the apparent explosion in patenting arises from an overstatement in the number of countries designated in European patents. Correcting for this mismeasurement, however, the data nevertheless imply substantial growth: 1) *published European patent applications grew by nearly 6% annually between 1991 and 2000;* 2) *this growth was not at the expense of patents sought directly through national patent offices, which were small in number relative to European patents throughout the period; and* 3) *the number of destinations designated for protection in a typical European patent has grown substantially, to the point where most now designate all EPO members. A simple structural model of an inventor's patenting decision attributes about 60% of the growth in European patents and all of the growth in the breadth of designation to the decline in EPO application and designation fees. Attributing the remaining growth in patenting to an increase in innovative output implies that innovative output grew at a more modest but nevertheless impressive annual rate of 2.3% over the decade.*

Introduction

Interest in international patent institutions has increased over the past decade. National patent offices have struggled under an increasing number of patent applications while weathering budget cuts. Some observers have pointed to the internationalization of the patent application and examination process as a solution.[1] Consolidating the filing, review, and issuance of patents under an international body, the argument goes, would reduce the cost of patenting inventions by eliminating duplication of these processes across jurisdictions.

The international patent body that has moved furthest in this direction is the European Patent Office (EPO).[2] It began with the International Patent Institute, established by a group of European countries in The Hague in 1947 as a common resource for patent searching and archiving, ushering in a more international approach to patenting. Two years later, the Council of Europe advocated the creation of the European Patent Office. The EPO, however, was not established until 1973 by the Convention on the Grant of European Patents. Despite what its name might suggest, the EPO does not issue European Union patents or even Europe-wide patents. The European Patent Convention, under which the EPO was founded, provides a single patent grant procedure, but not yet a single patent (as envisioned in proposals for a "European Patent"). Nevertheless, we will use the term "European patent" to refer to patents processed through the EPO. After grant, the European patent becomes a set of national patents. We refer to this set as a European patent family.

While the EPO was slow to get off the ground, by the last decade of the Twentieth Century its evolution accelerated to the point where it profoundly affected how applicants seek protection in Europe. Among other things, these changes have meant that researchers must reinterpret what international patent data tell us about innovative activity and the direction of technology diffusion.

An applicant seeking to protect an invention with a European Patent must pay a fee for the European Patent itself and an additional fee for each country belonging to the EPO designated for protection. The cost of designating a country for protection in a European patent is typically lower than the cost of filing for a patent directly through the individual national patent offices. Hence the European patent provides an attractive instrument for applicants seeking protection in several destinations among members of the EPO. Since the European patent itself is relatively expensive, however, applicants seeking protection in only a few members will find it cheaper to file directly through the relevant national patent offices.

This paper examines the EPO and its effect on international patenting behavior. We focus on the decade 1991-2000. At the beginning of the period the major members of the EPO were Austria, Belgium, Switzerland, Germany, Denmark, Spain, France, Great Britain, Greece, Italy, Luxembourg, Netherlands, and Sweden. Ireland and Portugal joined in 1992 and Finland in 1996.

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1. Examples are Bonitatibus (2001), Desantes and Strobel (2002), Campbell (2003), and Barton (2003).

2. The World Intellectual Property Organization, which traces its origins back to the Paris Convention of 1883, allows applicants to file applications in multiple countries under the Patent Cooperation Treaty. It does not, however, undertake a full-fledged examination of these patents, but rather only a preliminary review. Schmoch (1998) provides a thorough discussion of its procedures, and how they relate to the European patent.

We consider these 16 countries as destinations for patents. We include in our analysis patent applications from any of these 16 EPO members as well as those from Australia, Canada, Japan, Norway, New Zealand, and the United States. Thus, we consider 22 countries as sources of patents. The total number of national patents (in any of the 16 destinations) due to emerge from European patent applications (from any of the 22 sources) tripled, from under 430 000 in 1991 to over 1.3 million in 2000. The increase was due about equally to growth in the number of published EPO patent applications (from just over 58 000 to just over 98 000) and an increase in the average family size per application (from about 7.3 to around 13.3 countries).

The evolving fee structure associated with the EPO suggests explanations for growth in both the level and the breadth of patenting. The application and search fee for a European patent was about USD 1 500 for the first six years of the decade, falling to around USD 1 000 after 1997. The cost for each country designated for national protection fell more dramatically. It was a little over USD 200 for the first six years, falling to under USD 100 in 1997. Moreover, after 30 June 1999, the EPO offered free designation in any EPO member after payment for seven. Hence the cost of either patenting at all or of patenting widely through the EPO fell dramatically.[3]

Our analysis of the EPO comprises three steps. We first examine the various sources of data on patent applications, and point to serious pitfalls in interpreting World Intellectual Property Organization (WIPO) data on cross-country patenting during this decade. The WIPO data, published in *Industrial Property Statistics*, suggest that patenting over the period grew much more than it actually did. The reasons are twofold. First, the WIPO data appear to double count applications through the Patent Cooperation Treaty (PCT) that designate the EPO. Second, they treat an EPO application as an application to all EPO members even when not all members are designated for protection at the time of publication. The OECD used to produce a refined version of the WIPO data in its *Basic Science and Technology Statistics* that appeared to correct the first problem but not the second. We address these reporting issues.

With our revised data in hand, the second step of our analysis provides an overview of the basic patterns in the evolution of EPO and national patenting over the decade. Our approach is guided by the "gravity" literature examining cross-national patterns in patenting.[4] In particular we follow Eaton and Kortum (1996) and Kortum and Lerner (1998) in distinguishing "source" and "destination" effects in cross-national patenting. This approach allows us to assess how innovation varies across countries and evolves over time, and the probability that innovators will choose to file for patent protection in a given country. We incorporate data on whether filings were made directly in the national patent offices of EPO members or through the EPO to analyze the impact of the EPO.

We find that the European patent has had a substantial effect on how applicants sought protection among EPO members in three respects:

3. Even at the end of the period, however, getting protection in a single destination cost much more going through the EPO than through the relevant national office. Based on a survey, Helfgott (1993) reports the official application plus search fee in 1992 to be USD 188 in Germany, USD 285 in the United Kingdom, USD 540 in Spain, USD 815 in France, and USD 832 in the Netherlands.

4. Slama (1981) is an early contribution.

1. The European patent has almost entirely replaced direct applications to national patent offices. For almost all EPO members in most years, patents that do not originate with the EPO constitute fewer than 10% of patent applications arriving at the national patent offices.

2. In contrast with the earlier "gravity" literature, which suggested that the proximity of the source and destination mattered a great deal to patent applications, we find that the pattern of countries designated for protection varies only slightly across sources. The role of geography is only apparent in a few cases and diminishes over the decade.

3. By 2000 most European patents designated all EPO members for protection. Hence by then applicants were exploiting the European patent to protect their inventions across the Continent, more or less ignoring the national route. This universality contrasts significantly with the past. Putnam (1993), having assembled a data set of patent families for 1974, shows that the mean patent family size was two countries, and 70% of inventions that were patented at all were patented in only one country.

The third step of our analysis is estimating the extent to which the growth in the number of EPO patent applications during the 1990s is due to lower fees rather than an increase in inventive activity. To do so we develop and estimate a simple structural model of an applicant's decision to patent in different countries. The decision is governed by a comparison of the cost of filing a patent application in a destination with the value of a patent there, which we treat as the product of random and systematic components. Applicants may either file in individual destinations through their national patent offices or apply to a portfolio of EPO members through a European patent. An invention may turn out not to be worth patenting anywhere, in which case no protection is sought.

We estimate the parameters of the model to match: *1)* for each current EPO member country, the number of EPO patent applications designating that country, *2)* for each current EPO member country, the number of patent applications sought directly through the corresponding national patent office, and *3)* the distribution of family sizes of EPO patent applications, all for 1995. We then see how well the estimated model can explain developments throughout the decade in these three measures.

We find that we can explain the increase in the breadth of patenting among EPO members totally in terms of the declining cost of designating additional members, in particular the bulk discount offered after 1999. Moreover, the decline in the overall cost of seeking protection through the European patent can explain well over half of the 70% increase in the number of EPO patents. We attribute the residual increase in EPO patenting to an increase in inventive output over the decade.

Our paper is related to a variety of other work on the operation of the global patent system. In particular, a number of other papers have looked at institutional changes and their impact on the propensity to patent (and, in some cases, to invent). Kortum and Lerner (1998) undertake a variety of statistical decompositions and model-fitting exercises to explore the impact of the establishment of the Court of Appeals for the Federal Circuit on the number of filings in the United States. McCalman (2001) quantifies the impact of international patent harmonization effected by the TRIPs agreement of the 1993 General Agreement of Tariffs and Trade by estimating and simulating a model of international patenting. Lerner (2002) explores the overall response of patenting by domestic and foreign entities to patent policy changes over the past 150

years, comparing applications filed in the nation undertaking the policy change with those filed in Great Britain, a nation with a relatively constant patent policy. Eaton and Kortum (1999) and Eaton, Gutierrez, and Kortum (1998) model the effect of tighter, and more geographically extensive, patent protection on innovative activity and growth.

More generally, our work is related to the literature on patent statistics as indicators of scientific progress and technological innovation. Griliches (1990) provides an insightful, and rather cautionary, survey of the literature, which includes such classic contributions as Schmookler's *Invention and Economic Growth* (1966), Scherer (1965), and, of course, the many contributions of Griliches himself and his students, notably various papers in Griliches (1984), Schankerman and Pakes (1986), Griliches, Pakes, and Hall (1987), and Griliches (1989). This literature has long recognized how changes in patent institutions pose challenges to the technometric use of patent data. For instance, when discussing the seeming slow-down in patenting during the 1970s in his 1991 review article, Griliches urged researchers to be cautious about the possibility of "a statistical mirage, caused by a bureaucratic rather than an economic or technological cycle."

We proceed as follows. We next describe the sources of data. The third section then discusses specific issues in reconciling WIPO and EPO patent data. Having sorted out these issues as satisfactorily as we can, the fourth section provides a presentation of some basic features of these data. The fifth section presents our model of the decision to patent among EPO members, our estimation results, and a discussion of what they imply. The final section concludes.

Patent families in the EPO publications data

The standard source of data on patent applications and grants across countries is WIPO, which reports the total number of patent applications to each national patent office by country of residence of the applicant. Until recently, the OECD has compiled these numbers, making some adjustments in an attempt to avoid double counting of the same patent document (as described below), and published them in its *Basic Science and Technology Statistics* volumes (*e.g.* OECD, 1995). These patent statistics have served, among other things, as indicators of the intensity of inventive activity in source countries and the diffusion of ideas across borders.[5]

A drawback of these sources is that neither allows us to observe the extent to which patents sought in different national offices represent the same invention. Since applicants often seek protection in multiple destinations, these data do not provide unambiguous insight into applicants' decisions about the range of countries in which to seek protection.[6] An increase in the number of patent applications worldwide, for example, could reflect either more ideas being patented or else the same number of ideas being patented more widely. We need data on the portfolio of destinations in which single inventions are patented to resolve this ambiguity.

5. The OECD has now begun to publish patent statistics that are not based on the WIPO data.

6. The data distinguish between the "inventor," the individual or individuals who came up with the idea, and the "applicant," the entity seeking patent protection, which could be the inventor or, as is often the case, the firm employing the inventor. For our purposes this distinction matters if the inventor is located in a different country than the applicant. In our analysis we treat the source country as the applicant's country. Guellec and van Pottelsberghe de la Poterie (2001) examine the distinction in detail as it arises in the EPO data.

A third source of patent data, in this case at the level of individual published patent applications, is the EPO itself. The European patent allows an applicant to file for protection in any members of the EPO with a single application. Published EPO patent applications record (among other things) the applicant's nationality as well as the set of EPO-member countries that the applicant has designated for protection. Hence these data do allow us to infer the extent to which applications in multiple countries represent the same invention. These data record, for example, how many applicants from France choose to protect their invention in Germany and Belgium and in no other EPO countries.[7]

Since applicants continue to exercise the option of seeking patent protection directly through national patent offices, in modeling the EPO patenting decision we want simultaneously to consider the applicant's decision to use the EPO at all. We expect a selection issue to arise, since the decision to use the EPO process will be correlated with the desire for patent protection in a large set of countries (for which the EPO provides a relatively low-cost process).

This modeling procedure requires data on the family of destinations reported in EPO patents and on national patents applied for directly through the national patent offices of EPO members. Before turning to an analysis of these data we must first confront serious measurement issues in how these data are reported.

Reconciling EPO and OECD/WIPO patent data

To construct complete accounts of patent applications in EPO countries we merged the data from the OECD on applications (by destination country, country of applicant, and year of application) with the EPO publications data aggregated (from the level of individual EPO publications) by designated country, country of applicant, and year of application. Each EPO publication with designation in France and Belgium and no where else, for example, counts as one patent application in France and one patent application in Belgium. Our plan was to measure the number of patents applied for directly through the national patent office in each destination from each source by the total number indicated in the OECD data minus the number of EPO publications from that source designating that destination.

This procedure yielded a measure of national patents that, very frequently, implied that the majority of patent applications did not go through the EPO. Moreover, the measure indicates explosive growth in the number of non-EPO patents to EPO destinations. Pursuing the anomalies in this measure, we turned to the annual *WIPO Industrial Property Statistics* (Table II A: "Patent Application Filed by Non-residents Broken Down According to the Country of Residence of the Applicant") which are the basis for the OECD numbers.

Conceptually, applications for patent protection in an EPO-member country can follow any one of four mutually exclusive routes: *1)* applications to the national office directly, *2)* applications via the PCT, *3)* applications via the EPO, and *4)* applications via the EPO via the PCT.

7. The data on all published EPO patent applications was provided to us in a very convenient format by the OECD.

In each year, starting in 1985, WIPO presents up to four separate numbers for each EPO-member destination (what WIPO refers to as the "reporting country or organization"). WIPO defines these four measures as follows:

- (N): "Patent applications filed directly with the office concerned".
- (P): "Designations in international applications filed under the PCT" (not reported for some EPO members).
- (RE): "Designations in European patent applications filed under the European Patent Convention".
- (RPE): "Designations in applications filed under the PCT with a view to obtaining a European patent".

It might at first seem that these four categories in the WIPO data correspond to the four mutually exclusive routes to apply for a patent. Indeed, WIPO reports the sum of these four numbers in boldface. The OECD data on patent applications, however, report applications by foreign residents as the sum of only (N), (RE), and (RPE). When the country of applicant is the same as the destination country the OECD makes additional adjustments. The OECD procedure suggests that the (P) applications are contained within the (RPE) applications. Evidence in favor of the OECD's procedure is that WIPO itself reports that currently over 95% of PCT applications designate the EPO each year (while if the (P) applications were distinct from the (RPE) this percentage would be much smaller).

Our concern is that the OECD did not go far enough in correcting the over counting in the WIPO statistics. Figure 1.1a illustrates the problem from the perspective of German applicants. The figure shows EPO and WIPO measures of how many German applicants seek a European patent for protection in EPO-member countries. The EPO measure is simply a count of patents the EPO has published from German applicants designating a particular country. The series labeled WIPO (RE), representing WIPO's count of applications from Germany going directly to the EPO, appears to move roughly in proportion to the EPO measure, as it should. On the other hand, the series labeled WIPO (RPE), representing WIPO's count of German applications arriving at the EPO via the PCT, takes on essentially the same value in each EPO-member. Apparently WIPO treats a PCT application designating the EPO as if the resulting European patent application would designate all EPO member countries. The WIPO (RPE) measure thus overstates the set of countries in which such applicants will actually seek protection. Figure 1.1b shows that the same issue arises, but even more powerfully, when examined from the perspective of US applicants.

Figure 1.1a. **German patenting via the EPO, 1995**

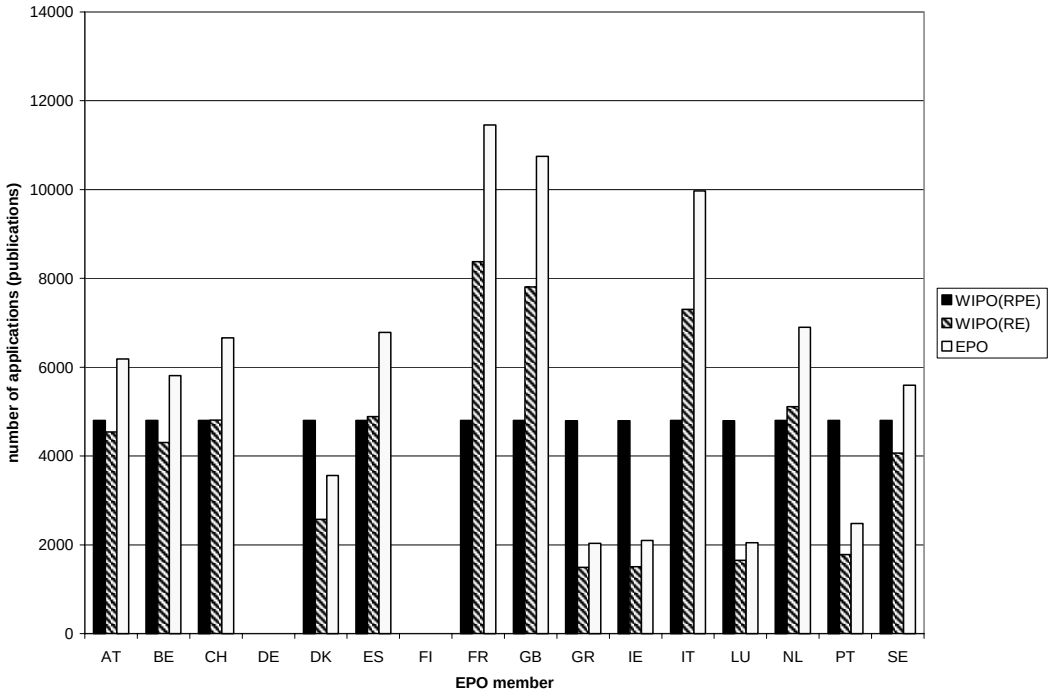


Figure 1.1b. **US patenting via the EPO, 1995**

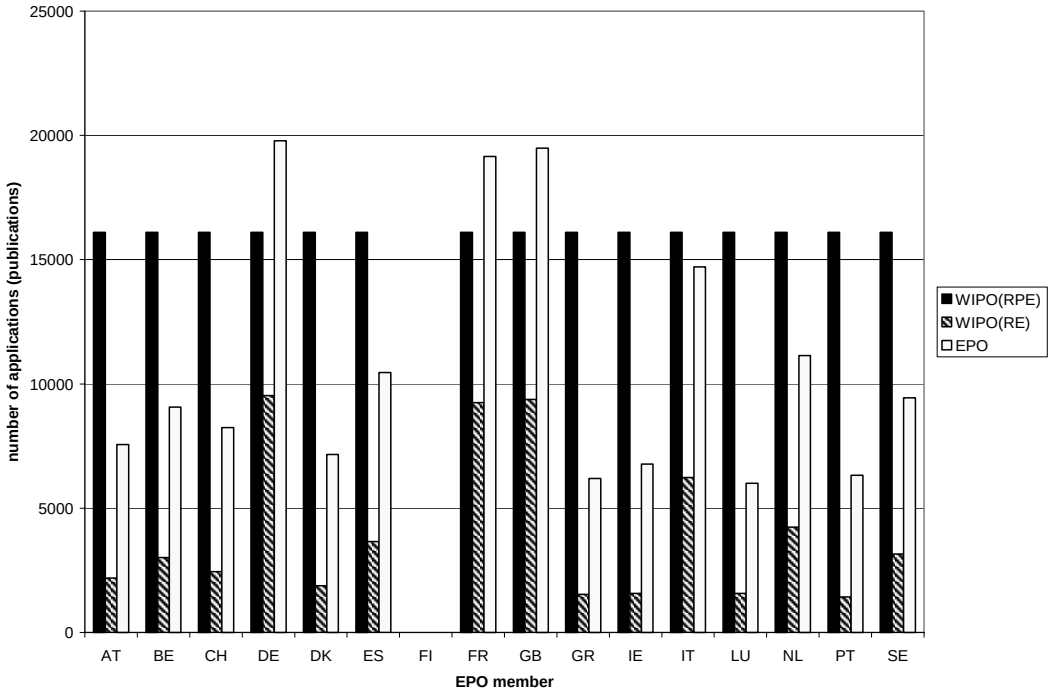


Figure 1.1c. **German patenting in Denmark**

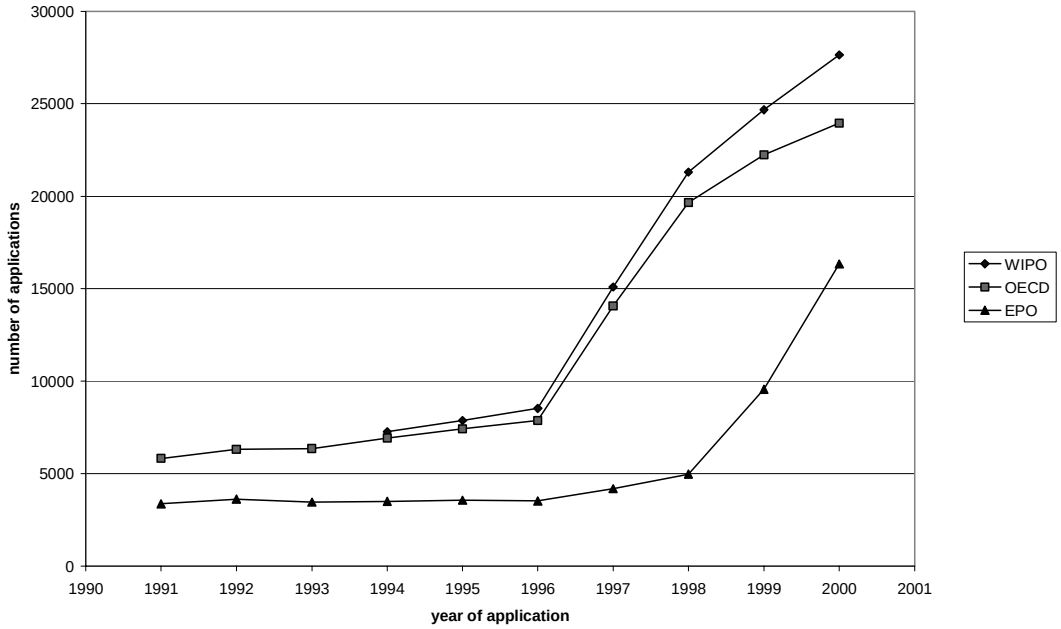
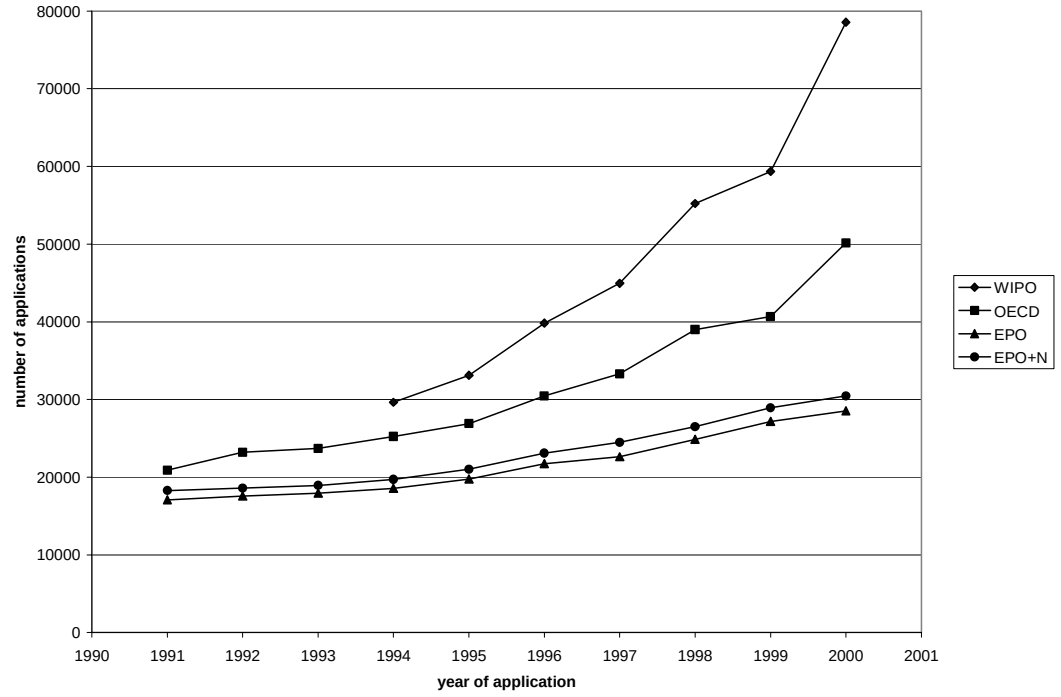


Figure 1.1d. **US patenting in Germany**



Figures 1.1c and 1.1d show that the over counting in WIPO (RPE) makes a huge difference for the pattern over the past decade of patenting in EPO-member countries. We illustrate for the cases of German applications in Denmark, and for US applications in Germany. For the WIPO series we plot the sum of (N), (P), (RE), and (RPE), the number that WIPO reports as total patent applications. As mentioned above, the OECD series excludes WIPO (P), yielding a slightly lower curve. But a more dramatic adjustment comes about if we ignore the WIPO statistics and simply rely on counts of published EPO patent applications. This last adjustment goes too far, however, if we want a measure of the total number of patent applications from one country seeking protection in another. The EPO data miss patent applications filed directly with the national patent offices, as measured by WIPO (N). Adding WIPO (N) to the EPO counts, however, is a fairly minor adjustment. For the case of German applications in Denmark, the adjustment is too small even to be apparent in the figure.

Table 1.1 illustrates the problem numerically. It reports data on patent applications from three sources (Germany, Japan, and the United States) to three destinations (Belgium, Germany, and Denmark) as well as to the EPO itself, in the year 1996. It reports, first, the number of EPO-published patent applications designating the destination as reported by the EPO, followed by the OECD/WIPO figure on total applications. It then reports the four types of applications reported by WIPO.[8]

Table 1.1. **Comparing data on patent applications in Europe**

Source	Destination	EPO	OECD/ WIPO	WIPO (N)	WIPO (P)	WIPO (RE)	WIPO (RPE)
Germany							
	Belgium	5581.4	9335	65	n/a	3816	5454
	Germany	12131.3	42957	42322	746	8230	5459
	Denmark	3525.6	7868	39	661	2374	5455
	EPO	12830.3	n/a	n/a	n/a	n/a	n/a
Japan							
	Belgium	1606.2	3928	25	n/a	918	2985
	Germany	11925.3	15515	2755	404	9470	3290
	Denmark	1005.3	3449	10	192	485	2954
	EPO	12196.3	n/a	n/a	n/a	9662	3303
United States							
	Belgium	10192.7	22697	42	n/a	2697	19958
	Germany	21747.6	30472	1345	9354	9160	19967
	Denmark	8321.9	21738	22	8972	1759	19957
	EPO	22122.2	n/a	n/a	n/a	9309	19969

* Data for 1996.

First, note that the OECD/WIPO figure corresponds to the sum of WIPO (N), WIPO (RE), and WIPO (RPE). Thus, as reported above, WIPO (P) is not included in the OECD/WIPO figures. Second, note that the number of WIPO (RPE) patent applications for each of the three sources is virtually the same across EPO destinations. This is the same phenomenon we saw in Figures 1.1a and 1.1b. It suggests that WIPO (RPE) is automatically counting each application to the EPO through the PCT as if it would be designated in every EPO member.

8. The EPO publications data occasionally report a single patent sought by joint applicants from more than one country. We use the OECD's procedure of dividing these patent publications as shares across the different sources. Hence the potential for non-integer values in the EPO column.

The number of WIPO (RE) patents varies much more across destinations than WIPO (RPE), but not enough to explain the much greater variation in the EPO figures across destinations. Note, finally, that when Japan is the source, the sum of WIPO (RE) and WIPO (RPE) for EPO as a destination corresponds quite closely with the EPO column for EPO total published applications. When the United States is the source, this sum is somewhat higher. The discrepancy between the EPO and WIPO figures for overall EPO patenting can be explained by the distinction between patent applications (WIPO) and published patent applications (EPO). Given that applications are occasionally withdrawn before publication, we expect the WIPO figure to exceed the corresponding figure from the EPO. Our explanation for the discrepancy at the level of national destinations is that WIPO is attributing EPO applications as destined for all EPO members when in fact only a much smaller subset of destinations were typically designated in the published application.

Data from other years tell the same story. By 2000, however, the problem is largely over as by then published EPO patent applications typically designate nearly all members (a phenomenon that our analysis below seeks to explain).

In the analysis that follows we calculate total EPO-member applications as the sum of (N) applications from WIPO and the counts constructed from EPO publications. Since there are relatively few (N) applications even as far back as 1986, the overall trends in our totals will largely appear just slightly higher than those we construct from the EPO publications data. For example, from US applicants in 1986 there were only 156 (N) applications in Austria, 329 in Belgium, and 2 034 in Germany (representing, at most, 20% of applications from the United States in those countries).

An overview of the data

The cross-country patent data have many dimensions to them: most importantly source, destination, and time. An applicant from some country can apply for patent protection in any number of countries, either directly or by designating members of the EPO. As just discussed, even by 1985 the European patent was by far the most popular means of seeking protection among EPO members. It grew in popularity to the extent that by 2000 the fraction of patents sought directly through the national patent offices rarely constituted more than 2% of the total. Germany and Great Britain are the only EPO members that by 2000 still received a sizeable percentage of applications for patent protection directly through their national patent offices, thus avoiding the EPO.[9]

Since the EPO patents tell most of the story, and are from a single consistent source, we direct most of our subsequent analysis toward the European patents. We first look at trends in who uses the EPO, and then look at the patterns of designated countries in EPO patent publications. We then look at the interaction of source and destination, and the size of families. In this analysis the destination countries are the major EPO members: Austria, Belgium, Switzer-

9. Almost 39% of Austrian, 23% of Swiss, 17% of Japanese, and 6% of US applications for patent protection in Germany skip the EPO and go directly to the German patent office. In the case of those seeking patent protection in Great Britain, this percentage exceeds 10% for applications from Australia, Belgium, Canada, Denmark, Finland, Ireland, New Zealand, and the United States. Since we have no data on the families of patents that do not go through the EPO, we do not know the extent to which inventors seeking protection through the German and UK patent office were applying for patents in other countries inside or outside the EPO membership.

land, Germany, Denmark, Spain, Finland, France, Great Britain, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Sweden. The source countries include these 16 plus Australia, Canada, Japan, Norway, New Zealand, and the United States.

Sources of European patents

Figure 1.2a depicts the evolution of European patents during 1991-2000 period, according to the country of applicant, what we refer to as the source.[10] For clarity we have dropped some of the smaller source countries. Over the decade the total number of patent publications grew from 58 210 to 98 505. The extent to which this growth reflects increased innovative activity rather than changes in the patent system is the topic of Section 5.

Looking at individual sources, US applicants were the most frequent users of the European patent, accounting for around 30% of the total throughout the period. The Japanese share fell from 22 to 18% while Germany replaced Japan as the second-most frequent user, with its share rising from 18 to 21%. France and Great Britain follow with initial shares of 8.8 and 5.4%, respectively, falling by about one percentage point over the decade. During the period the Finnish and Swedish shares grew from 0.7 to 1.2 and from 1.6 to 2.5% respectively. Overall, however, the picture is one of relative stability in terms of whose applicants were making use of the European patent. Notably, nearly half of the total EPO publications involved applicants from non-member countries, mostly from the United States and Japan.

Destinations designated in European patents

Figure 1.2b depicts the evolution of European patents during the same decade according to EPO members designated for patent protection in the published EPO applications. The total number of EPO publications is the top curve. Throughout the decade around 95% of the European patents designated Germany, the most popular destination. France and Britain follow closely at around 90%, rising to 95% in the last two years. In the first half of the decade other EPO members trailed significantly. Italy, the fourth most popular destination, was designated in 73% of applications in 1990, a share which remained stable until the last two years, when its frequency jumped to 87%. Switzerland and Sweden were designated in just under half the patents, again until the last two years when they started to be named in nearly 80%. The smallest members were designated in about 25% of the European patents for most of the decade.

10. As mentioned, a patent may list applicants from multiple countries. In these cases we followed the OECD procedure and allotted a *pro rata* share of the invention to the source country according to the fraction of total applicants listed from that country.

Figure 1.2a. **EPO patent publications from selected source countries**

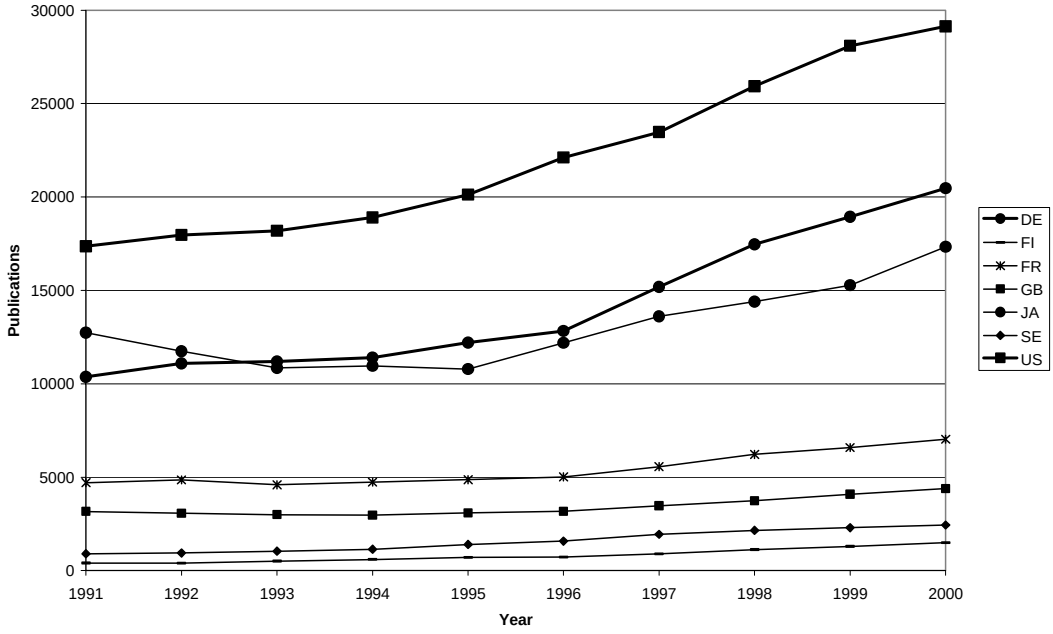
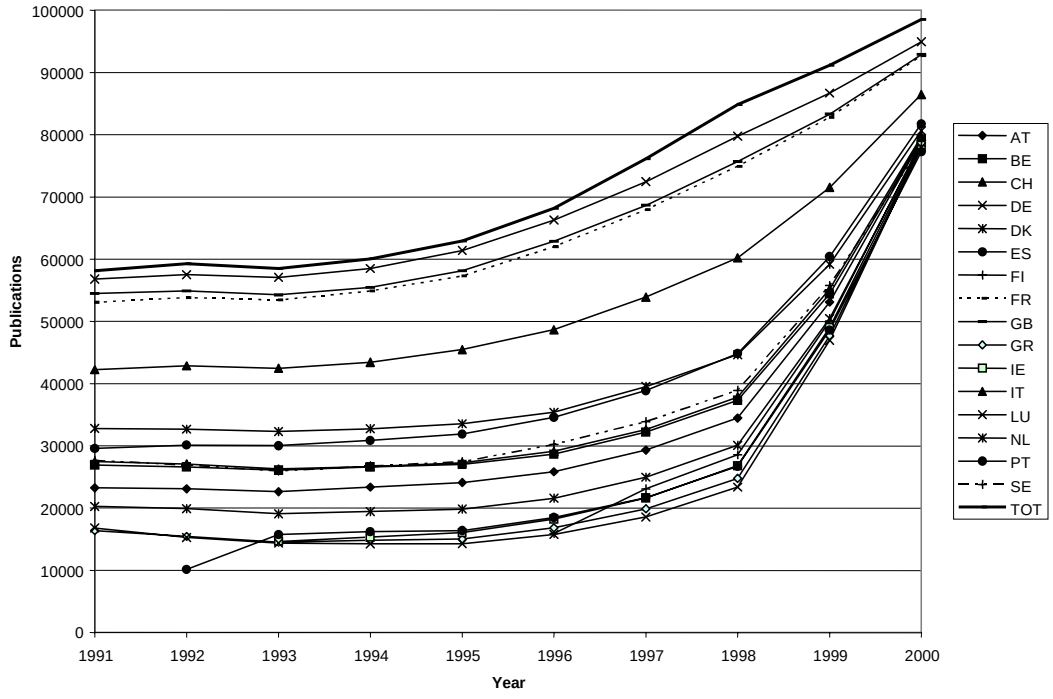


Figure 1.2b. **EPO patent publications by destination**



A remarkable development is the movement toward universality of designation in the last two years of the decade. By 2000 even the smallest EPO members were designated in nearly 80% of European patents. An obvious explanation is the substantial drop in the size of the fee per designee that occurred late in the decade.

Source-destination interaction

To what extent do source countries differ in their propensity to designate particular destination countries? As mentioned, by 2000 applicants were designating most EPO members irrespective of where they were from, while during 1991–1998 larger destinations were designated much more often.

An examination of designated states by source during the period reveals a couple of patterns. Most strikingly, Japanese applicants tended to omit smaller EPO members much more than average. A number of smaller countries (New Zealand, Denmark, and Ireland, for example) tended to designate smaller members, including those other than themselves, somewhat more than average. Otherwise designation patterns from the other source countries (*e.g.* Australia, Canada, France, Germany, Great Britain, the Netherlands, and the United States) conformed quite closely to the overall average. There is also some evidence of geography playing a role: applicants are more likely to designate countries nearby.

In summary, however, we find differences in designation propensities across sources sufficiently slight and idiosyncratic so as not to warrant systematic investigation at this point. The main story in these data over the period is the general movement toward universality in designating EPO members. For this reason we ignore differences across sources in designation propensities in what follows.

Indeed, the fact that designation propensities differ so little by source, especially in view of the strong geographic patterns found in earlier work, and the fact that designation is becoming so universal, suggest that the European patent has been highly successful in enhancing applicants' ability to obtain protection in a wide range of markets. One explanation is that the EPO, by unifying the process of applying for a patent across the Continent, has made it as simple to apply far away as nearby. Another is that European unification has made technology much more mobile across the Continent.

To the technometrician, however, this enhanced ability comes at a cost. By lowering the bar to patenting in a large number of countries, the European patent removes the need for applicants to spend much time thinking about where their inventions will ultimately prove useful. Hence where they apply for patents may reveal less about the flow of ideas across borders than was the case a decade earlier.

A simple structural model of patenting choice

As discussed above, the 1990's saw major growth in the amount of patenting taking place among EPO members, with much of this increase reflecting growth in the size of patent families. But that leaves a substantial increase in the number of inventions seeking patents. The lowering of the fees both for taking out a European patent and for designating an EPO member for protection may explain some of the increase both in the number of EPO patents and in the number of countries designated per patent. But how much? To get a handle on the answer we model the applicant's decision about how and where among EPO members to obtain patent

protection for an invention. We estimate this model using a cross-section of data on EPO and national patenting for 1995. We then see what the model predicts for the other years of the decade, and how much of the increase in patenting it attributes to the lowering of fees.

The applicant faces a trade-off between the value of obtaining patent protection in a destination and the cost of applying for a patent there. The European patent complicates the picture since, by paying the fixed fee cost for the European patent, the applicant can apply for protection in any EPO member at a much lower cost than if she filed directly through the national patent office.

Since we are only modeling the application stage, our specification of the value of patent protection implicitly builds in the expectation of future choices made by the applicant, and any additional fees resulting from these choices, such as shepherding the application through to a patent award and renewing the patent down the road.[11]

The value of obtaining patent protection in a country arises most directly from the reduced threat of imitation that a patent provides. To the extent that the imitator would sell in his home market, the value of fending off an imitator depends on the size of the market in question. To the extent that the imitator might use the invention for export, the value is linked to the size of the world market.

We reduce all these complications into a simple specification in which the value of patent protection in country *n* for invention *j* depends on the size of *n*'s market, Y_{nt}, on the size of the world market $\overline{Y_t}$, and on the quality of invention *j* as it applies to country *n*, all at time *t*:

$$V_{nt}(j) = a\left(Y_{nt} + b\overline{Y}_t\right)\eta_{nt}(j),$$

where *a* and *b* are parameters. The term $\eta_{nt}(j)$, representing the quality of invention *j* as it applies to destination *n* at time *t*, has two components

$$\eta_n(j) = \exp(u_t(j) + u_{nt}(j)),$$

where $u_t(j)$ and $u_{nt}(j)$ are the realizations of independent normal random variables with means zero and variances σ_1^2 and σ_2^2, respectively. The $u_t(j)$ term relates to the value of invention *j* wherever it is patented while $u_{nt}(j)$ relates to the value of invention *j* specific to destination *n*. It is important to remember that $V_{nt}(j)$ is not the value of the invention *j* in market *n* itself, but just the incremental value of having it protected by a patent there.

It costs c_t^E to apply for a European patent in year *t* and, having paid this cost, an additional cost c_t^D for each country designated by the European patent. For an applicant to file directly in country *n* through the national patent office costs c_{nt}^N at time *t*.

We simulate an invention as a particular draw of a $u(j)$ and a $u_n(j)$. We simulate 100 000 inventions by drawing $(N+1) * 100\,000$ standard normal random variables, weighting the first by

11. In particular, our model does not include the payment of renewal fees as part of the cost of patenting.

σ_1 and the last *N* by σ_2, to create our $\eta_n(j)$. We combine these with annual GDP, Y_{nt}, and the parameters *a* and *b* to calculate $Y_{nt}(j)$.

We then calculate the value of *(i)* optimally patenting in each national destination directly, $V_{nt}^N(j) = \max\left[V_{nt}(j) - c_{nt}^N, 0\right]$, and *(ii)* applying for a European patent:

$$V_t^E = \sum_{n \in EPO} \max\left[V_{nt}(j) - c_{nt}^D, 0\right] - c_t^E \ .$$

We assume that whenever $V_t^E \geq 0$ and $V_t^E \geq \sum_{n \in EPO} V_{nt}^N(j)$ then an EP is applied for, designating each country for which $V_{nt}(j) \geq c_t^D$. In this case no national patents are sought among EPO members. A national patent is applied for whenever $V_{nt}^N \geq 0$ and either (i) *n* is not an EPO member or (ii) *n* is a member but the conditions for an EP application fail to hold.[12]

We use the actual patenting costs to obtain the *c*'s, and data on GDP's for Y_{nt} (in billions of US dollars), and sum them across *n* to get $\overline{Y_t}$.[13] To deal with the countries that joined the EPO after our period of observation begins (Ireland, Portugal, and Finland) we set their designation costs in the EP, c_{nt}^D, equal to a prohibitively high number during their years of non-membership.

We estimate the four parameters of the model, *a*, *b*, σ_1, and σ_2 using a simple simulated method of moments procedure. We search for the parameter values that minimize the difference between patents in our simulated data and patents in the actual data for 1995 in terms of: *1)* the fraction of EP's designating each country, *2)* the number of applications filed directly with each EPO member national patent office as a fraction of total EP's, and *3)* the frequency of each family size. Specifically, we minimize the sum of squared deviations for each set of figures, equally weighted, using the amoeba algorithm programmed on GAUSS. We estimate: $a = 123$, $b = 0.4$, $\sigma_1 = 0.396$, and $\sigma_2 = 1.22$.

Figures 1.3a, 1.3b, and 1.3c show our within sample fit for each of the three criteria we try to match. Figure 1.3a shows that our model matches the patterns of designating destinations in EPO patent publications very successfully, particularly given the parsimony of the model. A simple measure of market size goes a long way in explaining which countries are designated as of 1995.

The model also captures the essence of patterns in patenting directly through national patent offices, although more roughly. For example, Great Britain is much more popular and France is much less popular for direct applications than the model predicts.

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12. Our procedure is slightly modified in the year 2000 to accommodate a change in the EPO fee structure that came into effect in mid 1999. At that point the EPO introduced a cap on the number of designation fees that needed to be paid. In particular, once designation was sought in at least seven EPO members, the designation fee in the remaining EPO members dropped to zero.

13. We incorporate the actual EPO fee structure each year including the cost of the search. We were unable to find systematic historical data on fees for applying directly to each national patent office. Some estimates of these fees are available, as of 1992, from Helfgott (1993). Based crudely on Helfgott's estimates, we assume a fee of USD 800 for applying directly to a national patent office (including the search fee).

Figure 1.3a. **EPO designations in 1995: model and data**

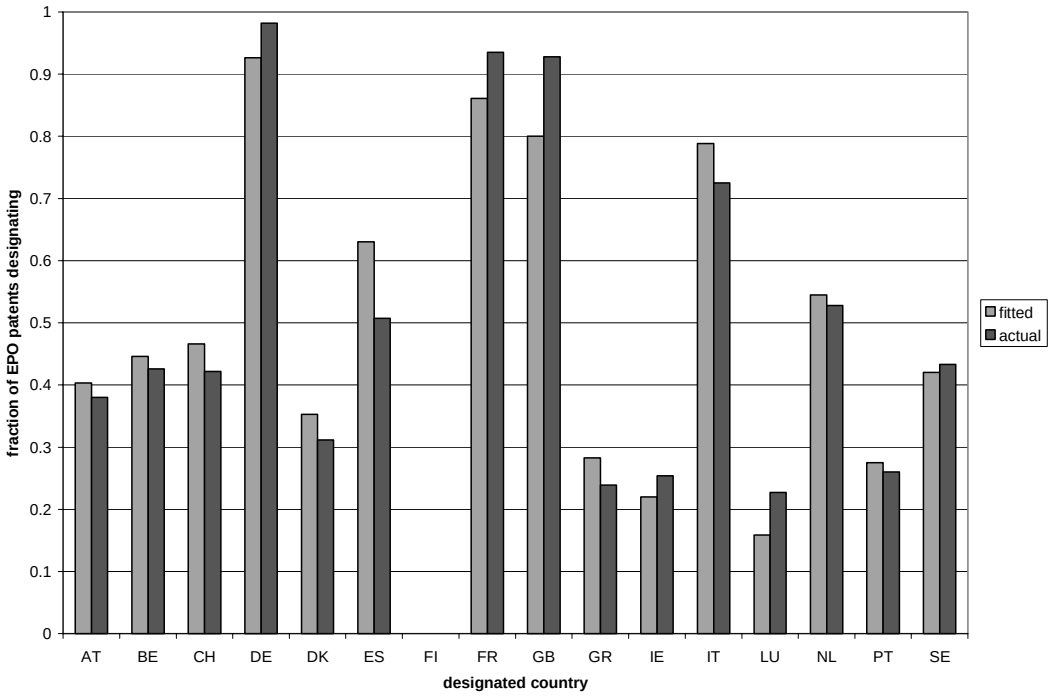


Figure 1.3b. **Patent applications to the national offices in 1995: model and data**

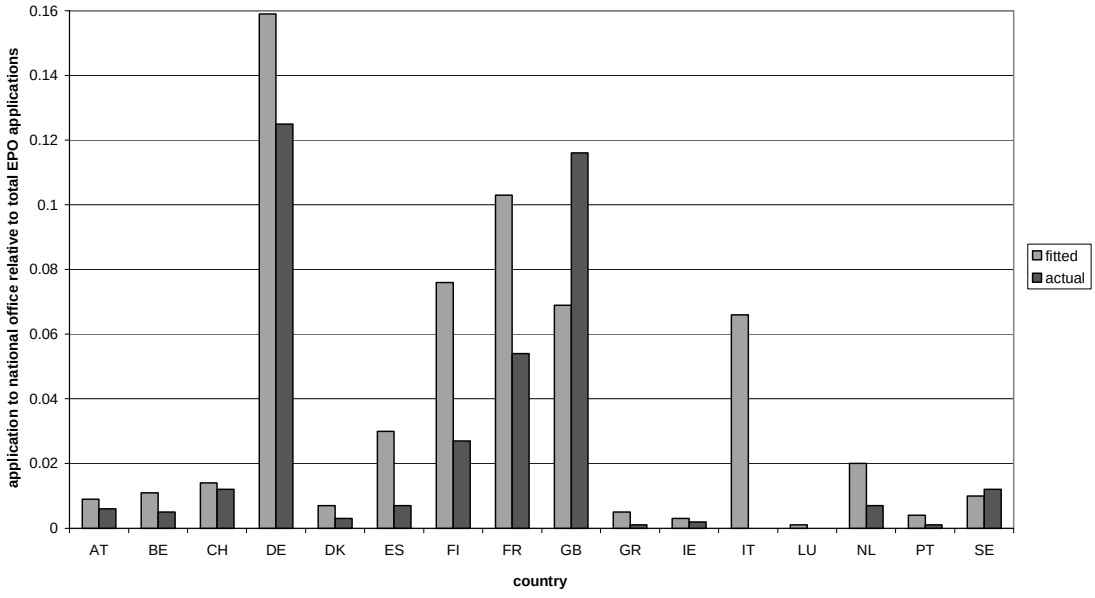
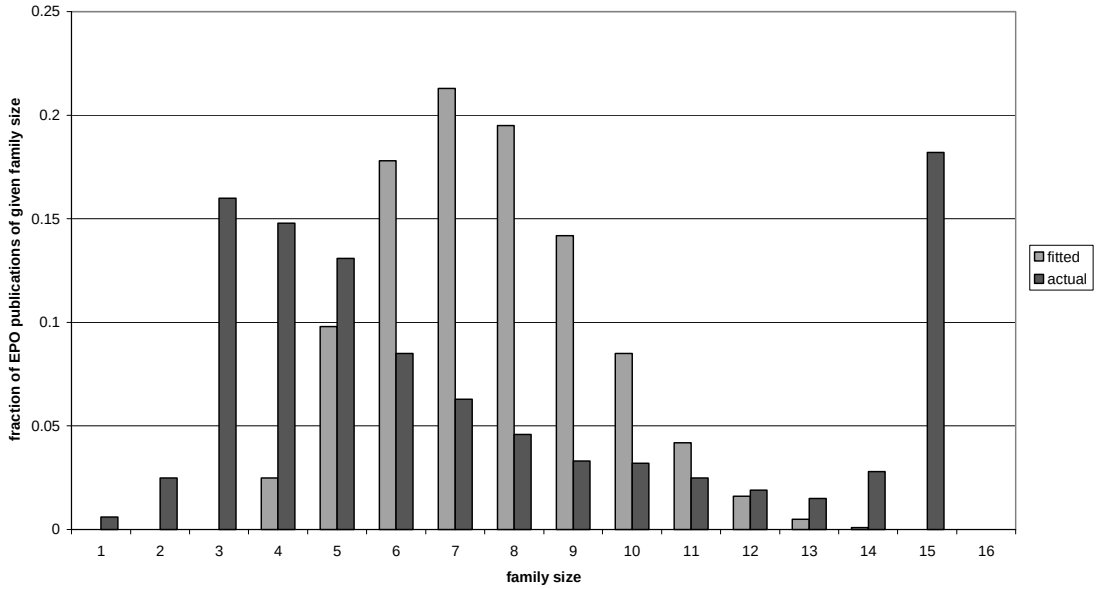


Figure 1.3c. **EPO family size distribution in 1995: model and data**



The model performs rather poorly, however, in fitting the shape of the family size distribution in 1995. In particular, it fails to capture the bimodal nature of the distribution. As of 1995, nearly 20% of European patents designated 15 or more countries, whereas the model predicts that almost no patent family would be this large. The poor performance along the family-size dimension suggests avenues for improving the model in future work.

How well does the model perform out of sample? Driving our simulation of the changes that took place toward the end of the decade was the dramatic fall in the cost of applying for patent protection through the EPO. Figure 1.4a shows the fee structure and Figure 1.4b converts these fees into the cost of applying for patent families of various sizes through the EPO. By 1998 the costs of designating an EPO destination had fallen from over USD 200 (during 1991–1996) to around USD 85. By 2000, the cost per additional designation had fallen to zero once seven countries were designated.

Figure 1.4a. **EPO fees**

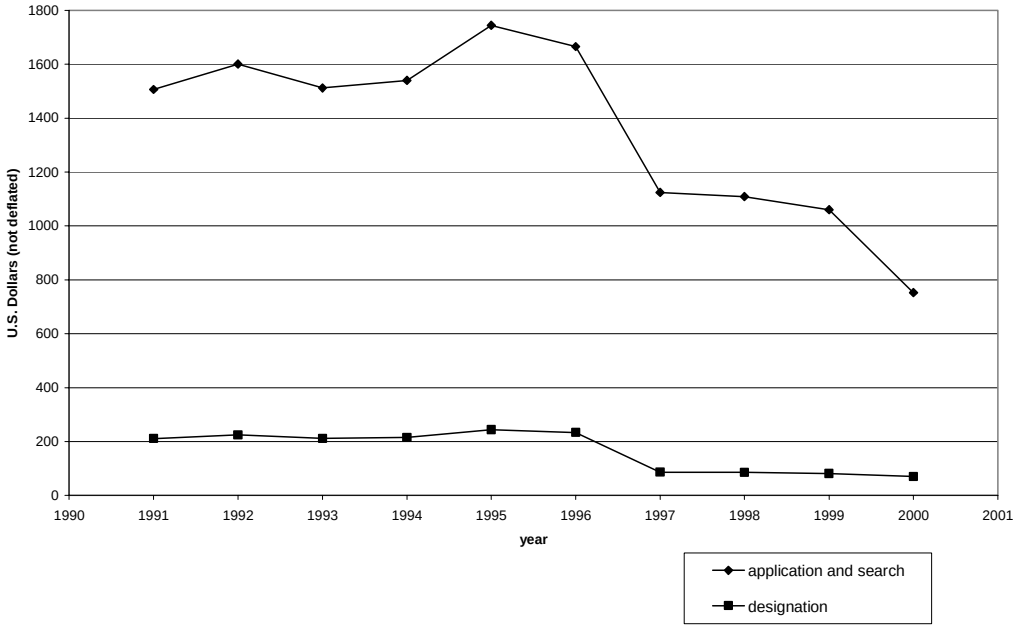


Figure 1.4b. **Fees for various size EPO patent families**

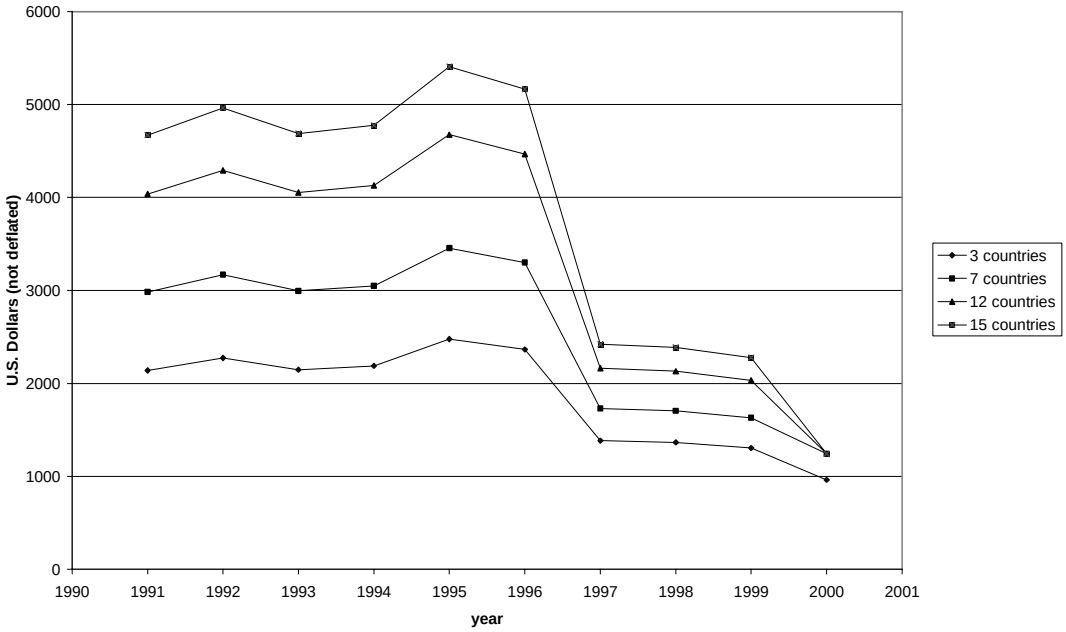
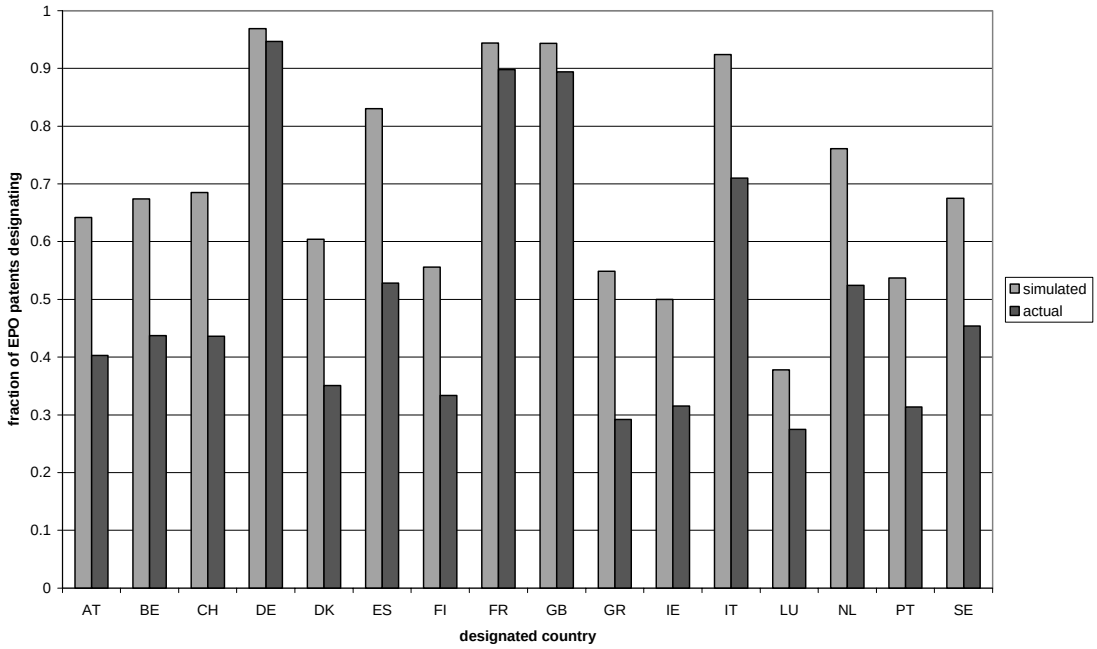


Figure 1.5. **EPO designations in 1998: model and data**



As Figure 1.5 shows, as of 1998 the applicants in our simulations responded by designating more broadly than did actual applicants. By 2000, however, when the EPO was offering a bulk discount, designation was virtually universal, and our model predicts full universality. (Figures 1.6a and 1.6b). Figure 1.7 examines how our simulations capture the evolution over time for the fraction of EPO patents designating various countries. Notice how closely this simulation captures the pattern in the data (Figure 1.2b). Although market size is a critical determinant of designation as of 1995, its importance dwindles as the cost of designation declines.

Figure 1.6a. **EPO designations in 2000: model and data**

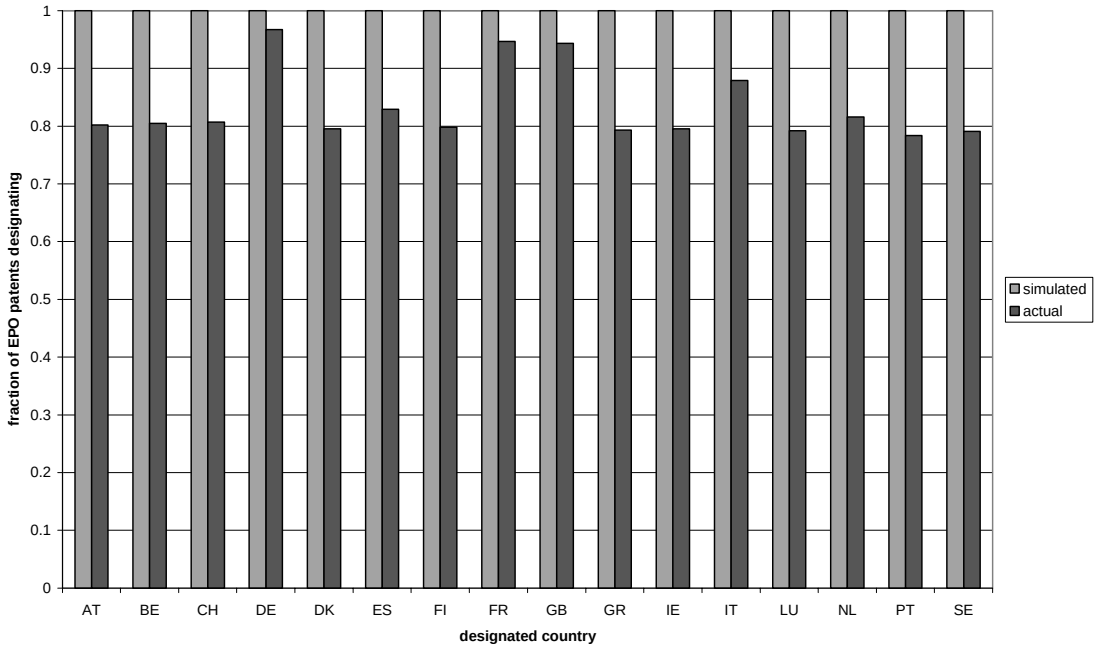


Figure 1.6b. **EPO family size distribution in 2000: model and data**

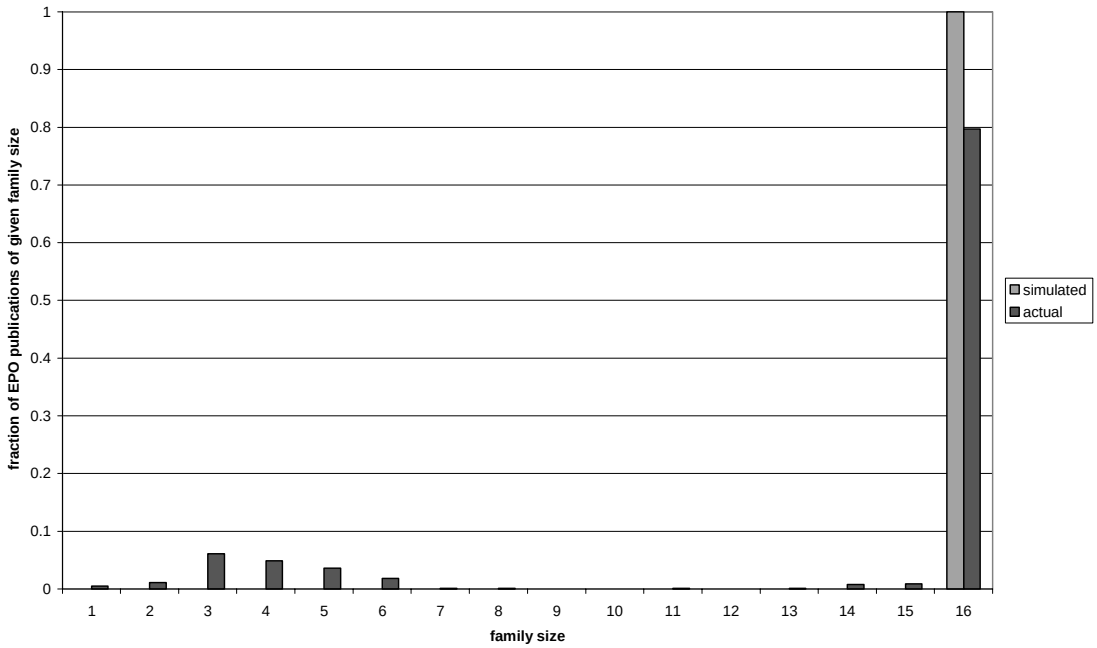
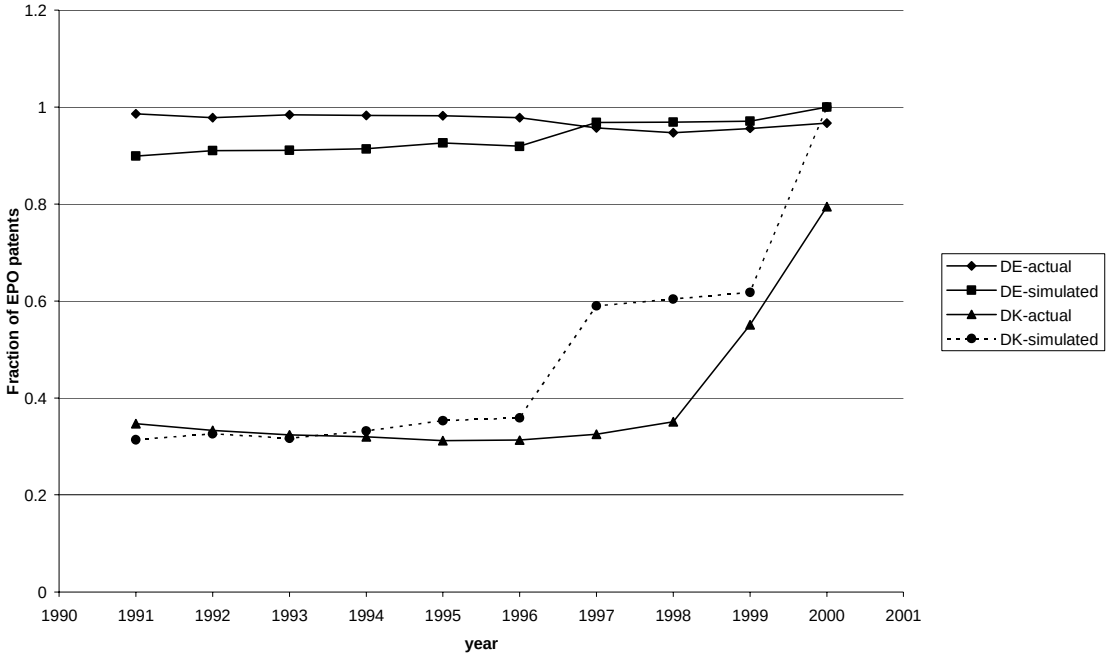


Figure 1.7. **EPO designations in Germany and Denmark: actual and simulated**



In simulating patenting behavior in years outside 1995, we keep the draw of inventions at 100 000 and, of course, assume the same distribution of the random components of patent values. We are holding inventive activity constant. Any changes in patenting activity in our model are thus due only to changes in GDP relative to patenting costs.[14]

To what extent, then, are developments in the level of EPO patenting simply a consequence of falling patenting costs? Is there any evidence in the EPO data that the rate of innovation itself has increased? Estimates of the model allow us to perform such a decomposition, in which the model accounts for the increase in patenting due to declining patenting costs (relative to GDP's) and the residual indicates innovation. Figure 1.8 shows that the model accounts for much of the increase in EPO patenting over the decade. More specifically, it explains more than 60% of the nearly 6% annual increase in EPO patenting. To explain the rest, innovative activity would need to have increased by a much more modest but nevertheless substantial 2.3% per year. The actual pattern of this residual measure of innovative activity is shown in Figure 1.9.

14. Another factor that would alter the value of patent protection is any change in the fees for renewing patents. We would expect these fees to be anticipated and thus embodied in the present value of obtaining a patent. In future work we plan to incorporate renewal fees.

Figure 1.8. **Actual and simulated EPO patenting**

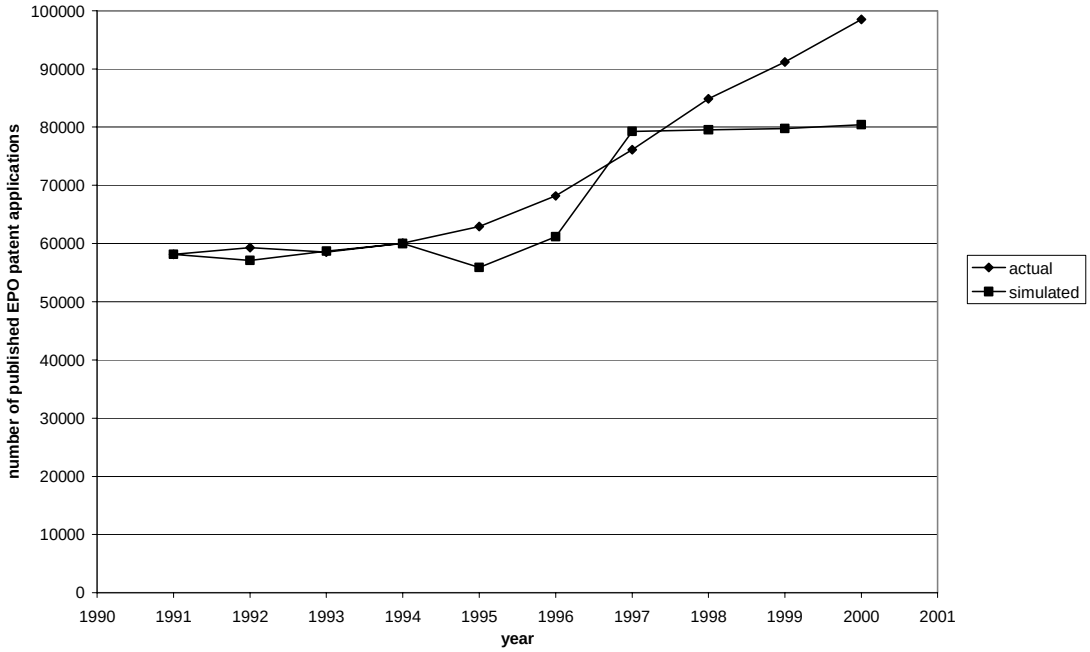
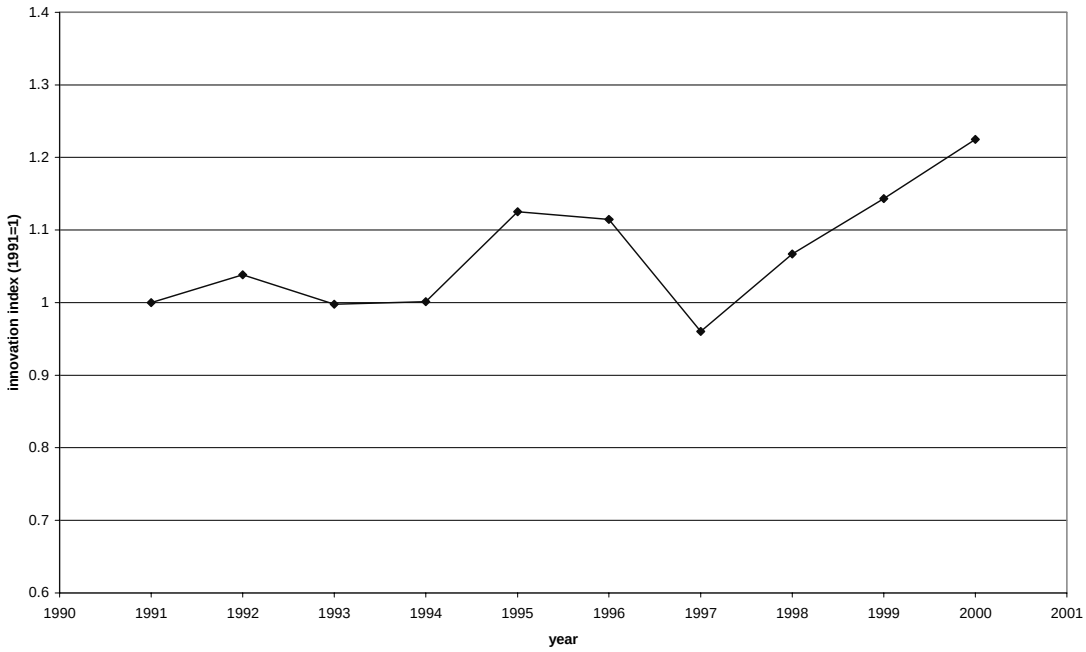


Figure 1.9. **Residual index of innovation**



Conclusion

This paper sought to understand the effect of a changing international institutional framework on the patent application process. Institutions like the EPO are increasingly held out as solutions to the problems facing the various national patent offices. But our understanding of their workings and their impact on innovation remains limited.

To address this issue, we have first sought to understand the flow of patent applications across nations. Such information is reported by, among other sources, the EPO, the OECD, and WIPO. We discover that the data can be misleading. We offer our own reconciliation of the patterns reported in the various statistical compilations.

We then focus on understanding the changing patterns of patent applications during the decade of the 1990s up through 2001. We first look at the simple patterns in the raw data. We then fit a more sophisticated model, which models the patenting decision in terms of the economic opportunity in each nation, the cost of the various routes to patent protection, and unobserved factors.

Several conclusions emerge:

- European patents became increasingly important over the course of the 1990s. Throughout the decade, only a modest fraction of applications arriving at the various European patent offices did make use of the EPO. The effect was particularly pronounced in the smaller European nations.

- The rise of the European patent coincided with a declining importance of geographic distance as a determinant of patent filings: Today few geographic patterns are readily apparent in the data.

- The changing fee structure of the EPO has had a profound affect on the distribution of patent applications across countries. Well over half of the 70% increase in European patenting between 1990 and 2000 can be attributed to the changing fee structure employed by the EPO. This analysis suggests the need to be cautious when employing raw patent applications as an indicator of innovation.

- Even after adjusting for the changing fee structure of the European patents, a substantial boost in European patenting occurred over the 1990s. Our best estimate is that over the course of this decade, the rate of innovation indicated by European patenting increased by a more modest (but still impressive) 2.3% per year.

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Chapter 2

JAPAN'S PATENT SYSTEM AND BUSINESS INNOVATION: REASSESSING PRO-PATENT POLICIES

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Since Japanese patent law was enacted in 1959, it has been revised several times, mainly for the purpose of international harmonization. Recently, the Japanese government has stressed the importance of pro-patent policies, i.e. strengthening intellectual property rights in order to stimulate business innovation and regain international competitiveness. This paper assesses the impact of a series of revisions of the Japanese patent system on firms' innovation activities by using statistical data, firm-level survey data and information from interviews with IP managers in IT and pharmaceutical firms.

The number of patent applications dropped in the early 1990s, but picked up again after 1995. It has been found that increases in patent applications in the late 1990s can be attributed to a surge in IT and pharmaceutical patents. This trend is paralleled with an upward R&D trend in these sectors and with a gradual expansion of patent protection in areas such as software and biotechnology. Policy changes to expand patent subject matter may have contributed to an increase in patent applications, but it is difficult to separate their relative contribution from that of other factors such as increased technological opportunities. As regards policy changes to strengthen patent rights, such as improving settlement systems and raising the amount of compensation for damages in patent infringement litigation, firms have not perceived significant impacts on their innovation activities.

In contrast, it is clear that IP sections within firms have started to play a more active role in the formulation of firms' innovation strategies in recent years, particularly in the pharmaceuticals sector. Tremendous technological opportunities in IT and biotechnology have pushed firms to rely on external knowledge pools via licensing activities, and the co-ordination of in-house R&D with licensing activities to tap external technology sources has become more important. In this context, IP sections are heavily involved in R&D and product development processes within firms.

Finally, it has been found that large firms in the IT and pharmaceuticals industries pay much more attention to the US patent system - which moves relatively quickly for new technology field patenting - than to the Japanese system. In this globalized world, it is important to increase efforts towards the international harmonization of IPR systems in order to ensure that firms can conduct innovation activities on a level playing field across countries.

1. Views expressed in this paper are the author's and not those of the organizations with which he is affiliated.

Introduction

The Japanese government published the Strategic Framework for Intellectual Property Policy in June 2003. The purpose of this framework is to enhance Japan's industrial competitiveness by promoting the creation, strengthening the protection, and promoting the utilization of intellectual property. In addition, the Basic Law on Intellectual Property was adopted in November 2003, and led to action plans to promote the creation, dissemination, and effective exploitation of IP to contribute to the development of new industries. Implementation of this action plan involves various related ministries, and is co-ordinated by the Intellectual Property Policy Headquarters, headed by the Prime Minister.

Since the beginning of the 1990s Japan's economy has been mired in a long period of stagnation. Stimulation of business innovation is vital to break out this constraining situation. The Strategic Framework for Intellectual Property aims to encourage innovation through proactive action plans to stimulate effective use of intellectual property. It covers a wide range of topics, including promotion of patenting by universities and public research institutions, revision of regulations on staff inventions within businesses, and revision of the Unfair Competition Prevention Law to prevent technology drain to overseas. Key elements of the Strategic Framework are pro-patent policies, such as speeding up patent examination procedures, revision of the tort system, and protecting IP in new fields such as biotechnology and information technology (IT).

Against this background, one frequently encounters the argument that the pro-patent policies adopted by the United States, which had been mired in decreasing competitiveness in the 1980s, provided the driving force behind today's rebirth of American competitiveness. Representative examples of pro-patent policies advanced in the United States in the 1980s include the establishment of the Court of Appeals for the Federal Circuit (CAFC) to specialize in appeals concerning patent infringement, and the extension of patent protection in the biotechnology and software fields. Such extension and strengthening of patent rights is argued to have stimulated business innovation, leading to enhanced US competitiveness. In addition, the amount of damage compensation in connection with patent disputes has recently soared in the United States. This increase may also contribute to the trend toward strengthening patent rights.

However, even in the United States opinions are divided as to whether pro-patent policies to expand and strengthen patent protection have had any visible effects on business innovation. A wide range of factors influence incentives for investment in research and development (R&D) and new product development by businesses. These factors include the economic conditions of the businesses as well as expanding technological opportunities and policy factors not related to the IP system (for example, pharmaceutical safety regulations). Results of most analyses, primarily of US cases, indicate that pro-patent policies have only marginal effects on business innovation (Kortum and Lerner, 1999; Hall and Ziedonis, 2001; Lerner, 2002). In addition, one criticism of pro-patent policies lies in the "anti-commons" problem. Taking the pharmaceuticals field as an example, the anti-commons argument states that successive application of patent protection to genetic inventions results in decreased R&D efficiency by increasing the number of patent licenses required in order to conduct such R&D (Heller and Eisenberg, 1998). Another vital issue concerns the goal of IPR policies to promote the circulation of technology by providing incentives for business innovation and clarifying rights to established technologies. Granting excessive exclusive rights to specific technologies may impede such circulation of technology.

This paper empirically analyzes the effects on business innovation of changes in Japan's patent system. Although the pro-patent approaches of Japan and the United States differ, until now most research on the subject has concerned the United States. Indeed, empirical research on the relationship between Japan's patent system and innovation is virtually nonexistent[2]. In addition, strategies for securing exclusive rights to technology, including patents, are understood to differ between Japanese and American firms (Cohen *et al.*, 2003). For these reasons, analysis of the effects of the Japanese system on business innovation is important to draw proper policy implications for the patent system in Japan. In this paper, we will first examine changes to Japan's patent system and trends in innovation, including patent application and R&D investment. Next, we will analyze the effects of patent system changes as viewed by businesses, using results from a survey conducted by the Institute of Intellectual Property. We will then employ an analysis based on interviews with businesses to gather qualitative information unobtainable through the survey. These interviews focused on the biotechnology and IT fields, which have experienced notable recent technological progress. Finally, we will address the policy conclusions that may be drawn from this research.

Business innovation and changes to Japan's patent system

The history of Japan's patent system goes back to the Statute of Monopoly Patent, established in 1885. Patent law at that time, modeled on French and American law, applied the "first-to-invent rule". The law underwent numerous subsequent revisions, and from 1921 the patent law applied the "first-to-file rule". The current post-war Patent Law was adopted in 1959 and went into effect in April 1960. In addition to clarifying the requirements for an invention through provisions such as the inventive step, the law also fulfilled the requirements of modern patent law; for example, by adopting an international rule concerning the loss of novelty occurring when an invention enters the public domain through publication[3]. We shall now review changes in the post-war patent system based on this new Patent Law and examine the accompanying trends in patent applications and in R&D.[4]

Table 2.1 lists major revisions to the patent system under the new Patent Law. These fall into the following four categories: extension of patent protection to new spheres, such as the introduction of microbiology patents; extension of patent protection across technology fields, such as the revised system of multiple claims; strengthening of patent rights, such as increases in damage claim amounts; and modification of the way the patent system operates, such as introducing electronic patent application submission system.

2. An exception is Branstetter and Sakakibara (2001), who examined the effects of the revised system of multiple claims adopted in 1988 on business R&D and patent applications.

3. These historical references to Japan's Patent Law are based mostly on Kadota and Tatsumi (2000).

4. In Japan the Utility Model Law covers small-scale inventions not subject to patent law. Although the utility model system, along with the patent system, has made major contributions to Japan's economic development, since the late 1980s the number of applications under the Utility Model Law has declined dramatically. Under revisions made in 1994 the utility model system shifted to a registration system without examination, but applications and registrations continued to decline. In 2001, while approximately 440 000 patent applications were submitted, only 9 000 utility model applications were submitted.

Table 2.1. **Major changes in Japan's patent system**

	New technology patent	Wider range patent	Stronger patent	User-friendly patent
1970s	Microbe (1979)	Chemical compound (1976)		Application laying open system (1971) Request for examination system (1971)
1980s	Animals (1988)	Multi-claim (1988) Extension of patent period for drugs (1988)		
1990s	Definition of software patent (1993) e-money (1995) Software media (1997) (Gene-related patent) (Business model patent)	Doctrine of equivalence (Ball Spline case, 1998)	Post grant opposition system (1996) Raising penalty to patent infringement (1999) Review of penal provisions (1999)	Electronic application (1990) Application in English (1995) Application fee reduction (1998)* Application fee reduction (1999)*
2000s	Software (2000)		Expansion of remedies against infringements (2000)	Shortening time limit for request for examination (7 yrs to 3 yrs, 2001)

* Until 1998, application and registration fees had been raised occasionally (not described in this table).

The major areas subject to the extension of patent protection to new spheres are software and biotechnology. In 1985, copyright law was revised to provide clear protection for software as copyrighted material. However, since copyright law ultimately protects expression, not ideas, protection of software under patent law also came under consideration. In the consideration of patent protection for software, issues arose as to whether software qualifies under the patent law requirement that an invention include technological ideas along the lines of natural science theory. Through the early 1990s, software itself, which consisted simply of calculation methods, was not considered to be subject to patent protection. However, software enabling the functioning of hardware, such as the Japanese language input system used in word processors, was patentable together with such hardware. In line with the increase in packaged software not embedded in hardware, in 1997 patent protection was allowed for software re-

corded on media such as floppy disks. In 2000, software was made eligible for patent protection as software itself, and in 2002 this protection was extended to software that circulates on computer networks.

In connection with software patent protection, recently patent protection has been extended to business models, such as e-commerce auctions and settlement systems. Even Japan, which has lagged behind the United States in implementing such patent protection, has seen approval of a number of such business model patents. Currently, inventive step examination is becoming stricter as patent litigation cases accumulate. With regard to standards for patent protection, in Japan as in Europe, business model patents are only granted for business models that have technological aspects. For this reason, pure business methods unrelated to software are not granted patent protection. On this point, Japan's standards are stricter than those of the United States, where a wide range of business models may be patented if they have utility, regardless of technological aspects. However, the results of research comparing standards for software-related business model patents in Japan, the United States and Europe, conducted by the patent offices in those regions, show no major differences between the three markets (Japan Patent Office, 2000).[5]

In the field of biotechnology, beginning with the introduction of microbiology patents in 1979, the range of inventions subject to patent protection has expanded in line with technological developments in the field. In the 1980s, genetically engineered pharmaceuticals, plants and animals became subject to patent protection. Since the 1990s, patents have been available for genetic functional analysis and research tools. With regard to gene fragment patents, in 1999, Japan, the United States and Europe agreed not to extend patent protection to gene fragments unless they have specific functions or special utility; however, it has been pointed out that each patent office has its own methods of determining whether a gene fragment has such functions or special utility. In Japan, patent requirements are clearly defined under the standards for genetic patent examination established in 1999. These examination standards have since been updated, *e.g.* with the addition of screening method precedents in 2000.

The extension of the scope of patent protection is not limited to new spheres such as IT and biotechnology. Also vital are measures for extension of patent protection across technology fields, such as the introduction of chemical compound patents (in 1976), the system of multiple claims (in 1988), and the system for extension of the patent term for pharmaceuticals (in 1988).

Until the introduction of chemical compound patents, only methods of production could be patented for a drug that was a new chemical entity. However, since 1976 such entities themselves have been subject to patent protection. Before, it was impossible to stop another firm from circumventing patent protection through the use of different production methods. Such circumstances inhibited incentives for the development of new medicines. Protection of pharmaceuticals based on new compounds through the adoption of substance patents is said to have had a major effect on pharmaceuticals R&D.

5. Among the three regions, examination standards are particularly strict in Europe, where business models are specifically excluded from patent protection. However, business model patents are most common in the software field, and such patents are awarded if they meet the technological requirements of software (Aida, Hirashima, and Sumikura, 2001).

In addition, the revised system of multiple claims adopted since 1988 allows a single patent application to cover multiple inventions. Japan's patent system used to operate on the one-patent-one-claim principle which required numerous individual patent applications for multiple related inventions. By enabling the collection of such inventions under a single patent application, a wider range of inventions may be subject to wider patent protection.

Along with the revised system of multiple claims, special measures were adopted to extend patent terms for inventions such as pharmaceuticals and agricultural chemicals, which require long periods for government approval before they may go on the market. The ordinary duration of a patent is 20 years, but under these measures this period may be extended by up to five years.

Furthermore, the doctrine of equivalents was adopted for interpretation of the breadth of claims protected by patents in 1998. This doctrine states that even if insubstantial elements of a patented claim are replaced with different elements, activities that have operational results identical to those of the original patent will still qualify as infringements of the original patent. In the 1998 Ball Spline Case, Japan's courts affirmed the doctrine of equivalents. General adoption of the doctrine of equivalents with regard to patent disputes could result in a broadening of the scope of claims protected by patent rights. Other revisions recently implemented have also tended to strengthen patent rights. Major examples include increased damage claim amounts for patent infringements (implemented in 1999 and 2000), the revision of the patent dispute processing system, and the revision of legal judgment procedures.

Since the late 1990s, the Japan Patent Office (JPO) has also worked to strengthen the protection of patent rights. In this context, it is recognized that revisions to the patent system itself are strongly linked to the strengthening of patent protection. Many of the measures implemented by the JPO have been specifically aimed at speeding up patent examinations. For example, in 1996 the allowable period for lodging objections to the granting of a patent was extended beyond the grant of the patent, in an effort to shorten the time required for obtaining a patent. In addition, although fees for patent applications, requests for substantive examination and registration had been steadily increased through the early 1990s, they were reduced both in 1998 and 1999. These measures were intended to encourage protection of the results of technological and other kinds of development through patents. In fact, the 2001 reduction in the required period between patent application and a request for examination (from seven to three years) was expected to result in a large number of requests for substantive examination in the short term. In response, fees for requests for examination were increased from the beginning of 2003.

Japan's patent system has thus undergone numerous revisions. We shall now examine the relationship between these revisions and innovation in business, including patents and R&D activities. Figure 2.1 shows long-term trends in the number of patent applications, R&D expenses, and GDP. Figure 2.2 shows trends in these figures since 1980 in greater detail. Until about 1980, these three indicators largely moved in parallel. However, since 1980 growth in the number of patent applications and R&D expenses has exceeded that of GDP. Japan saw high economic growth in the 1980s, *i.e.* 4% or more per year on average. The strength of the economy in those years can be seen to have stimulated business R&D and encouraged applications for patents. The beginning of the 1990s then saw the collapse of the so-called "bubble economy", leading to a decrease in economic growth to around 1% per year on average. Initially, at this time R&D expenses and the number of patent applications fell. Thus, we may consider trends in R&D expenses and the number of patent applications generally to reflect the economic conditions of the time.

Figure 2.1. **R&D, patents and GDP**

(1980 = 1)

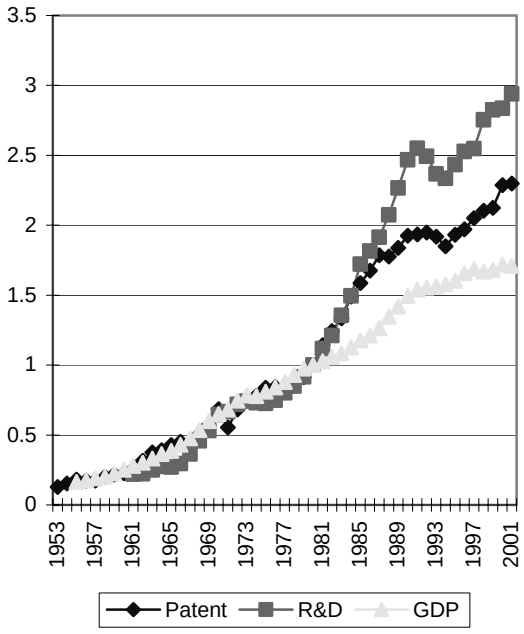
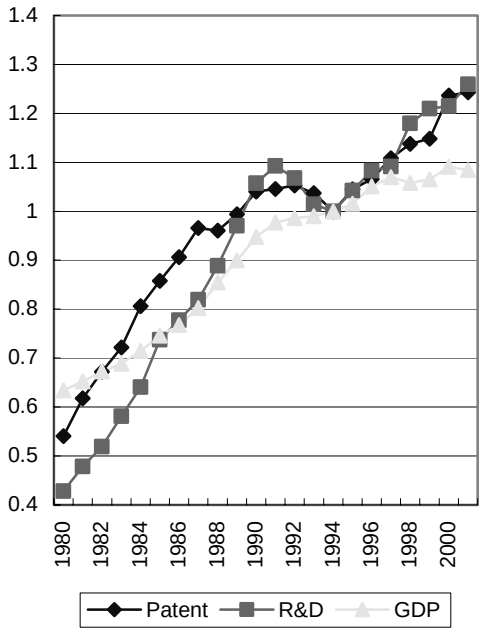


Figure 2.2. **R&D, patents and GDP**

(1994 = 1)



If we look at trends in the late 1990s, however, we see a different tendency: significant increases in patents and R&D despite unremarkable economic growth rates. With regard to patent application data in particular, if we take into account the fact that the adoption of the revised system of multiple claims in 1988 increased the number of claims that could be covered under a single patent, we realize that the increase in the volume of claims exceeded even the growth in patent applications.[6] As Table 2.1 shows, since the late 1990s various patent system revisions have taken place, such as the introduction of patents in new areas, the strengthening of patent protection, and revision of the patent system overall. However, it is difficult to determine using macroeconomic data whether or not this increase in applications is an effect of these changes to the patent system.

Figure 2.3 shows shares of the increase in patent applications (55 898 applications) by technological field from 1995 through 2000. Using the three-digit International Patent Classification (IPC) industry classifications, five of 120 technological fields accounted for 65% of the total increase. Most of these were IT-related fields (biotechnology fields related to pharmaceuticals were also represented). The share of the classification that includes software (G06: Computing; Calculating; Counting) was particularly large. The G06 classification accounted for approximately 34 000 patent applications in 2000, of which approximately 20 000 were software-related (G06F). This shows that the trend toward extension of patent protection to software, as well as to business methods, has had a significant effect on recent growth in the number of patent applications.

6. The average number of claims per patent has increased from 2.8 in 1989 to 7.6 in 2001.

Figure 2.3.
Increase in patent applications from 1995 to 2000

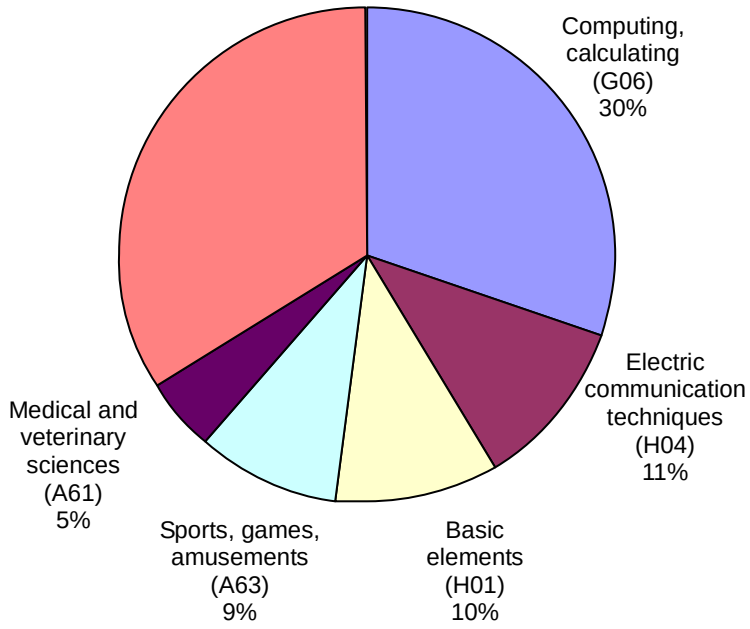
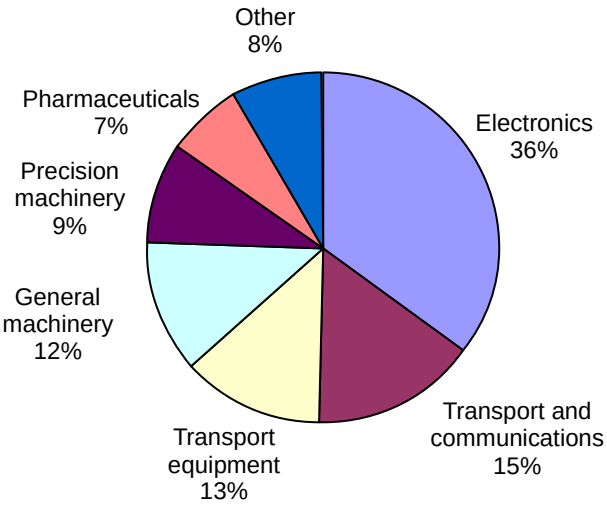


Figure 2.4 shows the increase in R&D expenses (JPY 1.46 trillion) over the period from 1995-2000, broken down by industry. Increases in R&D expenses in IT-related fields (such as telecommunications, measurement instruments, transportation, and communications) represented a significant portion of this amount. In addition, since firms in machinery-based industries (involving transportation machinery, general machinery, and precision machinery, for example) are likely to conduct IT-related research, to some degree these industries have also contributed to the increase in R&D investment and patent applications related to IT.

Figure 2.4.
Incremental amount of R&D from 1995-2000



Thus, growth in certain primarily IT-related technological fields had a major impact on increasing growth in R&D investment and patent applications in the late 1990s, despite low levels of economic growth. With regard to changes to the patent system, the extension of the scope of patent protection to include new spheres such as software seems to have had a stronger effect than pro-patent policies across fields such as revisions to patent dispute procedures and increased damage claim amounts. We will examine this point in more detail in the following sections.

Assessment analysis of pro-patent policies: survey data analysis

As we have seen, the current Patent Law has undergone various changes since its establishment in 1959. These changes largely stem from international requirements such as harmonization with international agreements such as the Paris Convention and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) of the World Trade Organization (WTO), in addition to measures adopted since the late 1980s based on the Japan-US Structural Impediments Initiative. Since the late 1990s, the importance of strengthening the protection of patent rights through pro-patent policies has become clear, and steady efforts have been made to protect inventions in new fields, in line with advances in IT and biotechnology. The previous section summarized these changes to the patent system and looked at their relationship to business innovation, as seen in macroeconomic and industry-specific trends in patents and R&D. In this section, we will analyze these matters in more detail, using the results of survey data from the Institute of Intellectual Property.

Under Japan's patent system, patent rights have been both extended and strengthened. Extension of patent protections to new technological fields and extension of the scope of patent protections (the breadth of claims) have resulted in covering a broader range of technology. In addition, patent protections have been strengthened, as evidenced by increases in damage claim amounts. What effects have these policies had on innovative business activities, such as R&D?[7]

By securing a fixed period of exclusive rights for inventions that have economic uses, patent rights provide economic incentives for R&D. In this context, pro-patent policies promote business innovation. However, when we consider innovative efficiency for the society as a whole, we must not neglect the point of view of technology users. Typically, R&D builds cumulatively on past scientific knowledge ("standing on the shoulders of giants" principle). For this reason, if from the user's point of view knowledge is excessively protected by patent rights, cumulative innovation will be impeded. Recently, genetic patents and patents for research tools have increased in the biotechnology field. These patents may have a negative effect on downstream R&D in pharmaceutical development. In addition, in the software field, multiple patents are sometimes combined into a single complete technology, in which case using such patents requires negotiations with multiple patent holders, resulting in increased transaction costs. Thus, when considering the relationship between the patent system and innovation, we must take note not only of the incentives to inventors but also of the mutual relationship between innovations and their users. In order to examine the relationship between pro-patent policies and technological spillover, it is useful to examine trends in licensing, which serve as an indicator of the state of technology markets.

Another essential purpose of the patent system is to encourage technological spillover by means other than licensing, including through publication of technological information. Benefits related to the publication of patent information on developed technologies include the stimulation of new ideas and reduced redundancy in R&D investment by other firms. Japan's patent system places emphasis on the publication of technological information and related spillover effects, as on the establishment of a system for publication of patent applications, in place since 1970.[8]

The Institute of Intellectual Property conducted a survey at the end of 2001 to determine the actual relationships between pro-patent polices and business innovation and licensing trends. Although this was a small-scale survey of 1 398 firms (valid responses were received from 373 firms, for a response rate of 26.7%), it provides useful information because it examined in detail both matters related to inventors, such as patent applications and R&D, and matters related to users, such as third-party licensing of corporate patents (Institute of Intellectual Property, 2002). This survey classified pro-patent policies into the following three types and investigated the effects of each type on business innovation:

7. Concerning the relationship between pro-patent policies and innovation in the United States, Jaffe (2000) conducted a wide-ranging survey including both theoretical and empirical research. In addition, the survey by Nakayama (2002) focuses on anticommons issues resulting from pro-patent policies.

8. In the United States, a system of publishing applications was established in 1999 as a result of the international harmonization of patent systems. However, this publication of technology has come under intense criticism for handicapping small and medium-sized enterprises by weakening their negotiating power. (Gallini, 2002).

1. Broad protection: extension of protection to new spheres (*e.g.* patents relating to microbiology, gene fragments, software, and business models).
2. Broad protection: extension of the coverage of an individual patent (*e.g.* application of the revised system of multiple claims and the doctrine of equivalents).
3. Strong protection: increasing amounts of damage claims and speeding up the dispute process and other policies.

Table 2.2 shows percentages of firms by sector reporting increases in R&D expenses, increases in patent applications, or negative effects as a result of the three polices above. The data is classified to allow comparisons between trends among large firms in R&D-intensive industries, such as the pharmaceuticals and electrical machinery industries, and those of R&D-intensive small and medium-sized enterprises (high-tech start-ups), as well as the overall average. The most distinguishing characteristic of Table 2.2 is the high percentage of firms in the pharmaceuticals industry that reported some kind of effect. The pharmaceuticals industry is one in which patents are especially effective as a means of protecting exclusive rights to technology.[9] It is natural that this industry would experience major effects from changes to the patent system. In particular, policies to broaden patent protection by extension to new spheres appear to have had significant effects: close to half of responding pharmaceutical firms have increased their patent applications, and approximately one in three have increased R&D expenses. At the same time, the percentage of pharmaceutical firms reporting negative effects is greater than in other industries, indicating that while a firm's exclusive rights to its own technology may have increased, the same may be said for other firms as well.

Table 2.2. **Effect of pro-patent policy on firms' innovation activities**

		All	Drugs	Electronics	SMEs
Wide patent (new technology)	Increase R&D	8.0%	34.6%	22.0%	15.8%
	Increase patent application	24.1%	46.2%	26.1%	11.8%
	Harmful effects	6.2%	23.1%	4.3%	3.9%
Wide patent (not technology-specific)	Increase R&D	5.9%	19.2%	0.0%	11.8%
	Increase patent application	11.3%	23.1%	8.7%	10.5%
	Harmful effects	11.5%	23.1%	6.5%	3.9%
Strong patent	Increase R&D incentives	27.3%	30.8%	30.4%	19.7%
	Increase patent application	14.7%	19.2%	17.4%	9.2%
	More use of patent	17.4%	11.5%	23.9%	11.8%
	Harmful effects	7.5%	11.5%	4.3%	1.3%

When compared with the pharmaceuticals industry, the electrical machinery industry has not felt such strong effects of pro-patent policies. The effect on R&D expenses of policies to broaden patent protection by extension to new spheres is slightly higher than the average for all industries, but this is likely the result of the extension of patent protection to software. In addition, the effect on the number of patent applications is even lower than the average for all industries. With regard to the strengthening of patent protections, the large number of firms responding that they are actively exercising patent rights is of great interest. It appears that

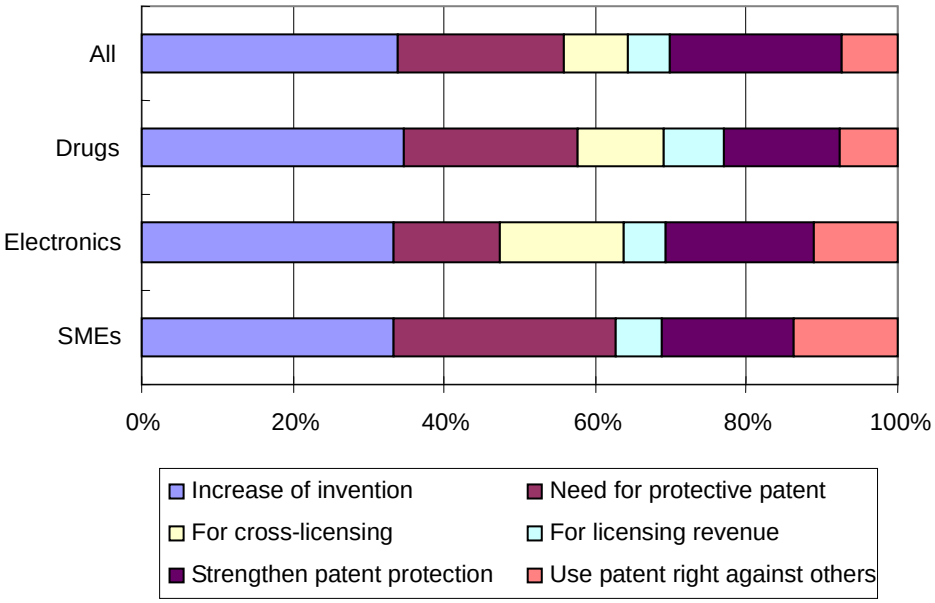
9. This characteristic of the pharmaceuticals industry has been confirmed in surveys conducted in both Japan and the United States. (National Institute of Science and Technology Policy, 1997).

some firms are adopting measures such as active licensing of existing patents to other firms in response to the strengthening of patent rights resulting from measures such as increased damage claim amounts.

Finally, small and medium-sized venture businesses do not seem to have felt the effects of changes in the patent system as strongly as large firms. Although the number of such firms reporting increased R&D expenses as a result of policies for broadening patent protection by extension to new spheres is larger than the average for all industries, the survey sample is composed of R&D-intensive small and medium-sized enterprises. Such firms may exhibit tendencies toward higher R&D investment regardless of pro-patent policies.

Figure 2.5 shows in greater detail trends in patent applications by businesses and factors affecting movements in such figures, including pro-patent polices. Of the 373 firms responding to the survey, 264 reported an increase in the number of patent applications in 2000 relative to the previous three years. However, the most common reason cited for such growth was an increase in the number of inventions, representing approximately one out of three responses. The percentage of firms in the pharmaceuticals industry citing strengthening of patent rights, considered as an effect of pro-patent policies, was small. As we saw in Table 2.2, this figure indicates that although IPR policies have had an effect, their relative impact has been weak in comparison with other factors such as increased inventions and efforts to prevent patenting by other firms. In the electrical machinery industry, cross-licensing was cited by a relatively large number of firms as the reason for the increase in patent applications. Despite the trends seen in Table 2.2 concerning the active use of existing patents, increasing negotiating power by cross-licensing appears to be more important to respondents than the increase in income accompanying patent licensing.

Figure 2.5. **Reason for patent allocation increase**



The Institute of Intellectual Property survey investigates the effects of pro-patent polices on the licensing activities of businesses. Pro-patent policies intended to strengthen patent protection through increased damage claim amounts, speeding up the processing of disputes, and other measures increase the negotiating power of licensors, who license their own patent rights to licensees. In addition, the trend toward broader patent protection may also work to the advantage of the patent holder in a dispute over the breadth of a patent claim. In such cases the effects of these policies may tend to increase licensing fees.

Table 2.3 summarizes survey results concerning the effects of pro-patent policies on licensing. Overall, total licensing fees seem to be increasing for both licensee and licensor activities. Responses from both the pharmaceuticals and electrical machinery industries in particular point to increases in the fees paid to license patents. However, this effect of increased licensing fees is barely acknowledged by small and medium-sized venture businesses.

Table 2.3. **Effect of pro-patent policy on firms' licensing activities**

		All	Drugs	Electronics	SMEs
Increase in licensing fees	Licensing out	14.7%	15.4%	19.6%	2.6%
	Licensing in	15.0%	26.9%	28.3%	1.3%
Increase of licensing out		51.5%	46.2%	69.6%	39.5%
Reason	Increase licensing needs	18.7%	30.0%	6.1%	37.0%
(increase firm only)	Seek for licensing revenue	57.8%	45.0%	61.2%	54.3%
	Necessity of cross licensing	23.6%	25.0%	32.7%	8.7%
Increase of licensing in		24.7%	42.3%	13.0%	11.8%
Reason	Increase licensing needs	13.3%	31.0%	6.0%	11.8%
(increase firm only)	R&D outsourcing	15.7%	17.2%	12.1%	26.3%
	Entry into new business	50.5%	44.8%	42.4%	47.1%
	Necessity of cross licensing	20.4%	6.9%	39.5%	14.7%

More firms expect future increases in total licensing fees for both licensees and licensors. However, outlooks in this area differ between the pharmaceuticals and electrical machinery industries. In the pharmaceuticals industry, more firms expect to increase licensee activity in the future, while in the electrical machinery industry the reverse is true: more firms expect to increase licensor activities. High percentages of respondents from the pharmaceuticals industry gave development of new businesses and increasing licensing needs as reasons for increased licensee activities. This is an indication of pharmaceutical firms' needs to cooperate with other parties in response to new technology, as R&D in the pharmaceuticals industry expands to new areas such as use of genetic information and bioinformatics.

In the electrical machinery industry, high percentages of respondents gave the desire for licensing income and the necessity of cross-licensing as reasons for increased licensor activities. These results indicate that, in response to the extension of the scope of patent protection, electrical machinery firms may have turned to a strategy of strengthening leverage through cross-licensing while more actively making use of existing patents, in order to gain a competitive edge over other firms attempting the same thing. More small and medium-sized start-up businesses expect their licensor activities with electrical machinery manufacturers to increase to a greater extent than their licensee activities with such manufacturers. In most cases, start-ups that do not have their own manufacturing processes and distribution channels thus may be adopting a strategy of actively gaining profit from their own technology.

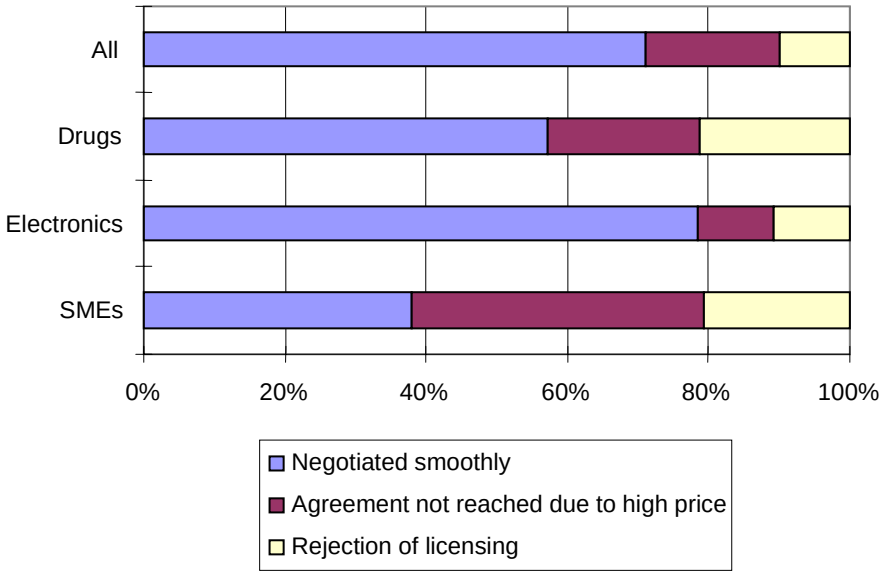
In this way, the effects of pro-patent policies on licensing differ according to the type of industry and the nature of the firm. In the pharmaceuticals industry, firms tend to increase licensee activities due to the necessity of development in technological fields that are new to them. The increase in licensing fees accompanying this process is likely a result of weakened licensee leverage due to the necessity of obtaining licenses in new areas of R&D. In terms of the relationship with the patent system, although the extension of patents into new areas such as genetic functions and screening technology is relevant, the expansion of technological opportunities (such as the use of genome information in the creation of pharmaceuticals) is of greater significance. On the other hand, in the electrical machinery industry, active attempts to put patents to use can be seen to accompany the strengthening of patent protection. Software-related patents, for which the number of applications has recently risen dramatically, have a special characteristic: multiple patents are required in the development of a single product. Accordingly, the key to competitiveness in software product development is a firm's ability to conclude licensing agreements with other firms. In other words, since a firm's technology is likely to be useful to other firms, many firms adopt cross-licensing as a working strategy.[10]

Firms appear to be actively patenting their own technological successes in preparation for cross-licensing with other firms. For small and medium-sized start-up businesses, many of which are specialists in their own technologies, patents by other firms resulting from pro-patent policies are unlikely to have negative effects on technological development. In fact, the strengthening of patent protection under pro-patent policies may have the benefit of allowing R&D-intensive venture businesses to place a higher priority on licensing strategies as a result of the simplification of the protection of their own rights.

Finally, since the late 1990s patent licensing fees are said to have increased (Nagaoka, 2002). We will examine the actual circumstances to determine whether this jump in licensing fees has had negative effects on the circulation of technology. Figure 2.6 summarizes the results of licensing negotiations overall. For the entire sample, negotiations seemed to be going well. One of the benefits of the patent system is the spillover effect caused by the circulation of technology protected by patents. At present, the jump in licensing fees has had no apparent negative effect on the technology market. Among small and medium-sized start-up businesses, there were many cases of failure to reach an agreement on licensing prices. However, this reflects the significantly restricted funding of such firms. Since, as seen in Table 2.3, few small and medium-sized start-up businesses noted increases in total licensing fees due to pro-patent policies, these cases may indicate merely a shortage of funds among small and medium-sized businesses in general and may not have a strong relationship with the patent system.

10. Patent pools are sometimes used when selling products that use various patents held by numerous firms. See Nagaoka (2002) for an economic analysis of patent pools.

Figure 2.6. **Outcomes from licensing negotiations**



IPR and innovation in the IT and biotechnology fields: firm interview approach

As seen in the previous section, pro-patent policies have a relatively greater effect on innovation in R&D-intensive industries such as IT and biotechnology. In addition, these industries show major increases in investment in R&D and in the number of patent applications since the late 1990s. Although we cannot deny that pro-patent policies are a factor in such trends (particularly the extension of patent protection to new spheres), we have seen that additional factors such as increased numbers of inventions due to the extension of technological opportunities and to the strengthening of licensing strategies have also had major effects. Since pro-patent policies include the extension of the scope of patent protection to new areas (such as the genetic and software fields) and patent revisions in response to technological advances, it is difficult to distinguish between the effects of such policies and the additional factors mentioned above. However, in order to assess the value of pro-patent policies within the overall patent system, we must answer the following: What would have been the extent of innovation if patent protection were not available for these new fields? If R&D in IT and biotechnology would have been stimulated independently of the patent system, we would need to reconsider the trend toward the strengthening of patent protections currently under discussion. We will now attempt an examination of this issue, focusing on the fields of IT and biopharmaceuticals based on information from interview surveys.[11]

11. The survey was conducted with division-manager level personnel of the IP sections at major electrical machinery manufacturers (representing the IT field) and five major pharmaceuticals manufacturers (representing the biotechnology field).

Information technology

The followings are results of interviews with IP managers in four large electronics manufacturing firms.

Effects of pro-patent policies on patent activities (e.g. application, registration, licensing)

- In terms of the relationship with business innovation, only expanding technology fields for patent protection (*e.g.* to include business models) has had a significant effect. Other policies have played a minor role. Revision of software patent guidelines has been appreciated, but an efficient patent attorney can write an effective patent application even without them.
- A multiple claim system is important in the sense that various aspects of one invention can be protected with one patent. This helps allow to define the boundary of the patented invention more clearly.
- Improvement of dispute settlement systems is also important. Quick decisions are needed in fast-moving technology areas.

Effects of pro-patent policies on R&D and licensing

- The role of the IP section becomes important in firm-wide innovation strategies. However, the impact of IP policy is not strong enough to change R&D strategy and resource allocation.
- Licensing decisions are made by product development groups. IP sections provide information on IP for each licensing candidate.
- IT products combine many forms of technology, so that cross licensing and strategic alliance are common in the IT industry. Therefore, IP strategies should be in line with gaining advantageous positions in future negotiations for cross-licensing. Fabless companies without manufacturing facilities, find no use in cross licensing strategies as they rarely exchange R&D with other firms.

International patent strategies

- The US Patent Office moves relatively quickly on patents in new technology field. Firms pay close attention to this in the context of international patenting.
- The US Patent Office allows relatively broader areas for patent protection. Given that the limits of the exclusive rights provided by patents may be determined in patent lawsuits, it is necessary for international patent applications to follow US standards.

Trends in and background of R&D and patent applications in the late 1990s

- In many IT firms, the number of patent applications decreased after the 1990s. Firms make greater efforts in selecting inventions to be patented when their financial situation is deteriorating. Additionally, increasing numbers of international patents further push down numbers of domestic patent applications.

- However, some firms increased patent applications after the 1990s, maybe due to strategic patenting decisions rather than increased innovation. This does not directly reflect the firm's innovation output, but it is a reason for its strategic decision.

- The number of cross-licensing agreements and patent infringement disputes is increasing. Patent application decisions are related to the firm strategy as regards its technology and patent portfolio.

- For R&D management, it is important to tap into the next dominant technology area quickly, *e.g.* new PDAs, broadband and ICT in cellular phones. Pro-patent policies are not related to this kind of forward-looking R&D strategy.

It has been found that patents in new areas such as software and business methods have some impact on firms' patenting activities, whereas other pro-patent policies such as improvement of the patent dispute settlement system have only marginal effects. Moreover, as it is the case for business method patents, the US Patent Office moves quickly to grant patent protection to new technologies, which makes Japanese electronics firms to pay close attention to the US patent system.

As for the impact on business R&D activities, since strategic alliances and licensing activities are continually gaining in importance, electronics firms make intensive use of patent information. However, in the survey, no firms stated that R&D is stimulated by pro-patent policies. Firms' IP sections play an important role in providing the R&D sections with information about technology, but the role of IP sections in firms' innovation strategies is passive, not proactive.

Figures 2.7 and 2.8 illustrate the number of patent applications made by nine large IT firms across all technology areas and in software-related patent classes (G06F), respectively. In many firms, large volumes of applications were submitted during the period from the late 1980s through the early 1990s, but the number of applications has decreased markedly since then. The trend in the 1990s differs by firm, with some firms (such as Matsushita and Mitsubishi) submitting a greater number of applications since the late 1990s and others (such as Hitachi and Toshiba) filing fewer applications over the same period. Although recent trends in the total numbers of patent applications vary by firm, all firms have increased the number of applications in software-related patent classes. A factor behind this trend may be the revision of guidelines concerning software patents, which expanded the scope of software subject to patent protection.

There are some points to be discussed. The first point is about a role of fab-less firms in the IT industry. In the United States, it can be observed that pro-patent policies in the 1980s facilitated entry by specialized semiconductor design firms (Hall and Ziedonis, 2001). Strong IP protection is important for these fab-less firms, but since they do not own fabrication facilities, cross-licensing cannot work for them. In the biopharmaceutical area, it is argued that IPR on fundamental technology or research tools hamper innovation in downstream R&D (*i.e.* new drug development), but what happens in IT? Interviewed firms did not express great concern about breakdown of sequential R&D in the IRT sector. If technology markets work well where licensing is concerned, stronger patents are effective from the viewpoint of technology spillovers.

Figure 2.7. **Number of patent applications**
(all categories)

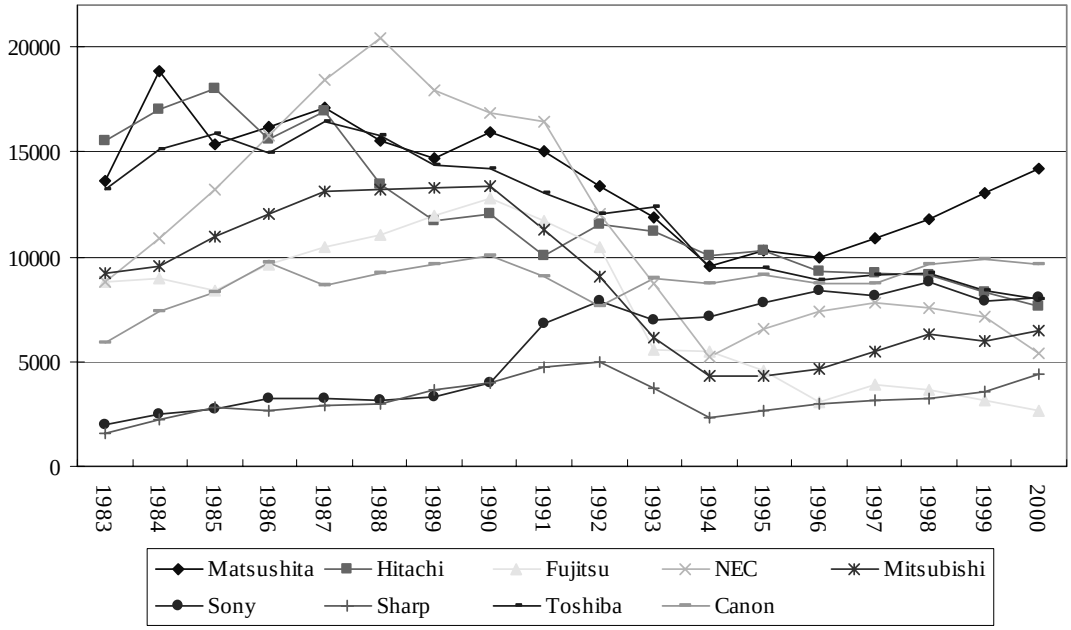
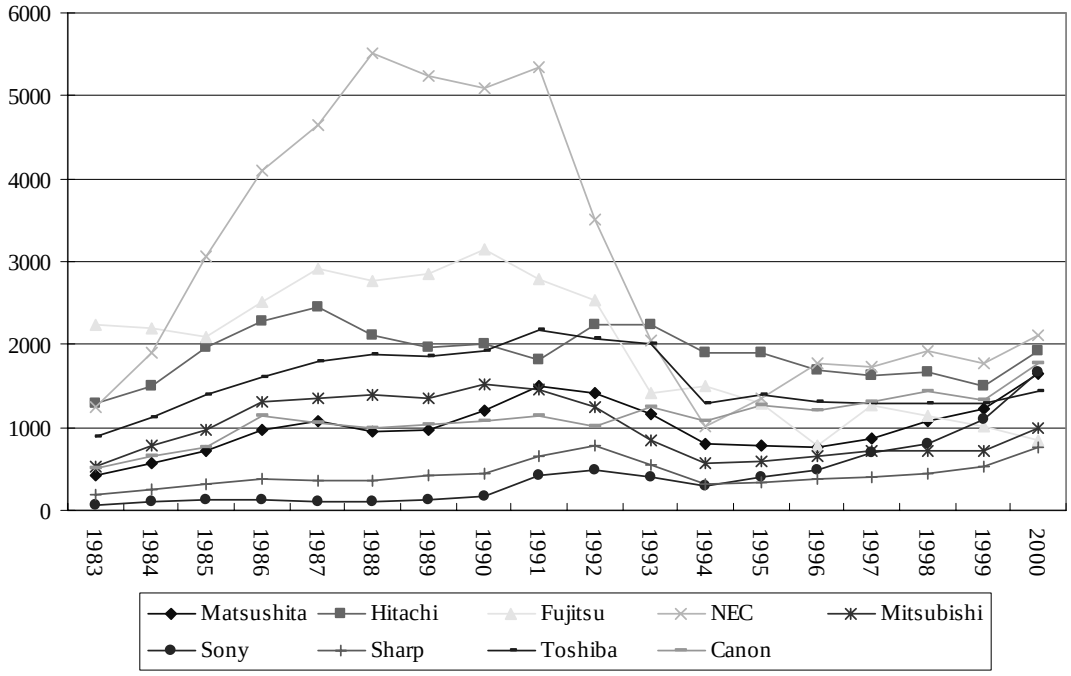


Figure 2.8. **Number of patent applications**
(IPC=G06F)



The second point is the differences between the Japanese and US patent systems. In the interviews, IP managers stressed the US Patent Office's quick movement toward new technology protection and relatively broader coverage of patent claims. As a result, globally operated firms set their IP strategy along US standards and pay little attention to the Japanese system. This may lead to a disadvantage for Japanese firms in the global market. However, this difference is deeply rooted in the juridical system in both countries, and there is no simple solution.

Biopharmaceuticals

Concerning biotechnology, we conducted interviews with five major pharmaceutical firms. The results of these interviews are as follows.[12]

Effects of pro-patent policies on patent activities (e.g. application, registration, licensing)

- The changes to the patent system that had the most significant effects were the introduction of the chemical compound patent in 1975 and the term extensions for pharmaceutical patents in 1987.
- In particular, the chemical compound patent is essential to maintaining incentives for R&D in the creation of new pharmaceuticals. In addition, since R&D for pharmaceuticals takes place over long periods of time (typically 10 to 15 years), pharmaceuticals that use compounds patented in the initial R&D stage may in some cases not reach the market until several years after the patent is awarded. Measures to extend the duration of pharmaceutical patents are extremely important in this context.
- The shortening of the time period between the submission of an application and the request for examination, from seven to three years, has had a negative effect, forcing more firms to determine whether to request an examination before knowing whether an invention is likely to lead to a new pharmaceutical product.
- Other measures, including the revised system of multiple claims and the acceleration of substantive examinations, have not had particularly strong effects. Increased damage claims have not had a strong effect either. Since numerous costs arise in the event of a dispute, the amount of damage claims is marginal in relation to the total cost.
- With regard to the extension of patent protection to new fields - to include genetic patents, for example - it is important to note that pharmaceutical products are aimed at a global market. Since the United States implemented such extensions earlier than either Japan or Europe, patent applications in such fields tend to take place in line with US patent standards. Changes to Japan's patent system have not had major effects.

12. The Institute of Intellectual Property has conducted interviews separately to investigate the status of licensing at pharmaceutical firms. Information from this survey was also used here, with respect to licensing-related topics (Institute of Intellectual Property, 2003).

Effects of pro-patent policies on R&D and licensing

- In the development of a new pharmaceutical product, the IP section co-operates closely with the R&D section from the early R&D stages. For this reason, an extension of the areas covered by patent protection should have an effect on R&D. However, this effect is not large enough to change the total amount of R&D costs.
- Until now we have focused on compound patents, which are relatively simple. However, with the extension of patent protections to new technologies and frequent changes in patent office policies, the patent system itself has become unstable. Formulation of R&D strategies has become more complicated, leading to increased costs. In addition, in the United States patents have been granted in some cases for pharmaceutical products without limitations on compound structures. This has led some to warn that the scope of protection of rights has become too broad.
- Since patents are increasingly granted for upstream components of the process of creating pharmaceuticals (*i.e.* in the development of new pharmaceuticals based on genetic information and screening), licensing costs incurred in R&D are also increasing.
- Increasing licensing costs have not led to changes in R&D strategy. Firms have simply licensed the technology they require to pursue their existing R&D strategies.
- Licensing between pharmaceutical firms and universities or venture businesses is also increasing, with the pharmaceutical firm mostly being on the licensee side, and rarely on the licensor side.

International patent strategies

- As growth in the domestic pharmaceuticals market stalls, major pharmaceutical manufacturers are creating products with global markets in mind. For this reason, patent strategies themselves are also based on international patents. The Patent Cooperation Treaty (PCT) system has been revised, so that in principle international applications are now conducted using a PCT system. However, some firms submit international applications selectively, depending on the type of invention.

Trends in and background of R&D and patent applications in the late 1990s

- Many firms are increasing R&D expenses in connection with the creation of pharmaceuticals using genetic information. However, since some firms have decreased spending in other fields, whether total R&D expenses have increased varies by firm. In addition, although overall most firms have increased the number of patent applications, some firms have become more selective in making patent applications. Patent strategies thus vary among firms.
- Increased R&D expenses and the number of patent applications are driven not by the effects of the patent system but by the effects of the extension of R&D to new fields and increased diversity among the subjects of patent protection. Firms apply for patents for their own use, more than for purposes of future licensor activities.

Other matters

- In firms within the pharmaceuticals industry, R&D and IP sections co-operate more closely than they do in other industries. Recently this tendency has strengthened.
- Reductions in patent fees have not had major effects, as the number of patent applications was previously relatively small. Firms select technologies that they will use themselves for patent applications, resulting in low patent-related expenses as a proportion of R&D expenses.

Of the changes to the patent system implemented since 1970, those commonly reported in the interviews to have had major effects on innovation are the adoption of chemical compound patents in 1975 and the extension of patent terms for pharmaceuticals, adopted in 1988. Interviewees did not consider other measures to have had major effects. Although in the survey discussed in the previous section more than 30% of firms in the pharmaceuticals industry reported that pro-patent policies had contributed to increases in R&D and patent applications, none of the firms interviewed reported such effect.

Figure 2.7 shows a graph of trends in the number of patent applications among the top nine pharmaceutical firms in terms of sales.[13] From this graph, it is hard to draw the conclusion that the adoption of chemical compound patents and special patent terms has changed application patterns. Furthermore, although an increase in the number of claims per single patent is visible after the 1988 adoption of the revised system of multiple claims, no effect can be seen on R&D expenses in large firms, including those in industries other than pharmaceuticals (Branstetter and Sakakibara, 2001).

In order to illustrate the role of biotechnology in pharmaceutical patents, Figure 2.9 shows trends in the number of patent applications filed by the top nine large pharmaceutical firms. Figure 2.10 shows trends in the number of patent applications for each of the nine firms. Figures 2.11 and 2.12 show trends in proportionate shares of biotechnology patent applications based on IPC classifications for biotechnology in the OECD-defined broad and narrow senses, respectively.[14]

13. These nine firms are Takeda Chemical Industries, Ltd.; Sankyo Co.; Yamanouchi Pharmaceutical Co.; Daiichi Pharmaceutical Co.; Eisai Co., Shionogi & Co.; Fujisawa Pharmaceutical Co.; Chugai Pharmaceutical Co.; and Tanabe Seiyaku Co.

14. OECD definition of biotechnology patents in the "broad sense": A01H1/06 + A61K48/ + C12N1/ + C12N7/ + C12N9/ + C12N9/ + C12N15/ + C12P21/ + C12Q1/68 + G01N33/50-98 and OECD definition of biotechnology patents in the "narrow sense": C12N15/ (OECD, 2002).

Figure 2.9. **Number of patent applications**
(Nine large pharmaceutical firms)

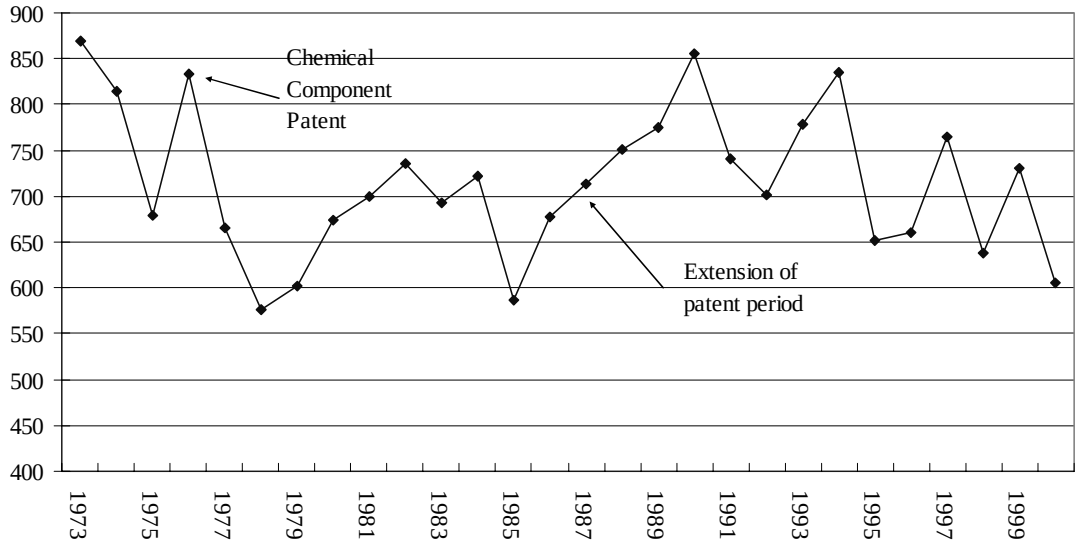


Figure 2.10. **Number of patent applications**
(all patents)

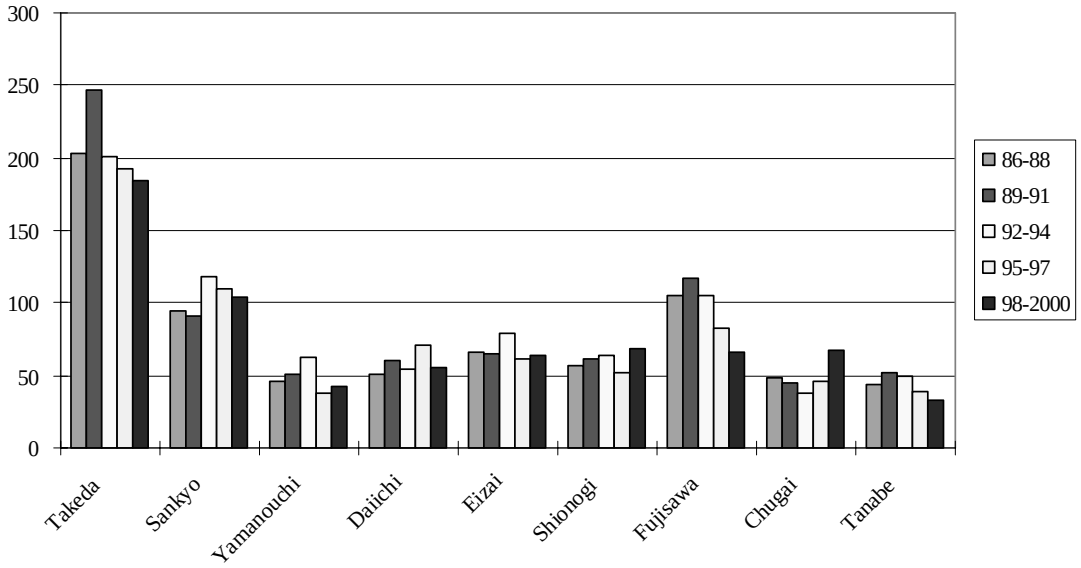


Figure 2.11. **Share of biotechnology patents**
(broad definition)

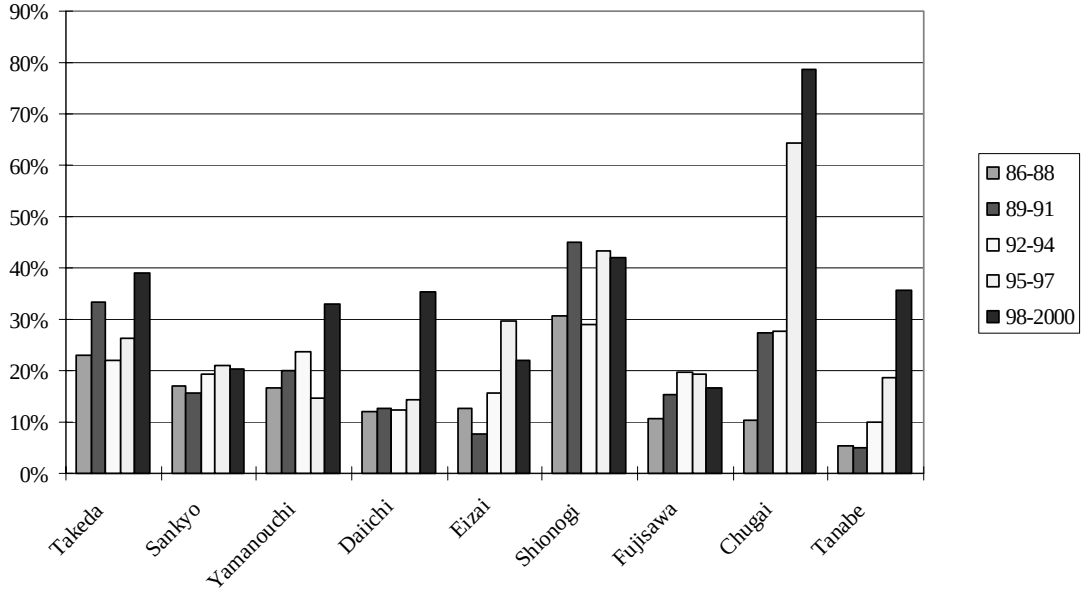
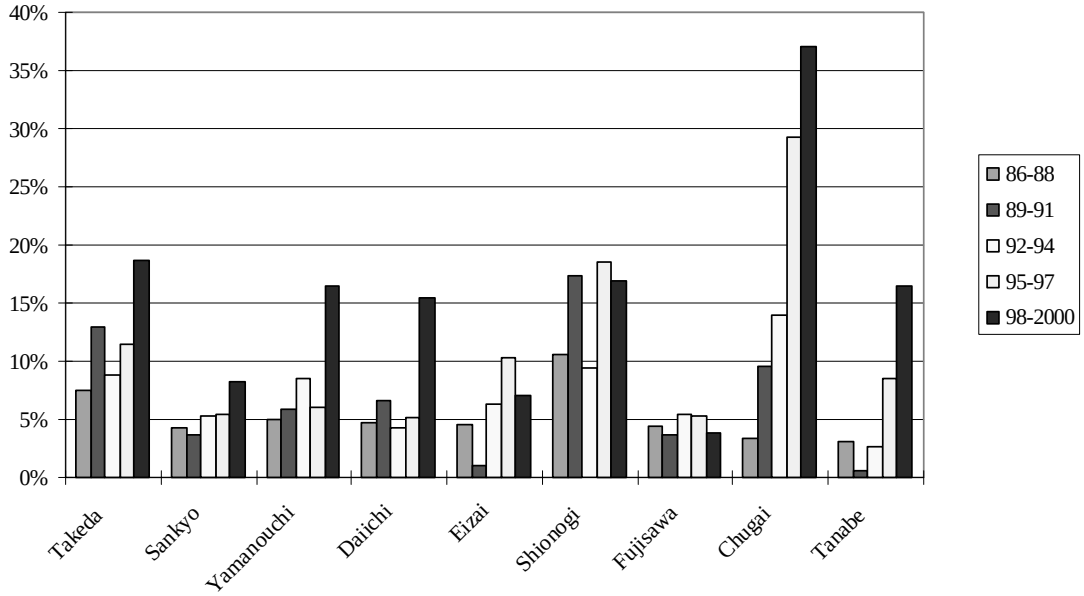


Figure 2.12. **Share of biotechnology patents**
(narrow definition)



As Figure 2.10 shows, the number of patent applications has recently declined, and for many firms, the number of patent applications peaked from 1989-1991. This may reflect the effects of slow growth in the pharmaceuticals market in the 1990s[15]. Even if the extension of the patent term for pharmaceuticals, enacted in 1988, did have an effect, this would not explain the drop in applications since 1992. In this manner, although the number of patent applications has not increased overall, many firms showed an increase in biotechnology-related patent applications in the late 1990s. Pharmaceuticals manufacturers overall are being more selective in patent applications, focusing on biotechnology-related patents. Although this is a result of many pharmaceuticals manufacturers enhancing their R&D efforts in the biopharmaceuticals field, some firms pointed out that the extension of areas subject to patent protection has also had an effect on some types of patents, such as genetic patents.

Figures 2.13 and 2.14 show trends in R&D expenses and sales of pharmaceutical products for the same firms. These figures show two extremes: firms with high sales of pharmaceutical products and those with low sales. These figures also show the ways in which firms such as Shionogi and Tanabe limited R&D expenses in the 1990s. In addition, a comparison with Figure 2.10 demonstrates that approaches to patent applications differ markedly among firms. For example, Takeda spent roughly 1.5 times the amount spent by Yamanouchi on R&D, yet submitted more than four times as many patent applications. If we view the number of patent applications as the output of innovation, Takeda demonstrates extremely high innovation efficiency. However, it would be more fitting to view this discrepancy as a difference in patent strategies.[16] Whether a firm applies for more patents or applies for patents more selectively due to pro-patent policies depends on the particular circumstances of the firm. In addition, the results of the interviews show that even within the same firm the status of the IP section and patent strategies may change over time.

Thus, it is difficult to discern the effects of pro-patent policies by examining patent application trends. However, generally speaking, pharmaceuticals manufacturers have recently focused their efforts on R&D relating to biopharmaceuticals, resulting in an increased number of patent applications. Although this may also be affected by the extension of patent protection to new fields (permitting patents on organisms and genetic patents, for example), the effects of the US patent system are particularly significant. This is because pharmaceuticals manufacturers conduct R&D tailored to the international marketplace, and therefore focus their patent applications on the US patent structure, which features the most lenient patent standards in the world.

At least among major pharmaceuticals manufacturers, we were unable to find evidence that Japan's pro-patent policies have promoted innovation in business. On the other hand, many firms reported their concerns about the "anti-commons problem" resulting from the gene patents and patents on research tools seen primarily in the United States.

15. With regard to the size of the pharmaceuticals market, measures to cut pharmaceuticals prices have been implemented as part of social security system reforms. For this reason market size has not grown since the early 1990s.

16. Limitations inherent in using patent data as an indicator of innovation have been noted; for one thing, not all innovations are patented, and for another, the quality of patents varies. The latter is often regulated in the United States using patent citation data (Hall, Jaffe and Trajtenberg, 2001). Since no database has been developed in Japan similar to that in the United States, analysis using patent data is difficult.

Figure 2.13. **R&D**
(in millions of JPY)

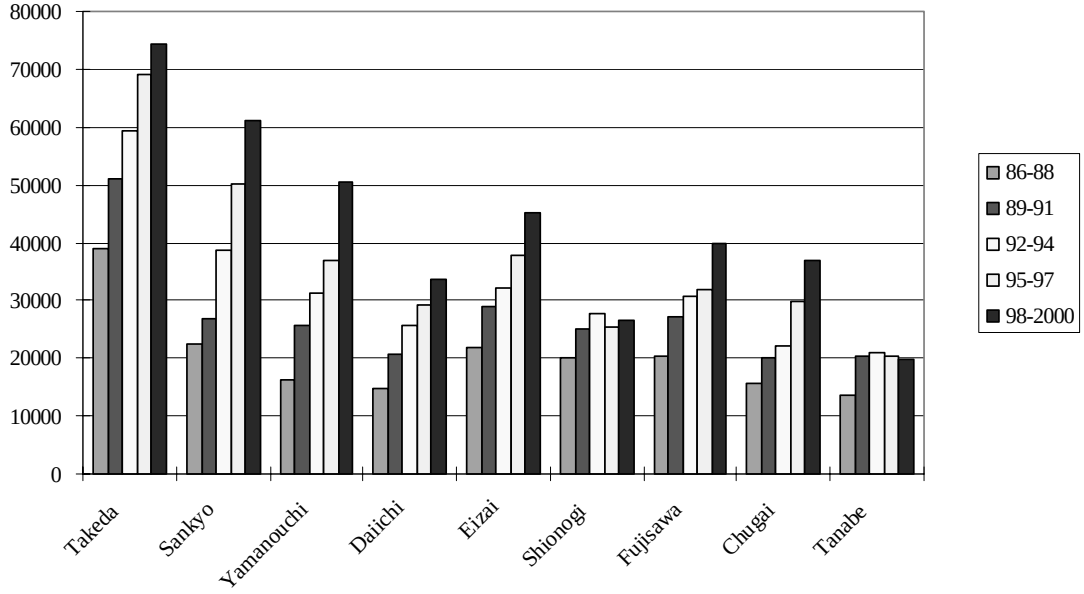
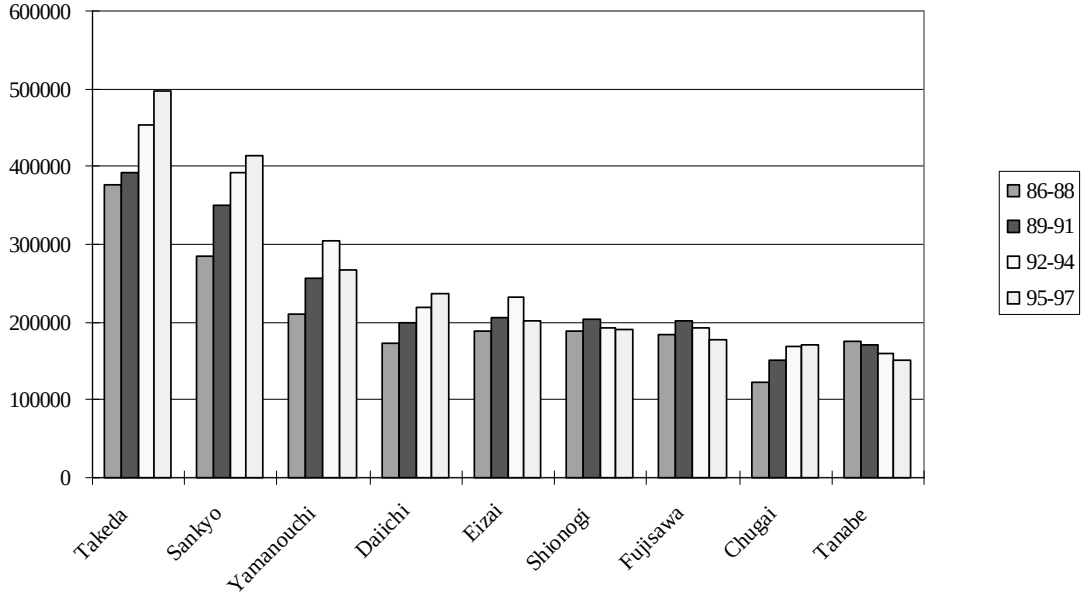


Figure 2.14. **Pharmaceuticals sales**
(in millions of JPY)



In the pharmaceuticals industry, R&D tends to take place in close cooperation with IP sections within firms, and recently this relationship has been intensifying. While patents in the past mostly consisted of substance patents, and fields subject to patent protection were clearly defined, the expansion of patent protection to upstream aspects of the pharmaceuticals creation process has made IP strategies a vital part of the early stages of R&D.

At the same time, progress in patenting new pharmaceuticals created using new genetic technologies has led to increased licensee activities and continuing increases in licensing fees. In theory, even if patent protections are strengthened, this should cause no problems as long as licensing negotiations take place before the licensee makes sunk cost investments such as R&D (Green and Scotchmer, 1995).

In the case of pharmaceutical products, since IP sections within firms take part from the early stages of R&D and research advances in line with patent mapping, the situation in the industry is close to the theoretical ideal. However, due to successive changes to patent examination standards in new areas and vague rules (such as those for determining whether a screening tool patent will result in a final product), we cannot discount the possibility that strengthening of patent protection for upstream technologies will have a negative effect on downstream innovation.

Although cancellations of R&D projects due to licensing refusals are rare, in not a few cases such a situation has been avoided only through the payment of high licensing fees. Licensors in such cases are in many cases overseas start-up businesses - American firms in particular. For this reason, while Japan's patent system has its own effects, in fact the influence of the US patent system on the R&D framework is greater. Interviewees pointed to recent cases in which the United States has granted patents covering a wide range of final pharmaceutical products aimed at genetic and protein functions (*i.e.* functional patents for medical use). Given the foregoing, progress in encouraging strict global implementation of the patent system through clarification of worldwide patent standards is thus vital; for example, by holding conferences between patent offices in Japan, the United States and Europe.

Conclusions

We have examined changes in Japan's post-war patent system and trends in business innovation. The current patent law, implemented in 1960, has undergone numerous changes as a result of trends toward international harmonization of IP systems and pro-patent policies. Extension of patent protections to new spheres in the IT and biotechnology fields, substance patents, extension of patent terms, increased damage claims related to patent disputes, revisions to procedures for processing patents, and other changes have led to the establishment of broader and stronger patent rights. These revisions were conducted in order to provide incentives for business innovation. In addition, Japan's patent system has developed not only to provide incentives to inventors but also to provide benefits to technology users, as seen in moves such as the adoption of a patent application publication system at an early stage.

Concerning the relationship between the patent system and business innovation, we were unable to discern a link between changes in the patent system and changes in business R&D expenses and the number of patent applications. Since changes to the patent system are continuous and reflect the situation at a given time, it is difficult to discern the results of each individual change. However, it seems appropriate to consider the patent system as just one of many factors affecting investment in R&D, which is also affected by long-term demand for target products, moves by competitors, expansion of technological opportunities, and other factors. The quantitative analysis conducted by Branstetter and Sakakibara (2001) of firm level

data concerning the effects of the 1987 patent system revisions, which included the revised system of multiple claims and extension of the patent term for pharmaceuticals, also failed to find effects of such revisions on R&D. In addition, although their study concerned the United States rather than Japan, when Kortum and Lerner (1998) analyzed the causes of the recent dramatic increase in patent applications in the United States, they concluded that it resulted more from the expansion of technological opportunities in the IT and biotechnology fields than from the structure of the patent system.

We have seen that in Japan the number of patent applications in the IT and biotechnology fields has increased tremendously since the late 1990s. Closer examination of the technological fields in which these increases took place shows that the growth has occurred in areas recently made subject to patent protection, such as the software field. Whereas the effects on innovation on the economy as a whole seem to be limited, they are relatively strong in the IT and biotechnology fields.

According to the results of a survey of businesses conducted by the Institute of Intellectual Property, large proportions of firms in the electrical machinery and pharmaceuticals industries have acknowledged the effects of recent pro-patent policies. However, it is important to note the differences between the pro-patent policies that have affected each of these two industries. Firms in the electrical machinery industry are more affected by revisions that strengthen the patent system, since these firms are looking for ways to put the patents they hold to use, through cross-licensing and other methods. Firms in the pharmaceuticals industry, on the other hand, are more sensitive to the extension of patent protections to new fields, such as genetics, because such firms are becoming more active in licensee activities in the biopharmaceuticals field.

In this paper, we have examined the incentive structure for business innovation at a micro level through interviews with firms in the electrical machinery and pharmaceuticals industries. In the electrical machinery field, major manufacturers attempt to utilize their own patent assets strategically. Although recent trends varied by firm, with some using more selectivity in applying for patents, all firms reported increasing numbers of applications for software patents. This is likely a result of the expansion of the types of software subject to patent protection. However, we have seen that the effects of pro-patent policies are limited to patent tactics and do not extend to R&D activities.

On the other hand, in the pharmaceuticals industry protection of rights via patents is extremely important, since R&D for pharmaceutical products can take more than ten years. However, we could not discern any apparent effects of pro-patent policies on business innovation, including R&D and patent applications. We must note that, with regard to R&D in the creation of pharmaceuticals utilizing genetic engineering and genetic information, the growth of technology has stimulated patent application in a number of related new fields. In addition, Japan's pharmaceuticals manufacturers are becoming more active in licensing patents from overseas venture businesses.

It may be true that were rights not subject to protection by patents, information on new technologies held by universities and venture businesses would not be released, reducing the speed of R&D for pharmaceuticals. However, in some cases a flood of patents has had negative effects on R&D. In particular, the US patent system employs the first-to-invent rule, sometimes resulting in sudden demands for licensing fees as a result of so-called "submarine patents". In such cases, there are no benefits to the patent user. In addition, due to increases in licensing fees and more frequent patent disputes, uncertainty with regard to R&D may increase, restricting investment. This issue concerns the US patent system, and not Japan's, the

latter being the main topic of this paper. This uncertainty is an issue, however, especially in the pharmaceuticals industry.

The Framework for Intellectual Property Strategy completed in June 2002 emphasizes strengthening the IP rights system through patents and other means, under the “IP Revolution” theme. At the forefront of the specific action plans is strengthening protection of IP through strong patent policies, such as speeding up the patent examination process, creating a “patent court”, and strengthening the damage claims system. However, we have seen from the analysis in this paper that strong patent policies, such as those improving the patent dispute processing system and increasing damage claim amounts, have only marginal effects. More important is the rationalization of the patent protection system with regard to high-technology fields such as IT and biotechnology. Vital to such efforts are balanced policies that take into consideration the spread of technology, rather than simply encouraging the expansion of the protection of rights.

The details of this rationalization process will vary among individual industries. For example, in fields such as biopharmaceuticals, in which businesses and universities in the United States and Europe have already taken out many basic patents, strengthening protection of patent-holders’ rights is likely to impede innovation among Japan’s pharmaceuticals manufacturers. On the other hand, application of scientific knowledge is vital to R&D in the field of pharmaceuticals, and a major role of the patent system is to encourage the appropriate dissemination of the results of research conducted at universities and public research institutes. For these reasons, it may be appropriate to strengthen the protection of rights through patents while simultaneously implementing special measures governing the use of patents in R&D.

With regard to the extension of patent protection to new areas — through patents for business models and genetic inventions, for example — the patent offices of Japan and Europe conduct relatively strict examinations, while in many cases the system in the United States is more lenient. Although examination rules are being reconciled as the three regions’ patent offices conduct comparative research based on precedents, strengthening of such activities is critical.

As the globalization of business advances, internationalization of patent systems is becoming even more important. Although patent systems are undergoing revisions in many countries in response to the WTO TRIPS agreement, there is a major gap in awareness between developed nations and developing nations regarding IP systems. As for harmonization of the patent system with regard to high-technology fields, more focused discussions are required at the OECD, with the support of the patent offices of Japan, the United States and Europe.

Finally, although our results show that improvements in the system for processing patent disputes have not yet had major effects on innovation in business, patent disputes have recently become more frequent, indicating that the importance of such measures will increase in the future. Establishment of a patent court modeled on the US Court of Appeals for the Federal Circuit would be an important step. However, it must be noted that even in cases that could result in patent disputes, such disputes are often avoided through payment of high licensing fees. One solution may be to consider the adoption of an alternative dispute resolution (ADR) system to arrange licensing before disputes arise.

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Chapter 3

SCOPE AND NATURE OF THE PATENT SURGE: A VIEW FROM GERMANY

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The patent surge in the 1990s – during which the number of German patent applications at the European Patent Office more than doubled - was not accompanied by similar development in R&D expenditure. This calls for explanations. Whilst acknowledging that there have been several institutional changes that affect the "supply side" of patents, this paper concentrates on the changing demand patterns for patents from the perspective of companies. Using a sample of more than 500 German companies active in patenting and responsible for 40% of German patent applications as a basis, we first investigate changes in the importance of patents and alternative instruments to protect intellectual property. As a second step, we ask whether the patterns in reasons for patenting have changed.

We found that in the last five years both formal patent protection and the role of informal protection strategies have become more important – especially for very large firms – whereas other formal IPRs have decreased in relative importance. Looking at motives for patenting, we observe several phenomena which may contribute to the explanation of the patent surge of the 1990s. First, the traditional motives to patent - protection from imitation or the exclusive use of intellectual property - are still the most important and have become even more so. In addition, patents are increasingly used to secure the technological space to develop new products (defensive use), but also to actively block competitors in their development activities (offensive use). Second, patents are recognised as part of companies' intangible assets, and foster their reputation. Third, patents are assets in the trading of knowledge in the knowledge economy, as in cross-licensing agreements and patent pools. These aspects have great relevance for large and small companies. Fourth, patents serve as indicators for the performance of R&D departments, especially in large companies. Driven by increasing pressure to compete and to collaborate with other companies, the interplay of these rationales leads to increased patenting activity especially by the large companies, but also the small ones, and explains the breaking up of the direct relationship between R&D expenditures and patent applications.

The starting point of this analysis is the apparent discrepancy between the rather modest increase in R&D expenditure of German industry and the doubling of German patent applications in the 1990s.[1] The objective was threefold. First, on the basis of a patent database analysis, the study sought to analyse in depth the structure of the German industrial patentees and their patenting behaviour. Second, the study tried to reveal the driving forces for the increase in patenting in the 1990s. Accepting that some efficiency gains in corporate R&D have contributed to a growth in patenting, the major hypothesis was that the motives to file for a patent application have broadened and shifted in importance. A third purpose of the investigation was to determine the consequences such a potential shift might have for the usage of patents as an indicator for R&D activities and technological performance.

The analyses of patent statistics on European and international applications of German origin show unequivocally that since the mid-1990s in particular, there has been a massive upsurge in patent applications which cannot only be explained by a related extension of R&D activities. For patent intensities (*i.e.* patent applications per industrial R&D expenditure) in the 1990s, growth lies at 70% for the manufacturing industry in general and differs among sectors. Part of the increase in European and international patent applications can be explained by the growing orientation of the firms towards foreign countries, as their share of the sum of domestic and foreign applications grew from 50% in 1990 to 60% in 1999. A second important phenomenon of the 1990s, which played a crucial role in the design and interpretation of the survey, is the fact that in all technological fields, with the exception of chemistry, a further concentration of applications to very large applicants (thus very large enterprises) took place. This result also means that the large gap between patent applications and R&D activities is driven above all by the large enterprises.

In the survey, over 1 500 German enterprises which in 1999 had applied for a minimum number of three patents were contacted in writing in 2002. Due to great interest in the subject, there was a response rate of over 33% and thus over 500 completed questionnaires were received. In this random sample of enterprises actively involved in patenting, patents therefore have very high significance as a protective measure for inventions and innovations among alternative formal and informal protective mechanisms. Patents also had the highest growth in significance in the last five years. The survey also confirmed that the orientation towards patent applications abroad has become more important. Whereas differences between sectors are rather weakly marked, the survey results make it clear that company size matters. With increasing company size, the significance of patents grows and very large companies (over 2 000 employees) also indicate that the relevance of patents has grown most in recent years. This is also reflected in actual patent applications reported. More than two-thirds of the large enterprises and a majority of the very small firms report a growing number of applications in the past five years, while this is only true for half of the whole sample. With reference to future development, all enterprises with the exception of the very large ones anticipate a further increase in their patenting activities.

This estimate is confirmed by analysing the share of inventions for which patent applications are filed. Here, the very large enterprises do not expect further increases in the future, but rather stagnation. On the whole, the answers to the questions about the significance of patents and patenting activities suggest that the large enterprises find themselves at the beginning of a consolidation process, while the small and medium-sized enterprises still want to intensify their involvement. In view of the

1. K. Blind, J. Edler, R. Frietsch and U. Schmoch (2003), "Erfindungen kontra Patente. Schwerpunktstudie 'zur technologischen Leistungsfähigkeit Deutschlands'", Endbericht für das Bundesministerium für Bildung und Forschung (BMBF). Available at *www.isi.fhg.de/publ/downloads/isi03b66/erfindungen-patente.pdf*.

strong quantitative influence of the very large enterprises on the amount of total patent applications, there are indications of a slowdown compared to past increases.

How, then, is the patent surge to be explained? To answer this question, a set of bivariate and multivariate statistical analyses have been conducted. If one takes a look at the explanatory factors and concentrates first of all on the developments in corporate R&D, it can be seen that two-thirds of the enterprises also report an increase in their R&D expenditure. Furthermore, the connection between the rise in R&D expenditure on the one hand, and the increase in patent applications on the other, is clearly positive and significant for the total sample. However, the developments regarding sector and enterprise size vary considerably. For the domestic patents, the correlation between R&D expenditure and patenting is clear cut and significant only for the three sectors: chemistry, mechanical engineering and electrical engineering, *i.e.* the three most patent-intensive sectors of the sample. For the other sectors in the sample, the increase in patent applications is not connected with the rise in the R&D expenditure. Concerning the connection between change in patenting and changes in R&D expenditure, there are no significant differences as regards company size, especially for the very large enterprises which have increased their patent applications most in recent years. This result corresponds to the conclusion from the analysis of patent statistics: the very large enterprises with a large number of applications are mainly responsible for the discrepancy in the development of patent applications and R&D expenditure.

A further aspect of corporate R&D in the context of the patent surge and almost stagnant R&D expenses is the assumption that increased R&D efficiency has led to more patents per euro spent for R&D. The data for this assumption are based on self-estimates of those questioned. Over 80% of the enterprises report increased R&D efficiency, in particular, firms in the motor vehicle and chemistry sectors and the group of very large enterprises reach very high rates of approximately 90%. It is true that R&D efficiency gains have a significant statistical correlation with the increase in patent applications. However, this picture is sharpened when possible influential variables are taken into consideration. For example, the propensity to patent - *i.e.* the share of inventions for which patents applications are filed - is also higher in firms which have increased their R&D efficiency, and considerably higher than in companies with stagnating R&D efficiency. In view of the fact that one-third of the enterprises measure R&D efficiency by using patents, a part of the efficiency gains can be explained by the increased propensity to patent. At the same time, the upsurge in patent applications correlates with the significance of patents in internal management. The enterprises for which patents also serve as an internal performance indicator report a significantly higher increase of patent applications in the past than companies for which patents do not play any role as an internal performance indicator. Likewise the increase of patent applications by firms which measure their R&D efficiency via patents is greater than for the enterprises which do not measure their efficiency via patents. Thus the conclusion that efficiency gains in R&D lead to more patents is to a certain extent a circular argument which is difficult to validate. The conclusion can also be that the patent applications rise because they are internal performance indicators. In any case, efficiency gains cannot sufficiently explain the patent surge.

Having identified the main actors and the R&D-relevant explanatory factors for the large rise in patent applications, the question arises as to what the reasons are for the partial uncoupling of patenting and R&D activities. Two sets of explanations emerged. First, the upsurge of patenting is simply an expression of the increased intensity of competition and of co-operation. Patents are a major and increasingly important instrument both for securing one’s position in joint efforts to generate knowledge and for securing competitive advantages in the technological competition.

The second set of explanatory factors consists of the altered motivation structure regarding the use of patents. Although it must be recorded that patents above all are still used as protection from imitation and as a means to secure markets. These reasons have become more important in view of rising competition, and other motives which are only indirectly connected to the R&D activities have gained considerably in relevance. First, the blocking of competitors by means of patenting must be mentioned, as patents are used to maintain one's own room to manoeuvre and at the same time to limit that of the competitors. Patents also increasingly contribute to the reputation of the company and help to increase the value of the enterprise. Patents in the knowledge society also serve as currency for knowledge and intellectual assets, and they adopt an exchange function not only vis-à-vis co-operation partners and licensees, but also with capital investors. As the pressure to co-operate and the options for doing so have increased in the last years, the number of patent applications has also increased commensurately. Lastly, for many companies patents are appropriate instruments for controlling internal performance and motivations.

Although the utilisation of patents differs by sector, basically very similar patterns emerge with regard to ranking different motives reported by respondants with the only exception being the pharmaceutical and biotech sectors, where reputation and exchange motives are found to be relatively more significant. The rather uniform sectoral pattern means that the fundamental strategies and driving forces are very similar across the sectors and have also come closer, and therefore differentiated patenting strategies have become a phenomenon for the entire industry. Thus a current theory in the literature cannot be confirmed (Cohen *et al.*, 2002)[2] according to which sectors that are characterised by complex, modular technologies (*e.g.* electrical engineering) display other motivational structures than those with so-called distinct technologies (chemistry).

On the other hand, the differentiation according to company size reveals a few important differences. While protection from imitation and the blocking motive are equally important for enterprises of all sizes, for the large firms the exchange and incentive motives are much more important than for the medium-sized enterprises. Moreover, together with the blocking motive, these motives have also gained greatly in significance for the large companies compared to the total sample. For small companies, patents are obviously important assets in negotiations with capital investors, but also with large co-operation partners. Patents are therefore important for the market entry of small enterprises and their establishment in the market.

One dimension often overlooked in survey-based analyses is the relevance of internal institutionalisation of patenting activities. There is an obvious correlation between size and the existence of a patent department. And it makes a difference who is asked. Managers responsible for patenting rate the significance of patents and the increase of that significance in the last five years higher than R&D managers, while the latter, stressing the technological value of their work, rate the relevance of modular patenting, *i.e.* patenting of single technological modules as more important than patent managers.

The key finding of the analysis is that for the very large firms which determine the changes in patent numbers, there is no connection between increase in R&D expenditure and rise in patent applications. Large companies report that the blocking motive, internal performance incentives and technological exchange have been gaining more significance in the last few years in relation to the sample as a whole. Therefore, as the increase in patent applications cannot so much be traced back to

2. W.M. Cohen, A. Goto, A. Nagata, R.R. Nelson and J.P. Walsh (2002). "R&D Spillovers, Patents and the Incentives to Innovate in Japan and the United States", *Research Policy*, 31, 1349-1367.

R&D increases, it is rather determined by the fact that the large applicants for patents have been using patents in the technology competition in a targeted manner (blocking) and understand them as "currency" in the external technology market as well as an indicator in internal R&D management. The main result, therefore, is that patenting has become a multi-motive game, the dynamics of which are essentially the result of a patent race between large enterprises.

How can these results be interpreted as regards the trends in patenting behaviour? The statistical analysis and the enterprise survey have demonstrated that there is a partial uncoupling of patent applications and the R&D activities of enterprises, even if part of the increase in patents can be explained by the gains in R&D efficiency. The driving forces for this divide were mainly the very large enterprises, in which increasingly strategic and management-relevant considerations led to a more intensive patenting behaviour such that this group of enterprises can claim larger shares of the total patent applications for themselves. However, there are hints that the very large enterprises will not extend their patenting activities in the future, and instead the smaller and medium-sized companies will intensify their involvement somewhat. This means that the temporary distortions between the patenting activities of small or medium-sized enterprises and large firms will return to a new equilibrium. A process of adaptation can also be observed between the sectors. While the chemicals industry already distinguished itself in the past by its markedly intensive patenting practice, other sectors have meanwhile caught up or plan to undertake more efforts in patenting in the future, whilst chemistry will probably develop along average lines.

Finally, the results for Germany point toward interesting conclusions as regards international comparison, even if other countries have not been explicitly investigated in this study. In contrast to US and Japanese companies, which adopted strategic patenting in the 1980s, European enterprises developed a strategically designed patenting culture only in the mid-1990s and so followed the Japanese and American models. On the basis of the applications at the EPA, however, a clear increase in patenting intensities could be registered for all large applicant countries in relation to industrial R&D expenditure. Fundamentally parallel developments are to be observed. Furthermore, the large multinational enterprises in all Triad regions are not only active in R&D, but also in patenting, such that this group contributes to an international convergence of the R&D-patent relations not only by its own behaviour, but also by the reactions provoked from the competitors.

What conclusions can be drawn from these results for the use of patents to report on technological performance? If the strands of arguments on the various analytical levels are summarised, one can assume distortions in the relationship between R&D activities and patent applications in the past. The study has revealed that this discrepancy cannot be explained by one single factor, for there is a whole bundle of explanatory factors which are often interdependent. It is important, however, to note that in the meantime, numerous factors are working towards a new balance between R&D activities and patenting which will lead to a new, more stable relationship. Above all due to the strategic patenting motives this new relationship between R&D activities and patenting will be characterised by a higher patent propensity than in the past. As for the use of the patents as an indicator, it is clear that it is still very suitable for inter-sectoral and inter-territorial comparisons and will especially be so in the future. However, when interpreting intertemporal comparisons through and beyond the 1990s, the turbulent developments towards a new balance must be considered. At the same time, the interpretations of existing international comparisons in the Triad dating from the 1990s must take into account that the development within Europe obviously ran fairly parallel, but started later than in the United States and Japan.

Chapter 4

UNDERSTANDING BUSINESS PATENTING AND LICENSING: RESULTS OF A SURVEY[1]

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To provide additional insight into the factors that have contributed to the growth in patenting, the OECD collaborated with the Business and Industry Advisory Committee to the OECD (BIAC) in 2003 to conduct a survey of businesses regarding their patenting and licensing practices. The purpose of the survey was to gather qualitative information that would provide insight into evolving business strategies for managing intellectual property, assist in interpreting results of more quantitative analyses of patenting trends (e.g. using the OECD Patents database) and compensate for the lack of consistent statistical information on patent licensing. Overall, results confirmed the increased importance of patents in business strategy over the past ten years, mainly due to increased innovation, more intensive competition and patent reform (notably expanded subject matter). Firms indicated that patents play an increasingly important role in disseminating technical information that is useful in planning their own R&D strategies, and stated that licensing is also gaining importance in complementing in-house R&D capabilities and accelerating innovation processes.

1. The authors would like to thank Gilles Estord, Cristina Serra-Vallejo and Sandrine Kergroach for their assistance in compiling the database of survey responses and conducting preliminary extractions and analysis of this data.

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3. Chief Economist at the European Patent Office (EPO). He was Senior Economist at the OECD Directorate for Science, Technology and Industry when the study was conducted. Opinions expressed in this document do not necessarily reflect the views of the EPO.

Introduction

Available statistics provide a clear indication of increased patenting in the major patent offices worldwide. The numbers of patent applications and grants at the European Patent Organisation (EPO), Japan Patent Office (JPO), and US Patent and Trademark Office (USPTO) grew rapidly between 1990 and 2000, as did the number of triadic patent families (applications applied to the EPO, JPO and USPTO to protect the same invention). A number of hypotheses have been proposed to explain the rapid growth in patenting, including increased inventiveness on the part of firms, changes in industry structure (*i.e.* the expansion of patent-intensive industries such as pharmaceuticals and information and communications technology), growing strategic use of patents to thwart competition, heightened importance of patents in facilitating co-operation and technology transfer, changes in patent regimes (*i.e.* expansion of patentable subject matter) and reduced administrative barriers to patenting. To date, however, limited empirical work has been undertaken to test these various hypotheses and compare their relative contributions to the growth in patenting.

To provide additional insight into the factors that have contributed to the growth in patenting, the OECD collaborated with the Business and Industry Advisory Committee to the OECD (BIAC) in 2003 to conduct a survey of businesses regarding their patenting and licensing practices. The purpose of the survey was to gather qualitative information about business patent and licensing practices and provide insight into evolving business strategies for managing intellectual property. The survey was designed to collect information that can assist in interpreting results of more quantitative analyses of patenting trends (*e.g.* using the OECD Patents database) and can compensate for the lack of consistent statistical information on patent licensing. This paper summarises the main results of the survey; aggregated responses to individual questions are set out in the annex to this chapter (see p. 99).

The survey instrument was developed jointly by staff of the OECD and BIAC. It included 23 questions about changes in patenting and licensing patterns, comparing the current situation to that of 10 years prior, and asking about expectations regarding future trends. To minimise the time required to complete the questionnaire and to encourage firms to participate in the exercise, the survey was designed to seek information on qualitative trends in patenting and licensing, not detailed quantitative data. To ensure confidentiality, respondents were instructed to send completed questionnaires directly to the BIAC Secretariat, which removed company-identifying information before sending anonymous results to the OECD for subsequent analysis. Information related to firm size, line of business, approximate level of R&D spending, and age of the firm were included in the information sent to the OECD and used to categorize responding firms. A preliminary questionnaire was tested on a small number of BIAC delegates in early 2003, and a revised questionnaire was distributed electronically to BIAC member organisations later in the year for subsequent dissemination to firms. Several OECD country delegations also contributed to the dissemination of the survey among firms.

As of 15 October 2003, 105 valid responses had been received by BIAC and sent to OECD (Table 4.1). Firms located in Europe returned the largest number of responses (68), followed by those in North America (20) and Asia-Pacific (17, mostly from Japan). The responses cover firms in a range of industry sectors, with the largest number of responses coming from the machinery, chemicals (excluding pharmaceuticals), pharmaceuticals, and ICT industries, with each region displaying slightly different distributions. For example, non-pharmaceutical chemicals and machinery accounted for most of the responses from Asia-Pacific; no responses were received from ICT firms in Asia-Pacific, despite their large presence in this region. European responses were most numerous from firms in the machinery industry, followed by pharmaceuticals, chemicals and ICT firms. More than half of North American responses came from machinery and pharmaceuticals companies. Nearly all responses were received from firms with 1 000 or more employees and with R&D budgets above USD 10 million. Only about 20% of respondents had fewer than 1 000 employees or less than USD 10 million in annual R&D spending. Although large firms

represent a small percentage of the population of innovative firms, they do tend to control a significant amount of R&D spending in most OECD countries; hence their responses may provide a good indication of overall patterns of patenting and licensing.

The results of the survey must be interpreted with caution, keeping in mind the limitations of the survey design. The small number of responses, for example, restricts the statistical validity of the results, especially considering the regional and sectoral biases outlined above. The classification of firms by sector of activity was mainly based on the choice of responding firms from a menu provided in the questionnaire, however, given that some firms opted for sectors of activity different from those in the menu, responses were finally aggregated in five broad sectors as set out below, using ISIC Rev 3 as a guide. In addition, while the survey was designed to capture the most recent trends in patenting and licensing — and their impact — by focusing on the previous ten-year period, the formulation may create additional biases across geographic regions, as patent reform and structural economic change have not proceeded at the same pace in all OECD countries. Hence, the survey results should be seen as providing indications of general trends in patenting and licensing strategies, rather than statistically robust results. Further empirical work will be needed, building on the results of this survey, to provide more precise, statistical information.

Table 4.1. **Survey responses by industry and region**

Sector	Total	Asia-Pacific	Europe	North America
Chemicals (excluding pharmaceuticals)	21	8	11	2
Pharmaceuticals	22	1	15	6
Information and communications	13	0	10	3
Machinery	33	7	20	6
Other	16	1	12	3
Total	105	17	68	20

Note: Information and communications includes computing and communications equipment manufacturing and services. Machinery includes instruments, machinery and motor vehicles. Other includes energy and utilities, financial and business services, and remaining sectors.

Results

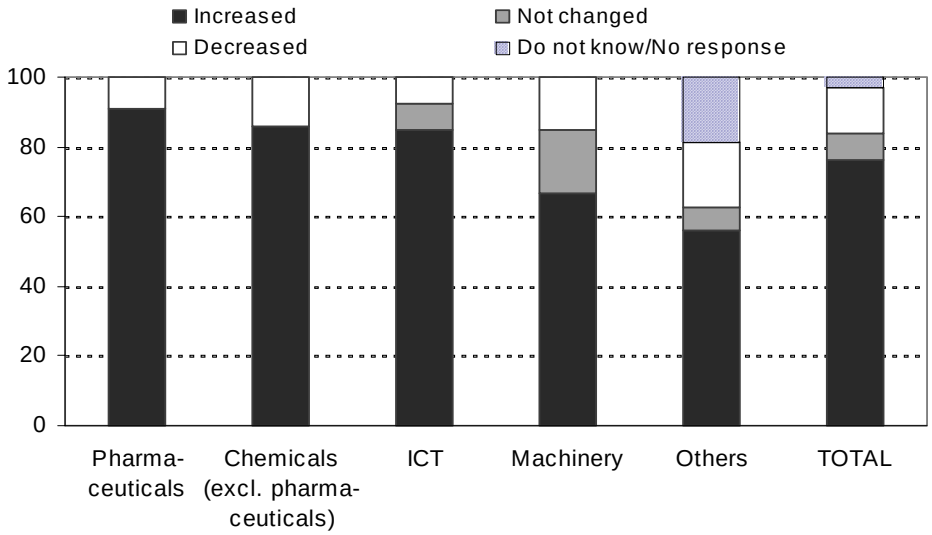
Firm-level patenting has increased across industry sectors

Responses indicate that firm level patenting has increased in all industry sectors, although to some-what different degrees. Across all industry sectors, 80% of firms report filing more patents now than 10 years ago (see Q.1 in Annex), despite the fact that 84% of firms report increase in the total cost of patenting, including the cost of filing, maintaining, and defending an individual patent (Q.9). Growth was most pronounced in the ICT, pharmaceuticals and chemicals sectors, where more than 85% of respondents reported an increase, compared to firms in the machinery sector, where only 67% reported an increase and 18% reported no change. Around 15% of firms in machinery and chemicals reported a decrease in patents, compared to between 8-9% in ICT and pharmaceuticals. Growth was reported more often in larger firms than smaller firms, by a margin of more than 80% to less than 60%. More firms in North America (85%) and Europe (76%) reported growth in patenting than firms in Asia-Pacific (65%).

These results are consistent with available patent statistics and other surveys of business patenting, lending support to the credibility of the survey. In particular, the results agree with statistical evidence of a general increase in patenting across the OECD. Interestingly, growth in patenting by Japanese inventors has been slower than that of US or European inventors; hence the share of patents owned by Japanese

inventors fell between 1991 and 2001. This result is consistent with the lower levels of growth in patenting reported by Japanese firms in the survey. In addition, statistical evidence indicates that approximately 50% of growth in patenting is related to ICT and biotechnology inventions. The survey also shows a higher share of respondents in these industry sectors reporting increased patenting. This finding is also consistent with earlier industry surveys that found a higher reliance on patenting to protect competitive advantage in these sectors. As the survey indicates, the growth in patenting in these sectors (as well as others) results from increased patenting at the firm level, not just from an expansion of these sectors and an increase in the number of firms competing in them.

Figure 4.1. **Change in number of patents filed by respondents over the last 10 years**
Q.1: Percentage of respondents



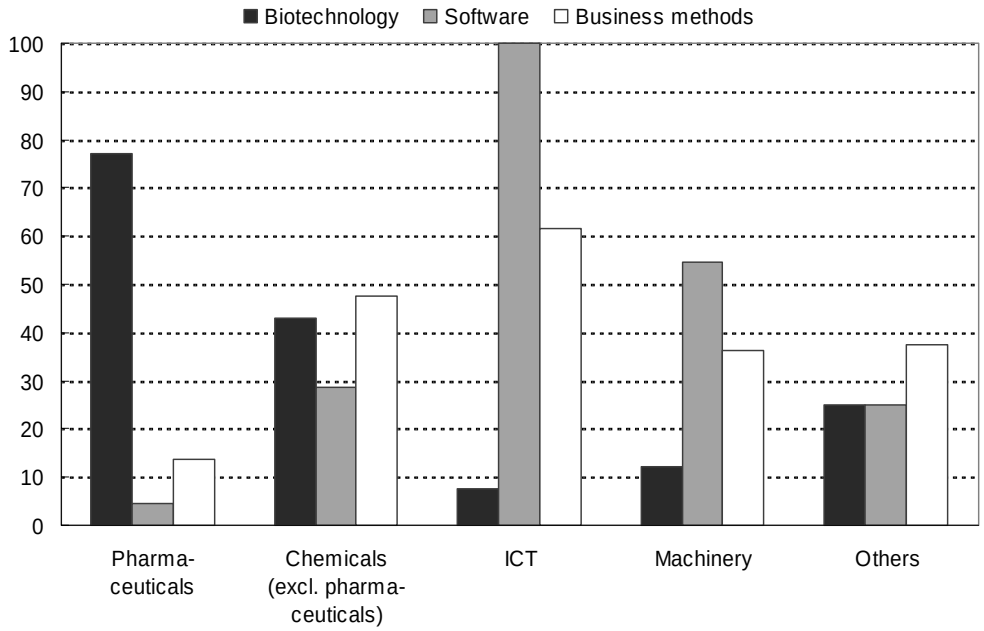
Growth in patenting appears to result in part from increased inventiveness. For example, 95% of firms reporting an increase in filings indicated that a very important or moderately important driver of such growth had been an increase in the number of inventions they had generated, with 71% of firms ranking increased inventions as very important (Q.2.1). This was more true in the ICT and pharmaceuticals industries (where respectively over 91% and 84% of firms reported increased inventiveness as a very important driver) than in the chemicals and machinery industries (where just 67% and 62%, respectively, reported increased inventiveness as very important). The effect was also more pronounced in North America, where it was cited by 94% of the firms reporting increased patenting, than in Europe (67%) or Asia-Pacific (55%). Regional differences may, in turn, reflect sectoral differences, as the Asia-Pacific region included no respondent from the ICT sector and only one respondent from pharmaceuticals, whereas more than 50% of the respondents in North America and Europe came from those industries.

Nevertheless, changing patenting strategies also contributed to increasing patent rates. 69% of all respondents reported that they now patent inventions that they would not have sought to patent 10 years ago even if those inventions were patentable then (Q.3). This effect was also most pronounced in the chemicals industry, followed by the pharmaceuticals and ICT industry. It was also more pronounced in Europe and Asia-Pacific than in North America. This latter finding may reflect the high share of pharmaceutical companies among US respondents, given that pharmaceutical firms have long considered patents an essential tool for protecting their competitive advantage. To a lesser extent, firms also report that they now file more patents per invention than 10 years ago (Q.2.2). Firms are also more likely to seek protection for a single invention in multiple patent offices (Q.2.3), further raising their total patent counts.

Changes in patentability affect research spending

The expansion of patent protection to new types of inventions (*e.g.* those related to biotechnology, software and business methods) has had pronounced effects on related fields of research (Q.4). Changes in the patentability of software had the largest effect on research, with roughly half of all respondents reporting increased software-related research as a result of changed patentability criteria. The effect was most pronounced among ICT firms, all of which reported increased research in software, but even in the machinery industry 55% of firms reported an increase, reflecting the broad product lines of many machinery firms and the importance of embedded software in a number of mechanical products. The patentability of business method inventions had a noticeable effect on research across industry sectors, with more than 60% of ICT firms and almost 40% of chemicals and machinery firms reporting an increase in related research. Pharmaceuticals were an exception to the latter rule with only 14% citing increased research as a result of the patentability of business methods. The impact of genetic patenting was much more localised, with 77% of pharmaceuticals firms and 43% of chemicals firms reporting increased research, compared to around 10% of ICT and machinery firms. The patentability of biotechnology-based inventions was the only change in patentability that had a significant effect on pharmaceutical firms, despite the increasing role of informatics and related software in sequencing and analysis.

Figure 4.2. **Effect of changing patentability criteria for on research spending**
Q.4: Percentage of respondents reporting and increase in research due to patentability changes



Differences in responses by firm size and region are also interesting. Large firms reported increases in related research in all three areas more frequently than smaller firms, most likely reflecting both their greater financial resources (*i.e.* more money to invest in R&D) and their broader research portfolios. Nevertheless, the existence of start-up firms and their ability to invest at all in research and development is often contingent on patentability of their inventions (a necessary requirement for venture capital in some fields), an effect that may not be revealed in the survey. Changes in patentability had the largest effects on research among Asia-Pacific respondents, followed by North American and European firms. This reflects, to some extent, the sectoral distribution of responses from the regions: the larger share of Asia-Pacific responses from the chemicals and machinery industries meant that changes in patentability of software and business methods had significant effects. In the United States, the strongest effects were attributed to bio-

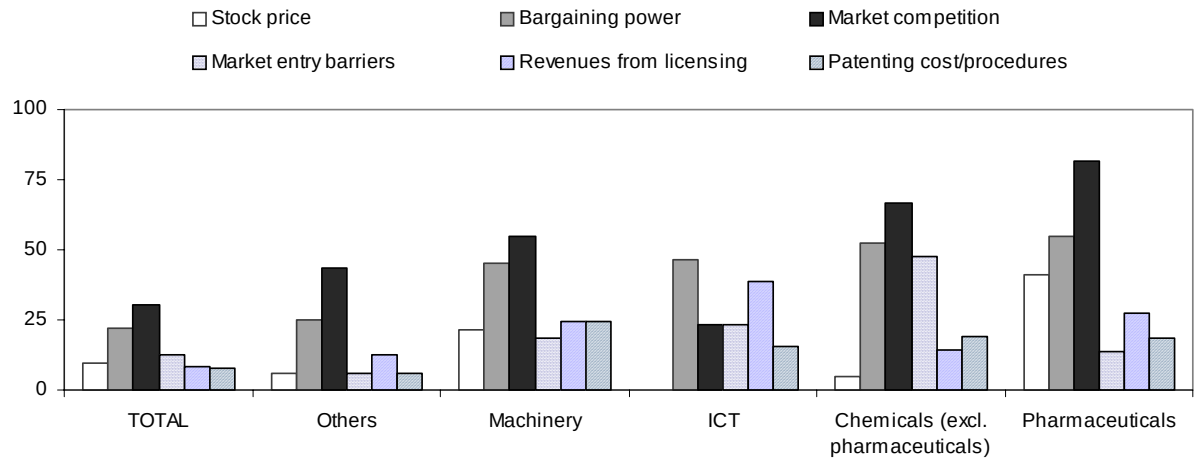
technology patenting, reflecting the large share of pharmaceutical firms among respondents. In none of the fields did a majority of European firms report increases in related research.

Patenting becoming a more effective means of protecting competitive position

Firms report that over the past 10 years, patents have become a more effective means of protecting competitive advantage. Two thirds of respondents perceived a rise in the economic value of patents, such as the value to be gained through exploiting the patented invention or licensing it to others (Q.10), and 89% reported higher risks associated with not patenting, such as might accrue from competitors making use of an unpatented invention (Q.11). The two factors that have the most influence on firm's patenting strategies appear to be increased product market competition and the bargaining power of a strong patent portfolio in negotiations with other firms. More than 80% of firms found them either very important or moderately important (Q.12). 60% of respondents cited product market competition, and almost 48% cited bargaining power as a very important determinant of patenting strategy. Patents are used by holders for securing their position both in competitive and co-operative processes. Other factors – reduced barriers to entry, potential licensing revenues, changes in the administrative ease and cost of filing patents, and effects on stock price – were considered very important by around 20% of respondents and not important by larger shares of respondents.

These findings were roughly consistent across geographic regions, although Asia-Pacific and North American firms tended to place greater emphasis than European firms on the importance of bargaining power, and North American firms rated product market competition and reduced entry barriers as less important than European or Asia-Pacific firms. The share of firms rating licensing revenues as a very important factor influencing patent strategies was higher in North America than in Europe and Asia-Pacific.

Figure 4.3. **Relative importance of factors influencing firm patenting strategies**
Q.12: Percentage of respondents rating each factor "very important"



Sectoral patterns were roughly consistent with the aggregate pattern, with the notable exception of the ICT sector. ICT firms placed considerably less emphasis than firms in other sectors on the importance of product market competition, with only 23% of firms rating it as a very important determinant of patenting strategy, compared to 55% of firms in machinery, 67% in chemicals and 82% in pharmaceuticals. In addition, ICT firms placed greater emphasis on potential licensing revenues as a determinant of patenting strategy. 39% of ICT firms cited licensing revenues as very important (compared to between 14% and 27% of firms in other sectors), making it the second most important factor for ICT firms after bargaining power.

This result is consistent with results discussed below related to the high levels of inter-firm licensing of technology in the ICT sector. ICT firms did not consider very important the effects of patents on stock price, which more than 20% of firms in machinery and pharmaceuticals considered very important. Another notable sectoral difference is the high significance firms in the chemicals sector place on the influence of reduced barriers to entry in their markets on their patent strategy.

The survey supports the notion that the increased use of patents to protect competitive advantage results from the increased control patent holders now have over their inventions. Firms reported a perceived strengthening of patent holders rights in all geographic regions, but most notably in North America (Q.6). This may reflect changes in the US patent system, such as the establishment in 1982 of the Court of Appeals of the Federal Circuit to hear cases related to patent infringement, which has tended to protect patent holders' rights and has led to growing levels of damage awards in the United States. Interestingly, firms were more likely to report stronger patent holders' rights in their home regions than in foreign patent offices (*i.e.* Japanese firms reported strengthened rights in the Japanese patent office than in Europe or the United States). In addition, more than 70% of firms reported growing involvement in patent infringement suits, whether as the claimant or the defendant (Q.7). This trend was more prevalent among larger firms (in which almost 80% reported growing involvement in infringement suits) than among smaller firms (only 23% of which reported involvement in infringement suits). This could reflect the larger patent portfolios of large firms, which creates more opportunities for infringement, and the larger financial resources they have for engaging in legal suits.

Increased patenting also appears to be affecting the research plans of firms. Some 46% of all respondents reported a heightened likelihood of competitors' patents blocking their research projects, and 44% reported no change (Q.8). This was the case more often in the chemicals, where 76% of firms reported that research projects had been blocked in the previous 10 years, than in the ICT sector, where 77% of respondents cited no change. Responses from firms in machinery and pharmaceutical sectors were balanced between reporting an increased likelihood of R&D projects being blocked due to patents and reporting no change in that respect. As with patent infringement suits, larger firms were more likely than smaller firms to report blocked research projects (by a margin of 50% to 32%), a finding that may also be influenced by the broader research portfolios of larger firms. These results are consistent with the disclosure function of patents, which serves to avoid duplication of research. What is not clear from the survey, however, is whether patents more frequently block duplicative research or follow-on research that may be important to incremental innovation. While the phrase "blocking research" implies that latter, the finding reported below that a number of respondents find the information provided by patents more useful now than 10 years ago highlights the importance of disclosure for research planning and information sharing.

Patents still an effective vehicle for technology diffusion

Despite the perceived increase in patent holders' rights and resulting limitations on the use of patented inventions, firms continue to find patents and patent licensing an important channel for diffusing technology. Almost 90% of firms report that patents are a useful source of information for their own R&D efforts (Q.13). Interestingly, this appears to be less true in the ICT sectors than in other industries; whereas half of all respondents found patents a useful source of information; half did not. Similar results were found in all three regions, with differences reflecting the sectoral responses by region. The value of patents for information diffusion appears to be more pronounced in larger than smaller firms.

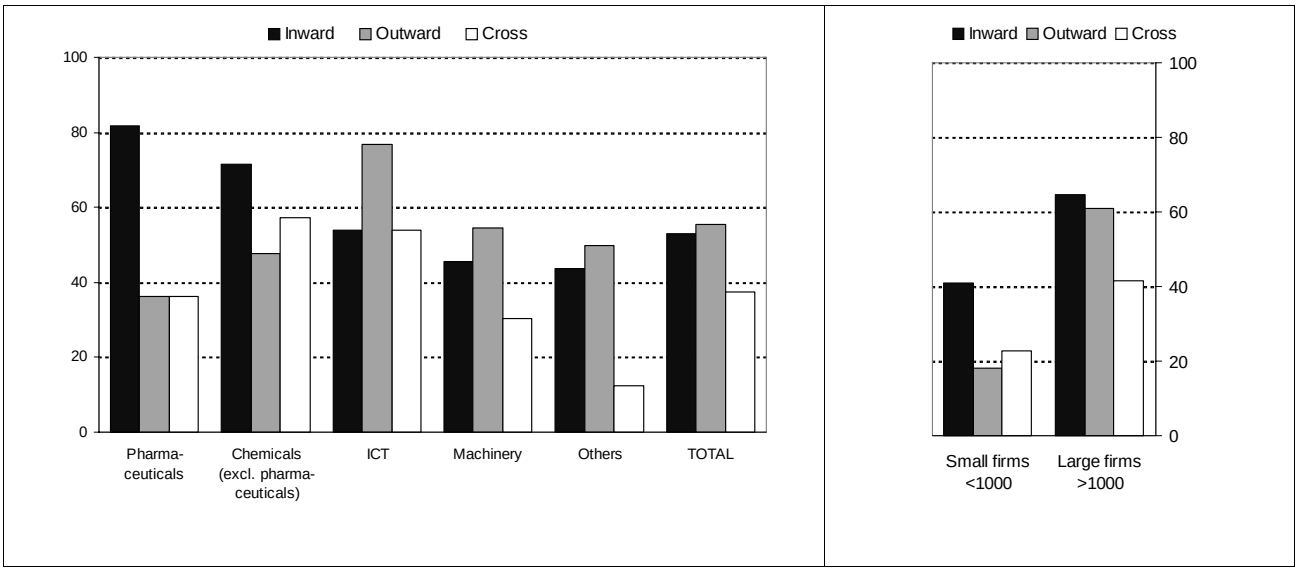
Furthermore, the utility of information contained in patents appears to have increased over the past decade. 44% of respondents reported increased utility; only 5% of firms reported a decline in usefulness, whereas 44% detected no change (Q.13.1). This result might suggest that firms are more active in reviewing relevant patents in planning their own R&D activities. The sector with the highest share of

respondents reporting an increased utility of patents (62%) was the pharmaceutical sector, which has also seen the sharpest rise in patenting, according to the survey results. A higher share of firms from Asia Pacific reported increased utility, compared to firms from Europe or North America.

The survey also indicates that licensing of patented inventions has become a more effective channel for diffusing scientific and technological know-how. In total, approximately 60% of responding firms reported increased inward and outward licensing of technology over the past decade (Q.14 and Q.18). Almost 40% reported increased cross-licensing (Q.17). Growth in inward and outward licensing was reported more frequently by firms in Asia Pacific and North America than Europe; growth in cross-licensing was reported most frequently in North American firms. Larger firms were more likely to report increased licensing of all types than were smaller firms. No significant changes were reported in refusals to license (Q.16); nor did the survey reveal significant obstacles to licensing (Q.19).

A sectoral decomposition of survey responses shows interesting differences in licensing patterns across industries. The machinery industry, for example showed higher levels of outward- than inward-licensing, and only 28% of firms reported increased cross-licensing. The ICT sectors had the highest share of respondents citing increases in outward licensing (77% of responses), reflecting the fact that many of the best-known outward licensors of technology tend to come from this sector (*e.g.* IBM, Texas Instruments). A large share of respondents from the ICT sector (54%) also reported increases in both inward and cross-licensing, highlighting the importance of technology sharing in this industry. The pharmaceuticals industry reported the highest levels of inward licensing (nearly 90% of respondents), a relatively low level of cross-licensing and below-average level in outward licensing. This result likely reflects the presence of large, multinational firms in the sample, many of which are active in acquiring technology from smaller biotechnology start-ups. Chemicals companies also tended to report high levels if inward licensing, and were most likely to report increased cross-licensing.

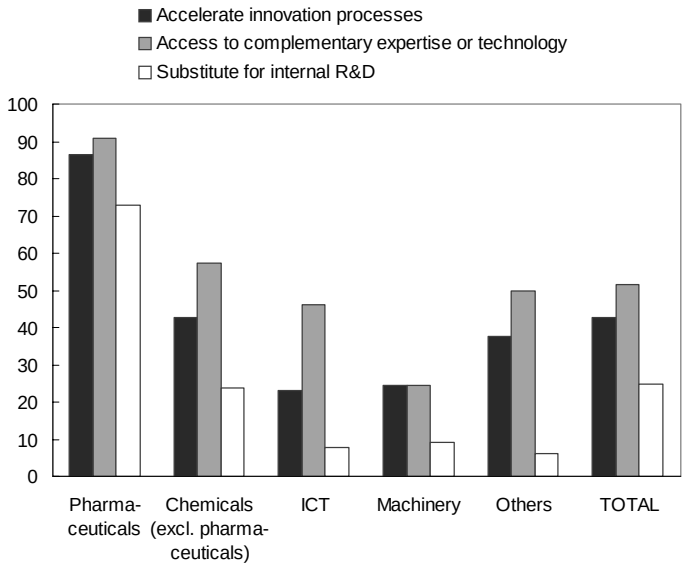
Figure 4.4. **Increase in inward, outward and cross licensing of patented technology**
Q.14, Q.18 and Q.17: Percentage of firms reporting increased licensing



For the most part, the increased inward licensing of technology complements firms' internal R&D efforts. More than half of all respondents (54%) cited the need for complementary knowledge as a very important factor in shaping their licensing strategy (Q.15.2). The need to accelerate innovation processes—often the result of increased competition—was considered very important by approximately 45% of respondents (Q.15.1). Only 26% saw substitution for internal R&D as a very important driver, and it was

considered not important by the largest share of firms (Q.15.3). These results were roughly consistent across industry sectors, with the relative importance of the three factors remaining the same, except for the machinery industry, in which the same percentage of firms rated acceleration of innovation and complementary knowledge as very important. There were also differences in the degree to which firms in different sectors cited these factors as very important. The pharmaceuticals sector had by far the largest share of firms report all three drivers as very important determinants of their licensing strategy, signalling the overall importance of inward licensing in driving innovation in pharmaceuticals and the need to focus their internal R&D projects.

Figure 4.5. **Factors influencing licensing strategies**
Q.15: Percentage of firms rating the factor very important



Looking to the future

Most survey respondents indicated that ongoing trends would likely persist into the near future (*e.g.* over the next five years). More than 80% of responding firms indicated that patents would become a more important form of intellectual property protection in the next five years (Q.20). This response was consistent across industry sectors, firm size and geographic region. The 15% of firms that did not foresee patents becoming more important tended to be based in Europe and reported that patents are already considered very important in their firms and were unlikely to become more so. Interestingly, patent statistics do show a drop in the growth rate of patent applications after 2001 and in patent families beginning in the late 1990s. While the former is consistent with a general slowdown in business R&D spending after 2001, the latter decline in patent families could suggest a more fundamental slowdown in the rate of patent growth.

Survey respondents agreed that licensing would become a more important part of company strategy, although the role of inward licensing was more universally accepted than outward licensing. More than 70% of firms expect inward licensing to increase in the coming five years, to gain access to complementary technology, reduce R&D costs and innovation time (Q.22). This tendency was seen more strongly in larger firms and in sectors other than machinery, but was supported in all three geographic regions. Outward licensing is expected to grow in two-thirds of responding firms (Q.21). This sentiment was overwhelmingly supported by respondents from the ICT, pharmaceutical and chemicals sectors, but only by half of the firms in the machinery sector. Likewise, only half of the firms with fewer than 1 000

employees and only just half of all firms from the Asia-Pacific region reported expected growth in outward licensing. Comments received along with the survey indicate continuing concerns in some firms about losing their competitive advantage through licensing. Although many such firms report increased inward and cross-licensing, they seem to be less inclined to license technology to other firms.

Firms offered a number of suggestions for improving patent systems. These tended to cluster into three areas:

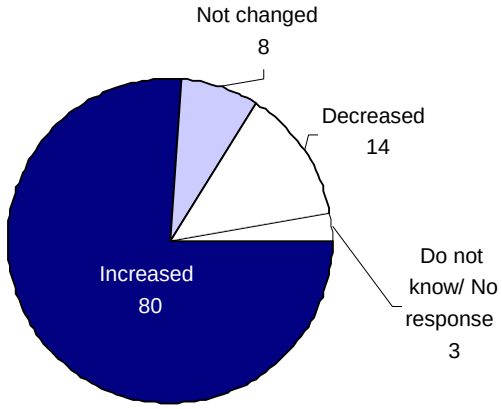
- *Increased harmonisation*. Many firms cited a need for improved consistency across patent regimes in terms of patentability of inventions (*e.g.* software, business methods) and in practices for evaluating prior art and enforcing patent rights. Firms from all regions supported the creation of a European patent. There was also some support for a shift from the first-to-invent to a first-to-file system in the US, which would further harmonise the US Patent and Trademark Office with the Japanese and European Patent offices.
- *Administrative reforms*. Firms called for reforms to speed the examination and patent-granting processes, citing the increase rate of innovation as a driving factor. Several firms saw a need to further reduce patenting costs, especially for SMEs.
- *Improved quality*. Firms recognised the importance of patent quality in ensuring the integrity of the patent system and the utility of patents in spurring innovation. They saw a need for better examination processes and higher standards for novelty and non-obviousness, especially in areas such as software and business methods.

Conclusions

Overall, the survey confirmed the increased importance of patents in business strategy over the past ten years. This is due mainly to a combination of increased innovation, more intensive competition and patent reform (notably expanded subject matter). While firms find themselves more frequently involved in patent litigation, they also report that patents play in increasingly important role in disseminating technical information that is useful in planning their own R&D strategies. The survey also shows the increased importance of licensing, notably for complementing in-house R&D capabilities and accelerating innovation processes. Cross-industry differences in this regard are significant; with pharmaceutical companies focusing on inward licensing while chemical and ICT companies are relatively heavier users of cross-licensing. This finding highlights the importance of market-based exchanges in facilitating knowledge diffusion and innovation in a range of industry sectors.

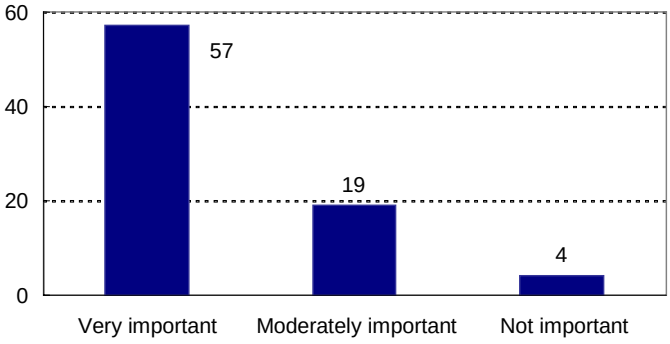
ANNEX: RESULTS FROM THE OECD/BIAC SURVEY

Q.1. Has the number of patents filed annually by your company changed with respect to 10 years ago?

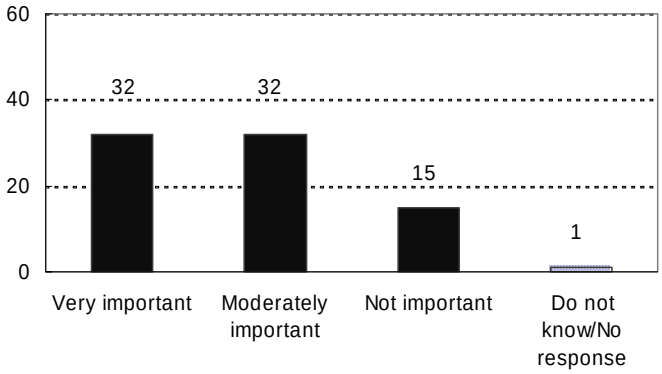


Q.2. If your company is filing more patents now than 10 years ago, please indicate what has been the relative importance of the following factors for this trend.

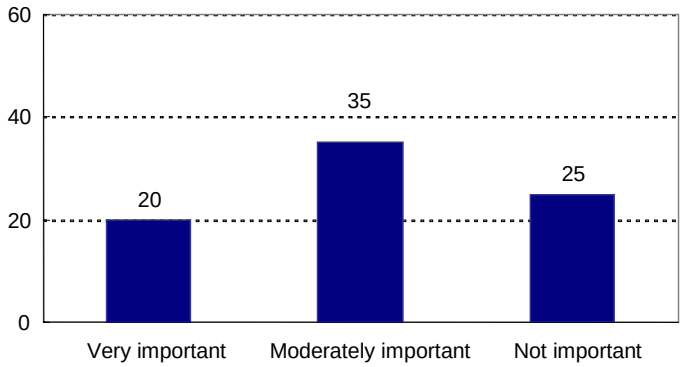
Q.2.1. An increase in the number of inventions generated at your firm



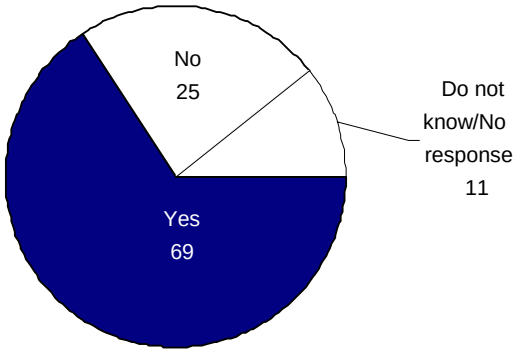
Q.2.2. An increase in the number of patents filed by your company at each PTO to protect an individual invention



Q.2.3. An increase in the number of countries in which your company seeks patent protection for a given invention

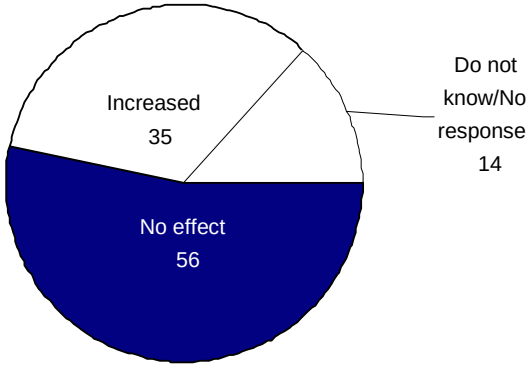


Q.3. Does your company seek patent protection now on inventions for which it would have been unlikely to seek patent protection 10 years ago (assuming they would have been patentable then)?



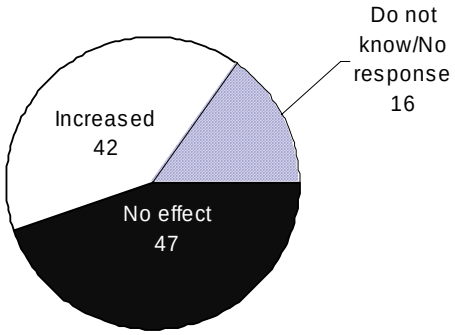
Q.4. What has been the effect of the expansion of patentability to new types of inventions on research at your company in the fields listed below?[4]

Q.4.1. Biotechnology

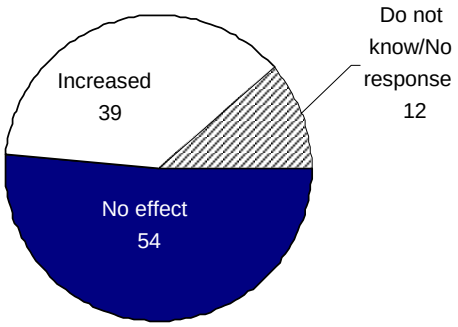


4. The option “decreased” was not chosen by any respondent and was thus not represented in the graph.

Q.4.2. Software

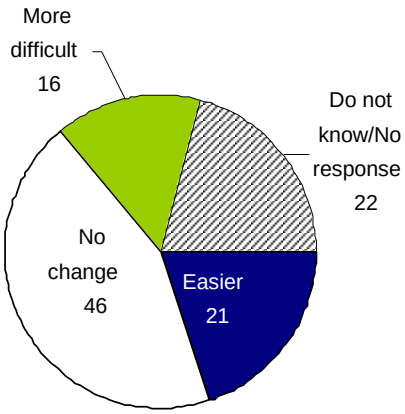


Q.4.3. Business methods

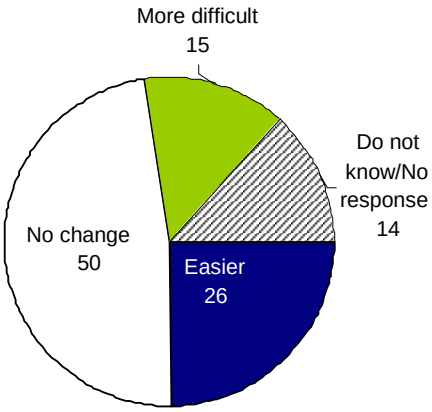


Q.5. In your experience, as compared with 10 years ago, obtaining patents at the following major patent offices has become

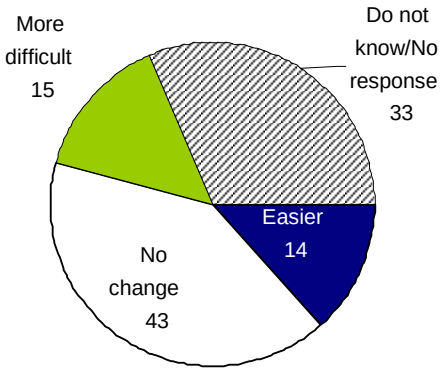
Q.5.1. USPTO



Q.5.2. EPO

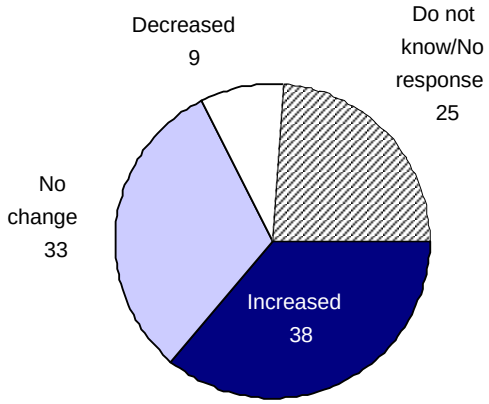


Q.5.3. JPO

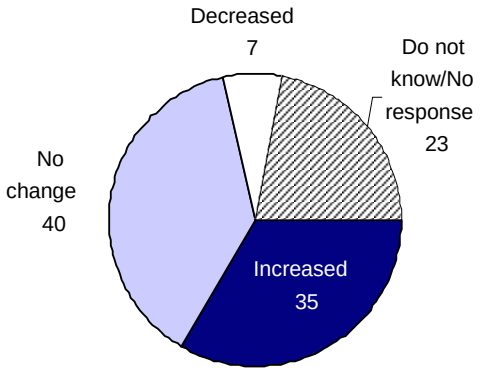


Q.6. In your opinion, has the ability of patentees to enforce the rights conferred by patents changed in the following regions in the past 10 years

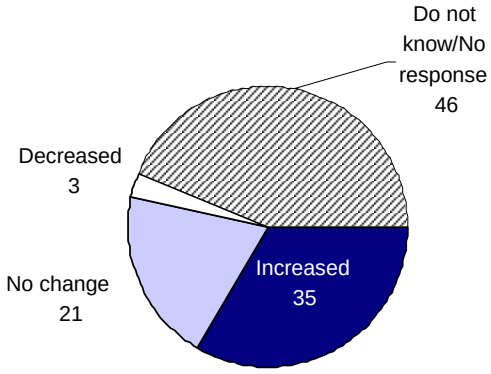
Q.6.1. United States



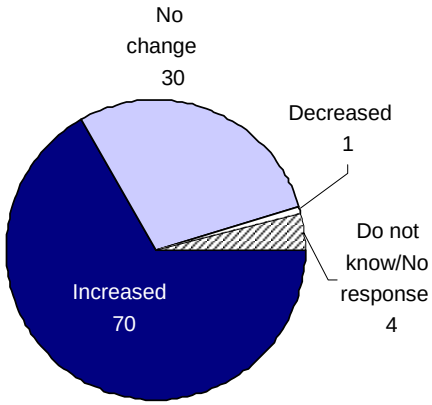
Q.6.2. Europe



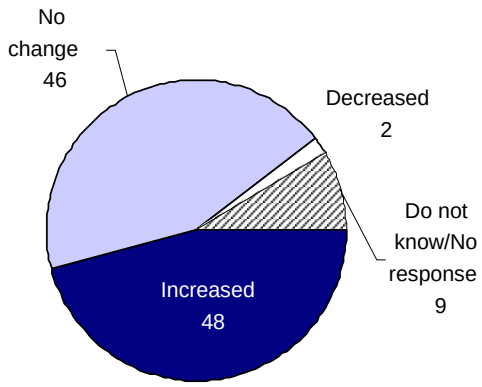
Q.6.3. Japan



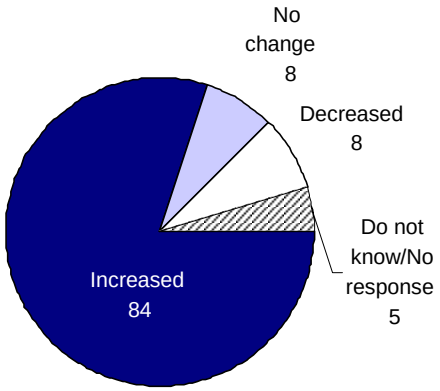
Q.7. Has the number of challenges related to patent infringement in which your company has been involved (either against or in favour of your company) changed with respect to 10 years ago?



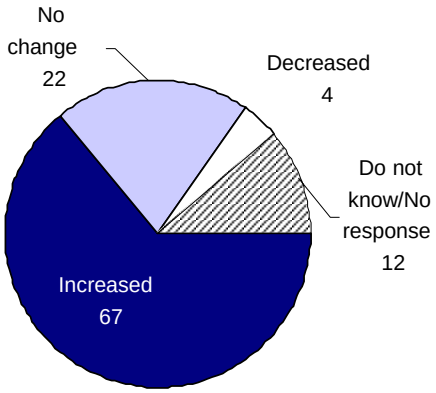
Q.8. Has the likelihood of research projects at your company being blocked (not started or stopped) due to patents from competitors changed with respect to 10 years ago?



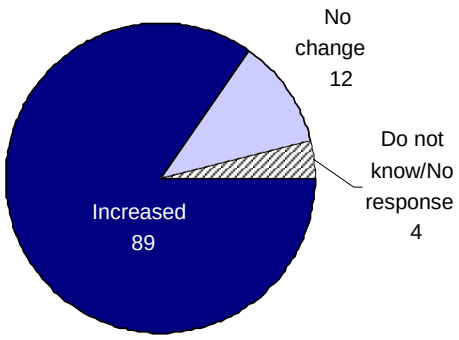
Q.9. Has the total cost of filing a patent (staff time, patent application costs, attorney fees etc) changed with respect to 10 years ago?



Q.10. Has the average value of a patent (be it from exploiting the patented invention or from licensing it) changed with respect to 10 years ago?

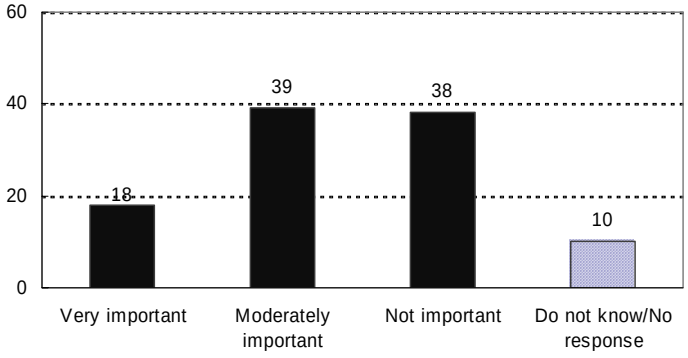


Q.11. Have the business risks of not patenting an individual invention (in terms of being imitated, in terms of another company filing a patent on the same invention, etc) changed with respect to 10 years ago?

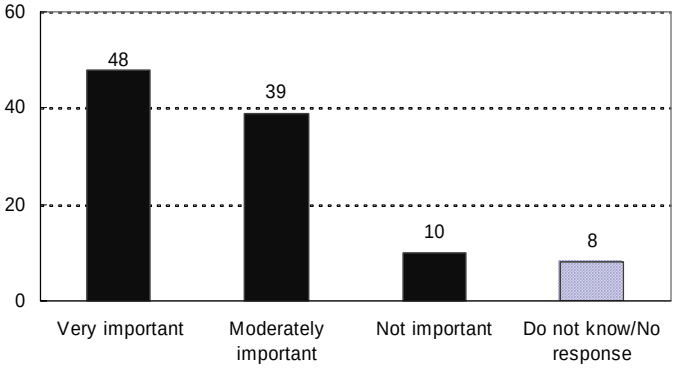


Q.12. What has been the relative importance of the following factors for your company's patenting strategy in the past 10 years?

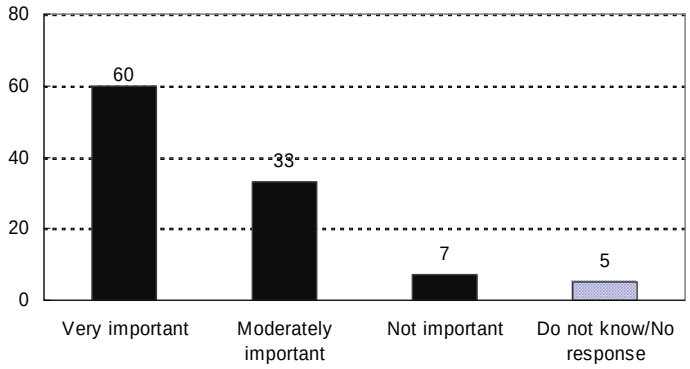
Q.12.1. Effect of your company's patent portfolio on the stock price of your company / on investor ratings



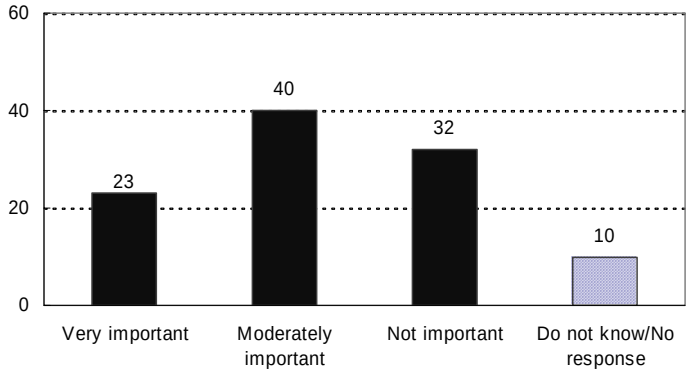
Q.12.2. Effect of your company's patent portfolio on its bargaining power when negotiating alliances with other companies



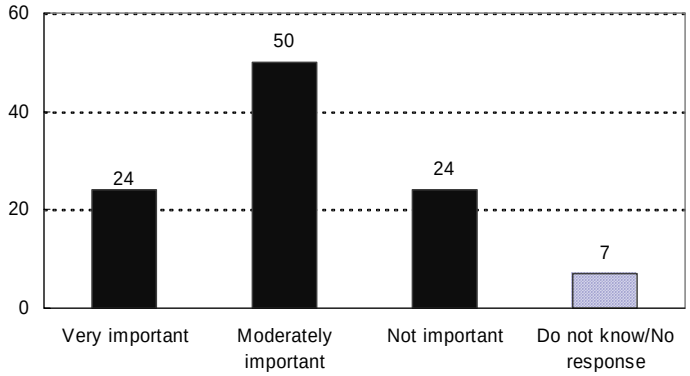
Q.12.3. More intense product market competition



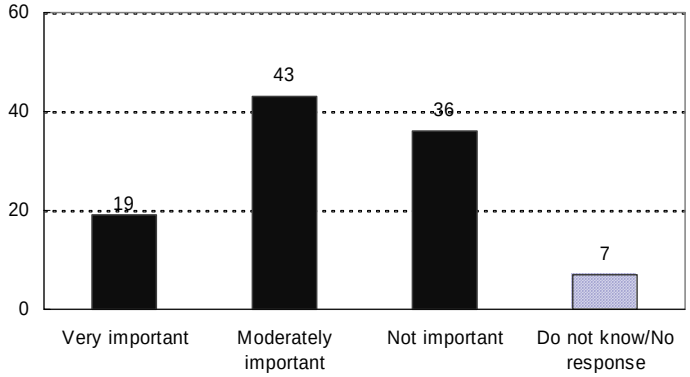
Q.12.4. Reduced entry barriers into your business (e.g. access to distribution networks, access to production facilities)



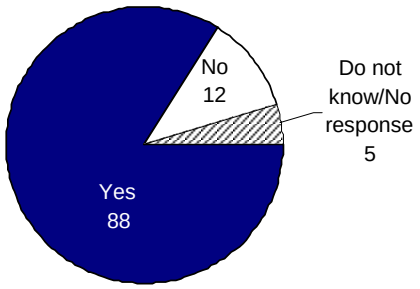
Q.12.5. Potential revenues from licensing patented inventions



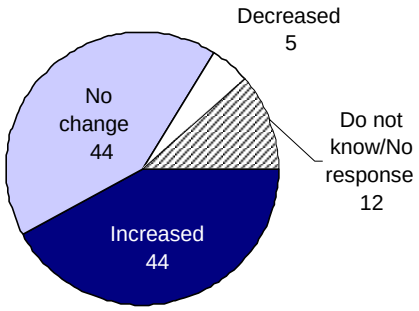
Q.12.6. Changes in the cost or administrative procedures for patenting



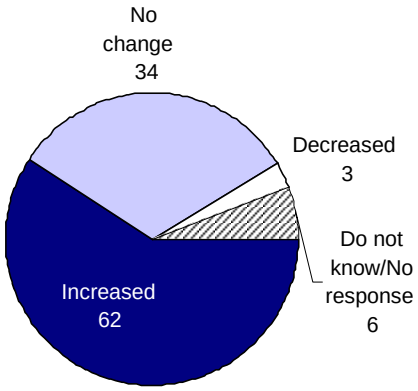
Q.13. Is the information disclosed in other firms' patents useful for designing and implementing your company's R&D strategy?



Q.13.1. In your opinion, has the usefulness of information disclosed in patents changed with respect to 10 years ago

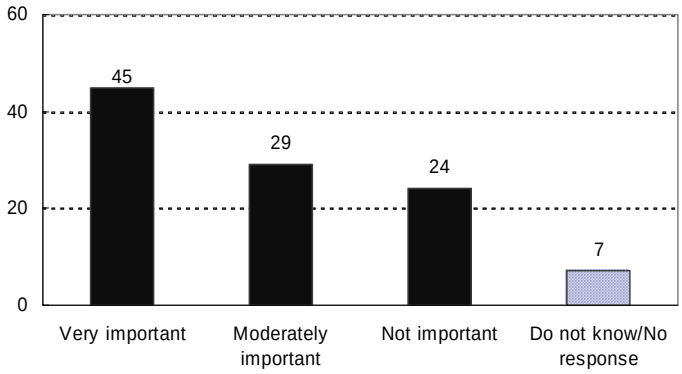


Q.14. Has the number of licenses your company acquires from other companies changed with respect to 10 years ago?

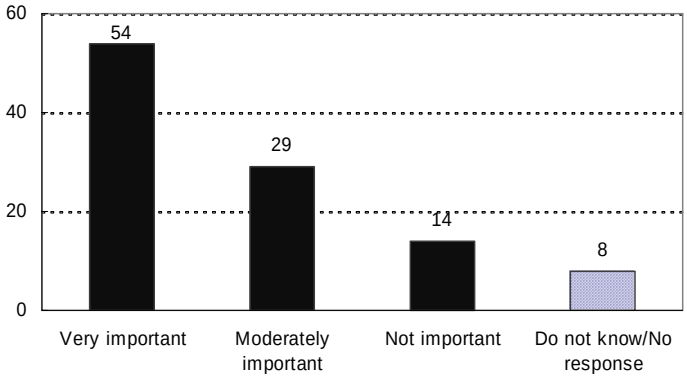


Q.15. How important have the following objectives been in motivating changes to your company's strategy as regards licensing patents from other firms in the past 10 years?

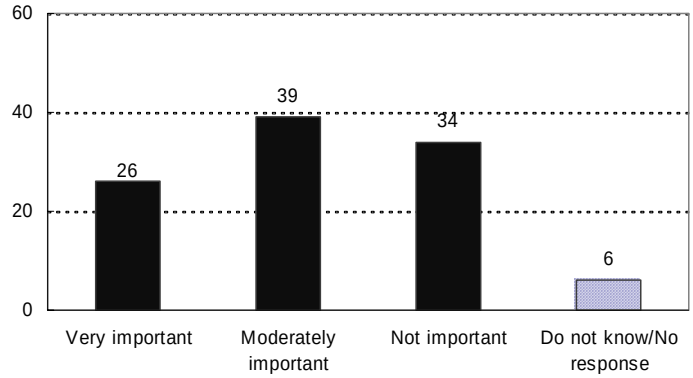
Q.15.1. To accelerate innovation processes and shorten time-to-market



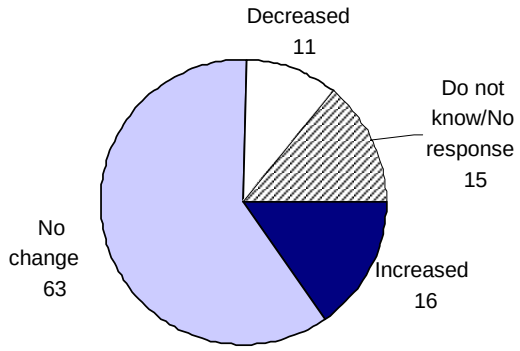
Q.15.2. To gain access to complementary expertise or technology



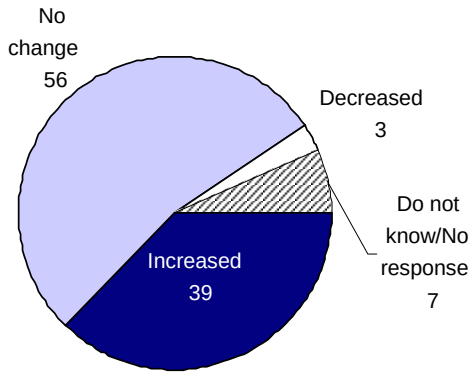
Q.15.3. To substitute for internal R&D



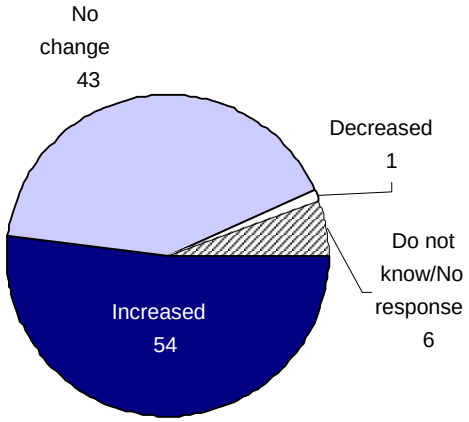
Q.16. Has the likelihood of your company facing refusals to license from other firms changed with respect to 10 years ago?



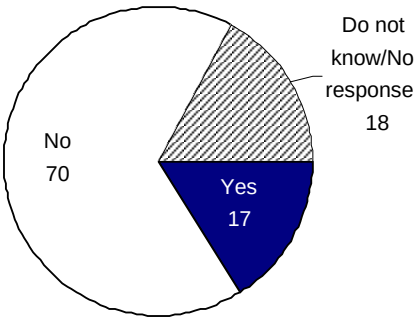
Q.17. Has the number of cross-licensing agreements your company has entered into with other companies in order to gain access to their inventions changed with respect to 10 years ago?



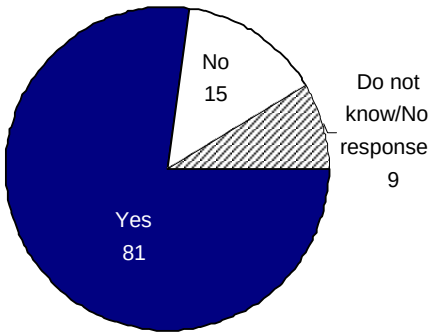
Q.18. Has the number of licenses your company has granted to others on its patented inventions changed with respect to 10 years ago?



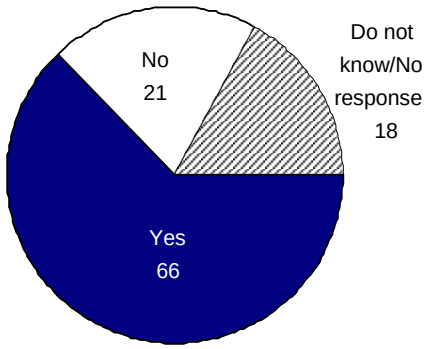
Q.19. Does your company face significant obstacles to licensing compared to 10 years ago?



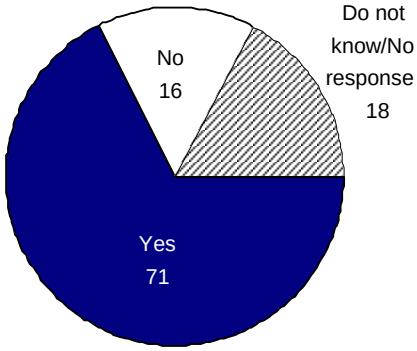
Q.20. Do you expect patents to become a more important form of intellectual property protection to your company in the next five years?



Q.21. Do you expect outward licensing of your company's patented inventions to become more important to your company in the next five years?



Q.22. Do you expect inward licensing of patented inventions from other companies to become more important to your company in the next five years?



Chapter 5

IMPROVING PATENT QUALITY: CONNECTING ECONOMIC RESEARCH AND POLICY

Stephen A. Merrill
Board on Science, Technology and Economic Policy
The National Academies

Beginning in 1980 in the United States, a series of judicial, legislative, and administrative actions and international agreements extended patenting to new technologies well upstream from commercial products (biotechnology) and to technologies previously without or subject to other forms of intellectual property protection (software and business methods), encouraged the emergence of new users of the patent system (universities), and strengthened the position of patent holders vis-à-vis infringers domestically and internationally. High rates of innovation since these changes began to be introduced arguably are evidence that the patent system is working well, although there is surprisingly little direct evidence that the benefits of more, stronger patents extend very far beyond a few manufacturing industries such as pharmaceuticals, chemicals, and medical devices. Meanwhile, several concerns and criticisms have been expressed about how the patent system is functioning, quite apart from its financial costs. In the United States the foremost criticism, voiced by many proponents of the system, has been that too many issued patents do not meet the statutory tests of novelty or utility or at the time they were made would have been obvious to people skilled in the respective technologies. This paper examines why patent quality matters and propose a measure to improve patent quality at USPTO: the implementation of an opposition system similar to the one in place at EPO.

Patent system changes and criticisms

Beginning in 1980 in the United States, a series of judicial, legislative, and administrative actions and international agreements extended patenting to new technologies well upstream from commercial products (biotechnology) and to technologies previously without or subject to other forms of intellectual property protection (software and business methods), encouraged the emergence of new users of the patent system (universities), and strengthened the position of patent holders vis-à-vis infringers domestically and internationally. Compared with the 1970s and earlier, patents as a result are being more zealously acquired, vigorously asserted, and aggressively enforced. There are many indications that firms in a variety of industries as well as universities and other not-for-profit institutions are valuing patents more highly and are willing to pay higher costs to acquire, exercise, and defend them in spite of the fact that those costs, mainly in legal fees, are rising rapidly (AIPLA, 2003).

High rates of innovation since these changes began to be introduced arguably are evidence that the patent system is working well, although there is surprisingly little direct evidence that the benefits of more, stronger patents extend very far beyond a few manufacturing industries such as pharmaceuticals, chemicals, and medical devices. It is even less clear that patents induce additional R&D investment in the ICT industries and service functions of the economy, although the roles of patents in these sectors are only beginning to be studied systematically (Cohen and Merrill, 2003).

Meanwhile, several concerns and criticisms have been expressed about how the patent system is functioning, quite apart from its financial costs. These include the conjecture that the proliferation of patents is raising the probability of hold-ups and the difficulty of negotiating essential licenses in fields characterized by cumulative technology development. In the academic community the concern is about restricted access to patented tools of research and even foundational discoveries as patenting extends to scientific research results that formerly would have been placed in the public domain. A third allegation is that the disclosure function of the patent system is not being well served, either because of the manner in which patents are written or because of legal disincentives for competitors to consult the patent literature.

In the United States the foremost criticism, voiced by many proponents of the system, has been that too many issued patents do not meet the statutory tests of novelty or utility or at the time they were made would have been obvious to people skilled in the respective technologies. Some critics have suggested that the standards of patentability — especially the non-obviousness standard—have been too far relaxed as a result of court decisions (Barton, 2000; Lunney, 2001). Other observers fault the performance of the US Patent and Trademark Office (USPTO) in examining patent applications, variously attributing the alleged deterioration to examiner qualifications, inexperience, or incentives, or to inadequate examining time or lack of access to prior art information. Although logically distinct, the notion that standards for patentability are slipping and the notion that USPTO examiners are failing to apply the legal standards appropriately are obviously difficult to distinguish in practice.

The role of theoretical and empirical research

Articulating why patent quality is important

How is theoretical and empirical research contributing to the task of determining if there is a patent quality problem and, if so, identifying solutions? First of all, economics has a good deal to say about why reasonably high standards of novelty, utility, and non-obviousness are important. Issuing patents on previous or trivial inventions confers market power to restrict access and raise prices and it

enables the patent holder to use litigation as a competitive weapon without any offsetting benefit in terms of incentives for making genuine advances. It represents an unjust reward of the patent holder at the expense of consumer welfare. Because of uncertainty about their validity, poor patents are likely to encourage more infringement and more litigation, raising the transaction costs of the system and discouraging some investment (Meurer, 1989). Or if not deterred, investors may incur the cost of product development only to abandon the market later when their technology is deemed to infringe (Levin and Levin, 2003). There is also some evidence that raising or lowering the standards of patenting can affect the character of R&D. If the standard is high, firms may be more likely to pursue larger innovations (O'Donoghue *et al.*, 1998).

Determining if patent quality is changing

Second, the claim that quality has deteriorated in a broad and systematic way could be put forward although it has not been empirically tested. Three seemingly direct measures of quality are *1)* the ratio of invalid to valid patent determinations in infringement lawsuits; *2)* the error rate in USPTO quality assurance reviews of allowed patent applications; and *3)* the rate of claim cancellation or amendment or outright patent revocation in re-reexamination proceedings in the USPTO. All three indicators suffer from serious deficiencies, however. The numbers of patents subject to litigation and re-examination are very small (just over 1% and 0.3%, respectively) and cases are selected non-randomly. Ostensibly, the USPTO's audits come closest to producing a measure of quality; but the protocol is designed to measure individual examiner more than system performance. Moreover, USPTO management has been erratic in devoting resources to the activity which therefore does not inspire confidence that its results are meaningful and consistent over time.

Nevertheless, one way to test empirically whether there has been a change in patent quality is to "peer review" the patent examination process with a representative sample of cases from different time periods, evaluated by a group of experts removed from the examination process, whether or not they are within or independent of the USPTO. Another approach to the question of patent quality may be to use patent indicators familiar to economists as measures of patent value or importance. A change in forward citations (*i.e.* citations to a patent or set of patents in subsequent patents) in one sample relative to another sample of patents may be a proxy for an increase or decrease in quality. Changes in the number or character of prior art references (*i.e.* backward citations) could indicate some change in the thoroughness of prior art searching (Graham and Mowery, 2003; Allison and Tiller, 2003).

In the absence of systematic testing of the hypothesis that patent quality has declined, there are several reasons to suspect that more issued patents are deviating from previous or at least desirable standards, particularly in technologies newly subject to patenting, although conclusions must remain tentative. One reason to believe that quality has suffered even before taking examiner qualifications and experience into account is that in recent years the number of patent examiners has not kept pace with the increase in workload represented by the escalating number and growing complexity of applications. Second, patent approval rates are higher than officially reported, higher than in some other major nations' patent offices (Quillen and Webster, 2001; Clarke, 2003). Third, changes in the treatment of genomic and business method applications, introduced as a result of criticisms of the quality of patents being issued, reduced or at least slowed down the number of patent grants in those fields. And fourth, there does appear to have been some dilution of the application of the non-obviousness standard in biotechnology and some limitations on its proper application to business method patent applications. Although quality appears to be more problematic in rapidly moving areas of technology newly subject to patenting and is perhaps corrected over time, the cost of waiting for an evolutionary process to run its course may be too high when new technologies attract the level of investment exhibited by the Internet and biotechnology.

Identifying and designing solutions

Third, research could shed a good deal of light on ways of solving or ameliorating the quality problem. A heretofore neglected area of research is the determinants of USPTO patent examination output or, in economic parlance, the production function of the agency. The National Academies' Science, Technology, and Economic Policy (STEP) Board commissioned two attempts to relate examination characteristics to subsequent court decisions in patent validity cases, but they are limited by the very small number of cases that proceed to judgment and even smaller number that are decided on appeal (Cockburn *et al*., 2003; King, 2003). In any case, although it is important to conduct reasonably thorough examinations of patent applications and improvements in the process need to be identified, given the volume of applications and the fact that only a small percentage of issued patents achieve any commercial importance, there is probably a point beyond which it is not practical or economic to invest all of the resources that would be needed to ensure uniformly rigorous and timely examination.

Another method of improving quality is to weed out invalid patents or revise and narrow the claims of patents by an administrative process after they are issued, and here there has been more research progress. Since 1981 the United States has had such processes, known as re-issuance and re-examination, which are available at any time during the term of a patent. Re-examination has two forms—*ex parte* re-examination initiated by a patent holder, the director of the USPTO, or a third party challenger who plays no further role in the proceedings; and *inter partes* re-examination, in which the challenger may participate but until recently has been barred from appealing issues raised and decided and even issues that could have been raised in the administrative proceeding.[1]

Almost one-half of *ex parte* re-examinations are sought by patent holders hoping to strengthen their patents, usually in the face of newly revealed prior art (Graham *et al.*, 2003). USPTO-initiated re-examinations are very infrequent responses to criticism of issued patents, some of them having been subject to ridicule. Because of the limitations on appeals, *inter partes* re-examinations have also been rare; challengers are loathe to forfeit an opportunity to litigate all of the potential validity issues if accused of infringement. Although that disincentive has been removed, re-examination has another serious limitation. It may consider only questions of prior art and, even more narrowly, only prior art not considered in the original application examination. Issues of non-obviousness and utility and the adequacy of written description and enablement, which are problematic to varying degrees in different technologies, may not be addressed in re-examinations, only in litigation.

Other countries have an administrative mechanism, known as opposition, for third party challenges to the validity of issued patents on any grounds. In a formal analysis published in the collection of STEP-commissioned research, Jonathan and Richard Levin make a strong theoretical case for the welfare gains of instituting an opposition procedure (Levin and Levin, 2003). These include the prevention of unwarranted monopoly profits, the alignment of patent costs and benefits to genuine novelty and utility, and a reduction in uncertainty for all participants in the relevant market. These benefits depend heavily on two effects or characteristics of the system – that it tends to substitute for rather than lead to litigation and that it is less expensive and faster than litigation. It is conceivable that opposition, even though it replaced litigation in many cases, could be so popular that its total costs would exceed the costs of litigation, but that outcome is unlikely.

1. 35 USC § 301-07 (2000) (*ex parte* re-examination) and 35 USC § 311-18 (2000) (*inter partes* re-examination). See Mossinghoff and Kuo (2002) for a discussion of the features and history of these procedures.

Legislation to institute an opposition procedure has been recommended by the administration of the USPTO in its 21st Century Strategic Plan, the Federal Trade Commission in a recent report on competition, innovation, and the patent system (FTC, 2003), and by the National Academies in their 2004 report, A 21st Century Patent System. If adopted, the procedure's design could benefit from recent research on oppositions in the European Patent Office (EPO), including work sponsored by the STEP Board.

In a detailed empirical comparison of US re-examinations and EPO oppositions, Stuart Graham and colleagues find that opposition works reasonably well in many respects. For one thing, it is used with some frequency. (Graham *et al*., 2003) Slightly more than 8% of European patents were opposed in the period studied, 1981-1998. Moreover, if one uses citations in other patents as an indicator of value, the opposed patents are more commercially important than the unopposed patents. Finally, the system produces significant changes in outcomes even though the EPO examination process is generally thought to be thorough and rigorous. Fully one-third of opposed patents are invalidated, and another one-third are amended in the course of opposition. In subsequent research, Dietmar Harhoff finds evidence from Europe supporting the Levins' prediction that the use of opposition will substitute for subsequent litigation over validity if the process is cheaper even if it may not be speedier (Harhoff, 2003). Of course, this experience may not translate to the United States because of system differences.[2]

Graham and colleagues do, however, confirm a widely held view that the EPO's opposition process is subject to long delays, as many as several years. In fact, the average length of time between patent issuance and the conclusion of opposition is approximately the same as the average time between issuance and the conclusion of litigation in the United States. This appears to be largely a function of the ability of either party in an opposition to extend deadlines for actions indefinitely — a state of affairs that should be precluded in the design of a US system. Thus, either by legislation or by regulation, an opposition proceeding should tightly constrain the schedule to ensure both the timeliness and the lower cost of the process compared with litigation.

Adoption of a system comparable to opposition has in the United States been fiercely opposed by the US "independent inventor" community as potential weapon of large businesses against individuals and small enterprises. Graham and colleagues show convincingly that this is not the case in Europe. Opposed patents are not disproportionately held by small entities nor are large firms disproportionately responsible for initiating oppositions. On the contrary, individuals and small businesses would be beneficiaries of an alternative, cheaper and faster system of resolving patent validity questions. As Jean Lanjouw and Mark Schankermann show in work supported by the STEP Board, it is in litigation that the greater resources of large firms give them substantial advantages both in prosecuting cases to conclusion and in achieving settlements on favorable terms (Lanjouw and Schankermann, 2003).

Assessing how reforms are working

An opposition procedure could have important side benefits. First, it could encourage firms to review newly issued patents, increasing technology spillovers. Second, it would provide guidance to patent examiners much earlier in the technology cycle than they currently acquire from court decisions. On the other hand, there undoubtedly would be unintended, unanticipated consequence. Any change in a legal institution creates opportunities for "gaming" the system. These possibilities could be addressed in subsequent research to determine how the opposition procedure is working.

2. In particular, it is likely that the European opposition rate is higher than it would be with a similar US procedure because an opposition is the only means of invalidating a patent in all European Patent Convention member countries whereas litigation is on a national basis.

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Chapter 6

HOW DO THIRD-PARTY PATENTS FOSTER INNOVATION?

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Vice-President of IP, Air Liquide
and
President, IP Committee, Mouvement des Entreprises de France (MEDEF)

This paper presents the views of the Vice-President of Intellectual Property at Air Liquide on how third-party patents may foster innovation. In order to illustrate the economic and business impact of patents, he looks at them from two different angles: first from the perspective of a firm as a potential patent infringer or user of third-party patents, and then from the perspective of a patentee. Provided a certain number of conditions are fulfilled, the patent system can play a positive role in the economic performance of firms, either when they use patents as a source of technical information or when they use them to obtain specific exclusive rights for a limited period of time on their inventions.

Impact of patents on potential infringers

As the controversy about patents grows, arguments held by representatives of large companies tend to be regarded as one-sided, coming from the patentee side only. However, large firms are also potential infringers or at least users in various ways of third-party patents. Based on my experience as Vice President of IP at Air Liquide, this paper covers both perspectives in order to illustrate the economic and business impact of patents.

Even if Air Liquide is the worldwide leader of industrial gases, its competitors have altogether more patents than Air Liquide will ever have or intend to have. Consequently, I am more frequently on the "potential infringer" or "user" side than the "patentee" side, and in fact patent attorneys in my department probably spend more time reviewing our competitors' patents than on our own. Is this negative? On the one hand it represents a cost -- money and efforts that could be spent on more directly productive matters. On the other hand, I think it is not negative because third-party patents have a quite positive and "structuring" effect on my company. This impact relates to technical knowledge, business strategy, customer needs, and human resources.

Technical knowledge

If patents were not available, enterprises would have significant difficulties finding information about the state of the art. Whereas fundamental and academic research tend to rely on publications, some 80% of the technical knowledge used in applied and industrial research comes from patents. The rest comes from publications, professional and technical journals, and conferences. Patent information is easy to find, easy to access from anybody's desk and it is in a coded format, which makes it easy to retrieve, interpret and exploit. Air Liquide organizes systematic and regular meetings among staff from the R&D and marketing departments and patent attorneys from the legal department to study competitors' new patent applications or grants. These meetings are a major source of information and inspiration for new inventions.

Business strategy

Careful analysis of patent applications from competitors after the 18-month publication stage helps us better understand their strategies. It reveals new technical advances, fields of activity they abandon, new fields of activity they undertake and countries in which they might commercialise products in the future. This competitive information is important to take into consideration when defining or adjusting corporate strategy. In addition, measurement of the efforts made by competitors (number of patents or number of inventors) makes it possible to have a fair idea of potential business in the market. In this respect, the geographical scope of patent applications is also useful to understand where future business opportunities may be found.

Customer needs

Air Liquide and its customers frequently hold patents in the same field. Understanding our customers efforts enables us to better understand what their needs are, the limits of their knowledge and how Air Liquide can bring added value to them and confirm its position as their provider of products or services.

Human resources

Regular meetings between staff from the R&D or engineering departments and staff from the marketing and legal departments are a major source of creativity. Third-party patents create a real challenge to a company's inventors within a company, who from time to time realise that someone else had good ideas before them. When that happens, they try to circumvent those patents and find other solutions to the same technical problems and increase customers' choice. These alternative solutions may perform worse than the third-party invention, and would probably be less costly too, but sometimes they are superior because the knowledge contained in a competitor's patents enables the inventors to find a better and independent solution. Patents are a unique source of information.

However, to be fair, there may also be circumstances where third-party patents block certain R&D directions and do not open the way to other viable technical solutions. I have seen this happen perhaps twice in 30 years. It is worth pointing out that in order to have the positive impact of patents described above, it is vital that patent laws authorize third parties to make experimental use of the content of patents. Recent court cases, particularly in the United States, show that some countries have a narrow interpretation of this freedom. Research exemptions should be a point in the patent harmonisation agenda.

Impact of patents on patentees

In what follows, I will set out the main economic and business impacts of patents on their owners. Here as well, I just intend to tell you what I observe in my company and rely on facts, not on theory.

"Time limited" competitive advantage

Contrary to what many economic studies say, I have not seen many broad "blocking patents" in my long life as a patent specialist. Certainly, all patents are "blocking", but what do they block? They block specific solutions within a certain scope which is frequently limited and refers to a particular technical solution and its possible equivalents. In most cases alternative solutions exist. In fact in almost 100% of cases, the patent just gives the patentee a time advantage. This time is in theory 20 years but empirical evidence shows that the average patent term is between eight and ten years. Exceptions, when they exist, are mostly related to pioneer inventions or connected to legal or de facto standards. This limited advantage for the patentee is probably enough and is already a good incentive to perform further research.

Customers

Patents are useful for customers to evaluate which companies they should deal with. Customers frequently estimate, based on the patent activities of a firm, the technical capacity of their potential providers and assess whether they may be able to provide good solutions for them. Consequently it is important that a company shows its innovation capacity through patents, both in terms of the quality of its patents and from time to time also in terms of the number of its patents (even if, personally, I have some doubts about the relevance of the number factor).

Shareholders and stakeholders

During the annual meeting of Air Liquide, generally attended by 4 000 to 6 000 shareholders, a large number of questions relate to R&D and patents. The fact that Air Liquide has a significant number of patents is important to shareholders because it is one way for them to measure the future of the company in terms of new business that will be created from inventions and innovations. This is also true with respect to financial analysts who increasingly want to know what kind of intangible assets a company has, essentially patents, and also want information on the way these patents are managed in order to maximize profit and industrial activities.

Internal motivation

R&D staff are not always easy to manage in a world where management skills are essential for promotion. The companies I have been with have created, upon my recommendation and proposals, inventor recognition programmes that are very motivating for the inventors and stimulate inventive activities. Being part of such a programme implies additional remuneration, but their real impact extends beyond this financial question. These programmes, based on patents and on the profit generated through patents, give greater visibility to a group of people who are usually not well known within the company. They show the impact that inventors have on the business and profit of the company to other employees. This is why the Vice President R&D of Air Liquide takes patents as one of the criteria to evaluate the performance of researchers. It is essential that this kind of program is connected to patents because they are granted by an outside authority and this neutrality plays a major role for having real recognition.

Conditions for a positive impact

Based on my experience, patents seem to exercise a positive impact on companies, even when they are not the patentees. In what follows, I will set out the conditions for this positive impact and its possible limits.

Predictability

When reading a patent, it is essential to be able to determine its scope of protection - in other words, to understand with a reasonable degree of certainty what belongs to the public domain and what does not. This can only be achieved with a reliable judicial system that exercises an implicit control on patent offices, and which is more of a regional nature than of a national nature in parts of the world which have regional patent systems, like Europe. In this respect, the present situation in Europe is not satisfactory because patentees and patent users are obliged to determine, after a European patent is granted, what decisions German, French, British or Italian courts would make. This has a negative impact in a territory which is supposed to be a single market, not only because national courts have different jurisprudences but also because, as they are all different, they exercise no influence on the European patent office. This is not acceptable. It is consequently essential to improve this situation. This is a reason why the Community patent is a matter of urgency.

Inventiveness

This is a difficult issue, on which the pendulum might go from one extreme to another if it is not dealt with carefully. It is nevertheless my belief that whereas about 20 years ago it was a real challenge to obtain a patent in certain countries, it has presently become too easy in certain parts of the world. Inventiveness should have a real meaning. It is important that court decisions are taken into consideration by patent offices and that they modify their rules for searches and examination accordingly when necessary.

Quality

Today, everyone focuses on quality and patent offices talk about high-quality standards. However, it is not clear whether the users of the patent system have been asked what the concept of quality should actually mean. It should mean that patents are granted within a reasonable time frame. Delays of five years, six years or more are unacceptable. It should also mean that the quality of search, which is the first hurdle, and the quality of examination are controlled by external bodies based on well-known criteria. Industry representatives should exercise a role in such a control and evaluate the performance of patent offices and challenge them.

Cost

Although a full discussion of the proper cost of a patent in terms of economic and production cost is out of the scope of this presentation, it is important to note that unnecessary cost should be avoided. Is the role of patent offices to make money from those who innovate? Most, if not all, of the patent offices in the world are profit centres. This is nonsense, and as a European Commissioner said a few years ago, it amounts to a tax on innovation.

Neutrality

Of course a patent system has to be neutral with respect to the nationality or size of applicant. Neutrality should exist at the level of both the patent office and the judicial system. Despite what one frequently reads about patents essentially being used by big companies against small ones, my own experience in the field of electronics shows that this is not the case. More and more patents are used by small companies or individuals. Recent cases relating to the software industry could be mentioned in this respect.

New fields of activity

For the last hundred years, questions have regularly been asked about the use of the patent system to protect inventions related to new technologies. In the 1950s, the question was: should we protect chemical products? In the 1960s: should we protect pharmaceutical products? And in the 1990s: should we protect software and business methods? For hundreds of years, patent systems have shown enough flexibility to adapt to new technologies. It is not clear whether this will always be true, but at least we should make experiments and study facts before refusing *prima faciae* to use the patent system to protect new types of inventions.

Research exemption

Finally, I would like to stress the importance of having a sufficiently broad definition of the research exemption to enable patents to play their role in promoting progress, and to ensure that the standards for the implementation of research exemptions are similar across countries.

Conclusion

The patent system has a positive role in the economic performance of firms -- provided that a certain number of conditions are fulfilled -- as they use patents either as a source of technical information or to obtain specific exclusive rights for their inventions a limited period of time.

PART 2

CHANGES IN PATENT REGIMES

Chapter 7

OVERVIEW OF RECENT CHANGES AND COMPARISON OF PATENT REGIMES IN THE UNITED STATES, JAPAN AND EUROPE

Catalina Martinez
OECD[1]

Dominique Guellec
EPO[2]

Patent regimes have gone through important changes in the past two decades, most of them in the direction of 'strengthening patent rights', in the sense of reinforcing the exclusive rights conferred to patent holders and expanding their coverage. OECD countries have experienced an upward harmonisation of their patent regimes based on the view that easily enforceable patents and broader rights for patent holders are beneficial for innovation. Reforms have been mainly led by requirements set out in international treaties, and decisions taken at major patent offices and courts. This paper compares and reviews the main changes to patenting regimes in Europe, Japan and the United States and examines the degree to which they have strengthened patent rights.

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2. Chief economist at the European Patent Office, was senior economist at DSTI when the study was conducted. Opinions expressed in this document do not necessarily reflect the views of the EPO.

Introduction

Patent regimes have gone through important changes in the past two decades, most of them in the direction of strengthening patent rights, in the sense of reinforcing the exclusive rights conferred to patent holders and expanding their coverage. OECD countries have experienced an upward harmonisation of their patent regimes based on the generalised belief that easily enforceable patents and broader rights for patent holders are beneficial for innovation. Reforms have been mainly led by requirements set out in international treaties, and decisions taken at major patent offices and courts. This document reviews the current status of patenting regimes in Europe, Japan and United States and recent changes they have gone through.

The main factors underlying changes to patent regimes in the past few years have been as follows:

- *Greater recognition that intellectual property has major influence on innovation and growth.* The conventional wisdom that has driven policy changes in recent years considers patents as an essential instrument to foster R&D investment and economic growth.
- *Emergence of new governing bodies.* The design and enforcement of patent policies has lain increasingly in the hands of international organisations such as the World Trade Organisation (WTO) and the World Intellectual Property Organisation (WIPO), major patent offices and courts specialised in Intellectual Property Rights (IPRs) issues, such as the Court of Appeals for the Federal Circuit (CAFC) in the United States.
- *International harmonisation of patent regimes.* Patent laws have followed an upward harmonisation process across countries via bilateral and multilateral treaties and especially since the inclusion of IPRs as an essential issue in international trade negotiations with the agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS).

And their effect on the patent system has been characterised by:

- *Extended coverage of intellectual property protection.* Areas that used to be outside the realm of patents are now increasingly protected, notably service-type inventions (*e.g.* software and business methods). Inventions are more frequently based on the results of basic research, especially in the field of biotechnology (*e.g.* genetic inventions).
- *Patent holders are entitled with broader rights, especially in new areas.* Patent claims in new areas are often broader than in mature areas. Pioneer inventions in emerging technology fields tend to be larger in scope than follow-on inventions. Some patenting practices such as the use of "reach-through claims" in biotechnology can extend protection to a broad range of applications unknown at the time of patenting. The explicit adoption of the doctrine of equivalents for infringement litigation may have also contributed to a general broadening of patent scope in some countries, as well as the move to a "multiple claim" system in Japan
- *Filing procedures are increasingly flexible and less costly, notably at the international level.* Several mechanisms to defer filing and examination procedures at patent offices have transformed the initial patent application step in a sort of "option to patent" which allows inventors to retain the right to delay the following steps in the application process for longer periods of time. Applicants using the Patent Cooperation Treaty (PCT) system at WIPO can obtain official international search results before entering the national/regional phase. A substantial reduction of fees at the European Patent Office (EPO) and the project of establishing

a Community Patent in Europe, together with the introduction of electronic filing procedures in most jurisdictions reflect efforts to reduce the cost of filing patents.

- *Reinforced examination processes at patent offices.* Since its creation at the end of the 1970s, EPO provides centralised examination procedures for applicants willing to obtain patent rights in signatory countries of the European Patent Convention (EPC) – before then, more than half of the EPC members did not provide examination at their national offices and only had patent registration systems in place. At the Japanese Patent Office (JPO), the time limit to request examination was reduced from seven to three years from filing in 2001 to accelerate the examination process and reduce uncertainty for third parties. At the United States Patent and Trademark Office (USPTO), following a doubling of patent applications for business methods and concerns expressed about some of the patents recently granted in this field being obvious, a second review was introduced in 2000 for all applications classified in the patent class related to business methods.
- *More countries offer third parties the possibility to challenge validity of granted patents via administrative procedures.* Several changes have reinforced post-grant administrative procedures at patent offices, providing third parties the opportunity to challenge validity of granted patents at a lower cost than judicial procedures. EPC applicants have access to a centralised post-grant opposition system. Japan moved from a pre-grant to a post-grant opposition system in 1996. USPTO amended its re-examination process to allow more participation of third parties in 2002.
- *The rights of patent holders are more frequently validated in court.* Patent holders receive higher damage awards in patent litigation trials across countries. Since the creation of the CAFC in 1982, the number of patents invalidated in court has decreased in the United States.
- *Limited conditions for loss of rights*. Recent court decisions in the United States indicate that conditions to apply research exemptions may become increasingly restrictive.

These changes have contributed to rapid growth in patenting activity in most countries over the past decade and have coincided with a wave of innovation, notably in fields such as information technology and biotechnology. However, it is still debated to what extent recent trends in patent regimes are a determinant or an effect of this new course in innovation. It is not the purpose of this paper to answer this question; rather, it reviews the current status and main recent changes to patent regimes in Europe, Japan and the United States and examines the degree to which these changes have gone in the direction of strengthening intellectual property rights.

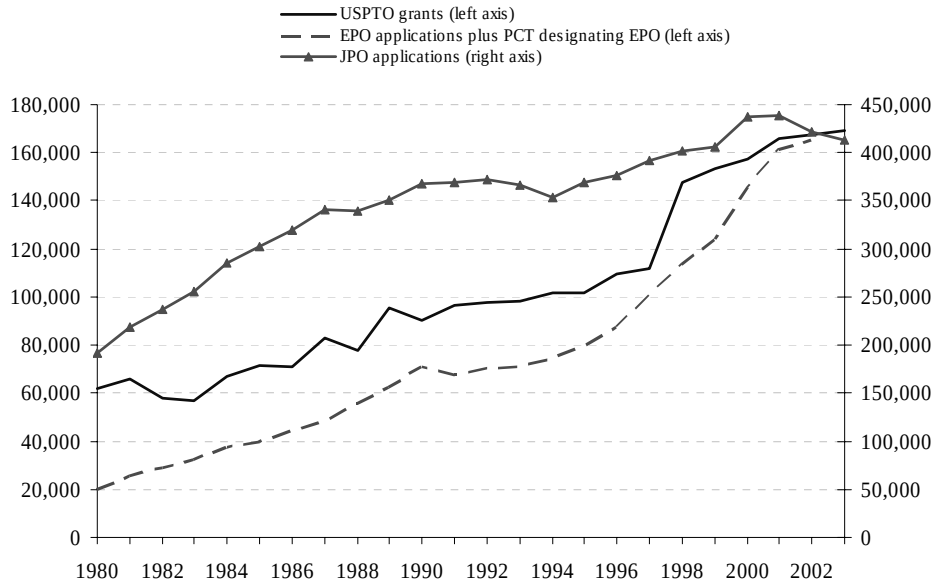
This paper is organised as follows. The next section describes recent changes in the governance of the patent system. The fourth section analyses the expansion of subject matter to new areas such as biotechnology, software and business methods. The fifth section describes some differences in the definition and application of patentability criteria across jurisdictions. It then describes a number of mechanisms that have largely increased the flexibility and reduced the administrative costs of patenting procedures. The following section then examines the question of whether the scope of patent protection has broadened in recent years and patent holders are now entitled with stronger rights than before. The eighth section describes how incentives for patenting at public research organisations have recently increased. The ninth section describes the exceptional conditions under which the exclusive rights conferred by patents may be limited, such as research exemptions. This is followed by the concluding section. A table with a comparison among major patent offices of the current situation as regards selected issues such as patent subject matter and filing and examination proceedings is included in the Annex (beginning on page 159).

Increased patenting and changing patent regimes

Patent regimes have experienced in-depth changes worldwide over the past two decades: they have strengthened, and their role in the economy has broadened. As a result, an increasing number of inventions are protected by patents, the exclusive rights they confer are less likely to be invalidated in court, patent holders enjoy broader rights, filing procedures are more flexible and the administrative costs of patenting have significantly decreased, especially for international applications.

Some of these trends could be seen as responses to new challenges, such as the emergence of new technology areas or the globalisation of economic activity. In a knowledge-based economy intellectual property contributes more directly to competitive advantage and to innovation, and even more so in a global environment in which competition is increasingly international and when emerging areas of economic activity are more closely linked to new scientific and technological knowledge (*e.g.* ICT and biotechnology). The emergence of new technological areas is reflected in the growing number of patents granted in high technology areas, and the effect of globalisation is illustrated by the higher propensity to seek protection in foreign markets.

Figure 7.1. **USPTO grants and EPO, JPO applications, 1980-2003**



Note: USPTO grants sorted by grant year until 2003; EPO applications (including PCT) sorted by application year until 2002; JPO applications sorted by application year.

Sources: EPO, JPO and USPTO.

But these factors do not explain all the growth experienced by patents in the past few years. Patent counts have increased in all technology fields and a large part of that growth comes from domestic applications, at least in the United States (Kortum and Lerner, 1998). Country characteristics such as market size, innovativeness, well-functioning of the patent system and other factors may influence the propensity to patent domestically and abroad. What has determined the recent growth in patents across countries? What is the impact of an increasing number of patents on the economy? Economists have tried to answer these questions, but no clear-cut solution emerges from their studies (Hunt, 1999a; Jaffe, 1999; Kortum and Lerner, 1998; Lerner, 2002). One of the obstacles found, apart

from the complexity of the issues at stake, has been the difficulty to disentangle the technical, legal and economic features of patents and to find empirical evidence for the latter.

In contrast, policy makers seem to share a common and strong belief in the positive impact of patents on innovation and economic growth which has been frequently reflected by policy statements in the United States, Japan and Europe, countries whose patent offices grant around 84% of all patents worldwide. At USPTO the growth in patent applications has been recently qualified as *"a boon for America's economy, as well as contributing to our genius for innovation"*[3]. In turn, the Japanese government considers intellectual property to be "*the source of industrial competitiveness*"[4] and created in 2002 the Strategic Council on Intellectual Property under the Prime Minister's Cabinet with the aim *"to establish a national strategy for intellectual property and to powerfully advance the necessary policies*".[5] A pro-patent view is also felt in Europe where the European Commission views the project of establishing a community patent as an essential tool *"to succeed in transforming research results and the new technological and scientific know-how into industrial and commercial success stories"*.[6] Likewise, the EPO released a mission statement in 2001 making clear that its objective is *"to support innovation, competitiveness and economic growth for the benefit of the citizens of Europe"*.[7]

Patents are arguably one of the best incentive systems for innovators and help diffuse technology by requiring disclosure of inventions, supporting entrepreneurs and facilitating the creation of markets for technology. However, the exclusive rights they confer may distort competition and the efficient allocation of resources, and may represent an obstacle to follow-on innovation. Patent policy needs to ensure the right balance between creating incentives for innovation and enabling the diffusion of knowledge to stimulate further research. This balance is influenced by the economic and institutional environment and results in an ongoing evolution and articulation between changes in economic activities and patent regimes, which in recent years have led toward stronger patents.

However, the strengthening of patent protection is not a new phenomenon. Historically, periods were patent strengthening measures were predominant have alternated with periods of weakening patent protection. Several countries questioned the utility of patents between 1850 and 1875, and even the Netherlands abolished its patent system in 1869, although a pro-patent wave followed at the end of the 19th century with the signature of the founding treaties of international harmonisation in IPR, the Paris Convention in 1883 for patents and the Berne Convention in 1886 for copyright, and a number of measures taken across countries to strengthen intellectual property regimes. A period of weakening patent protection followed in the United States in the 1920s, when the reinforced antitrust measures that followed the great depression of 1929 had a negative effect on the perception of patents. The latest pro-patent cycle starting in the 1980s seems to be different from previous ones in its overwhelming character and expansion across countries.

Some studies have tried to quantify and characterise the sequence of different cycles in the strength of patent protection across countries. One of them is the event study undertaken by Lerner (2001) of 177 policy shifts in 60 countries over a 150-year period starting in 1850, where he finds that

3. James Rogan, Director of USPTO, 2002.

4. Japan METI Task Force on Industrial Competitiveness and Intellectual Property Policy, Report, 5 June 2002. *http://www.meti.go.jp/english/information/downloadfiles/cICIPPfulltexte.pdf*

5. *www.kantei.go.jp/foreign/policy/titeki/index_e.html*

6. European Commission, COM 2000 412 Final.

7. *http://www.european-patent-office.org/mit*

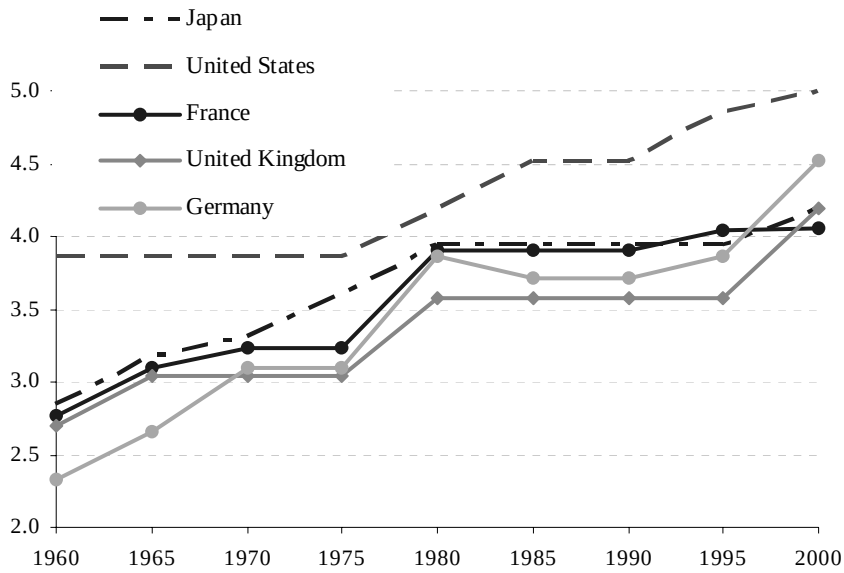
measures towards strengthening patent protection have been dominant over the period. Strengthening measures include those extending patent protection length, expanding patent subject matter, decreasing patent costs, and reducing provisions under which patents could be revoked or compulsorily licensed.

> "*Most shifts (64%) unambiguously increased patent protection. The remainder either unambiguously reduced patent protection (24%) or else contained both protection-enhancing and detracting elements (12%).*"[8]

Some authors have also attempted to construct comparable indexes of IPR strength across countries over a period of years, such as the one developed by Rapp and Rozek, including copyright, patent and trademark policy changes (Rapp and Rozek, 1990), and the quinquennial index of patent rights built by Ginarte and Park for 110 countries for the period 1960-1995 (Ginarte and Park, 1997). The composite index of patent strength developed by Ginarte and Park, which is the most widely used in empirical studies, consists of an unweighted sum of the scores achieved for five categories of patent laws by each country at a certain point of time, with higher values of the index ranging between 0 and 5 indicating stronger protection. These categories are *1)* extent of coverage; *2)* membership in international patent agreements; *3)* provisions for loss of protection; *4)* enforcement mechanisms; and *5)* duration of protection. However, despite its virtues to identify differences between developed and developing countries, convergence over time towards the maximum level of protection within the set of developed countries have lessened its usefulness to highlight differences across OECD countries.

Figure 7.2 illustrates the evolution of Park's patent strength index between 1960 and 2000 for a selection of OECD countries. Although it clearly reflects a strengthening of patent protection in these countries over the period, it is not sufficient to understand whether and how the trend has been experienced differently across countries, what has determined the changes and whether new changes are previewed in the future that could either reinforce or go against the main trend.

Figure 7.2. **Patent strength index, 1960-2000**



Source: OECD, based on data from Ginarte and Park (1997), Park (2001) and Park and Wagh (2002). Index values range between 0 and 5, where 5 indicates the highest level of patent strength.

8. Lerner (2001), p. 19.

Emergence of new governing bodies

Patent standards are set by law, voted by national parliaments in accordance with international treaties. These standards are then interpreted by courts and implemented by patent offices. In that framework, major governing bodies of the patent system are: international organisations (WIPO, WTO), national courts, and national patent offices. These three categories of bodies have experienced structural changes over the past decades, most aimed at supporting an expanded role of patents in the economy.

A series of new bodies has taken an increasingly prominent role in the design, implementation and enforcement of patent policies. These include international organisations such as WIPO and WTO, major patent offices, such as EPO, USPTO and JPO, and courts specialised in IPR, such as the CAFC in the United States. Whereas policy makers at national governments are in charge of designing patent laws within their jurisdictions, these are increasingly determined by international minimum standards, bilateral and multilateral treaties. Since 1995 WTO has enforcement power to guarantee that member countries fulfil the minimum standards of IPR protection agreed upon members in TRIPS. Moreover, examination guidelines, mission statements and day-to-day practice at patent offices and case law in litigation trials are key to the implementation of the principles set out in the law.

International organisations and upward harmonisation of patent regimes

The creation of WIPO in 1967 is the first milestone in the history of international patent harmonisation in the 20th century. The convention establishing WIPO, clearly states the following objectives: "*i)* to promote the protection of intellectual property throughout the world through co-operation among States and, where appropriate, in collaboration with any other international organization; *ii)* to ensure administrative cooperation among the Unions."

However, major widespread upward harmonisation efforts, in particular in developing countries, only started in 1995 when WTO was created and minimum standards in IPR protection and enforcement on TRIPS entered into force with the TRIPS agreement, as one of the pillars of WTO.

> *"The only previous period of comparable activity in IPR came at the end of the 19th century with the negotiation of the Paris and Berne conventions concluded by a small number of countries…the Paris convention was adopted during the extensive industrialisation of that era, suggesting that patents were in demand as a significant component of public support for appropriating the returns to invention in the manufacturing age…Today's even greater advances in protection anticipate the importance of IPR in supporting the high technology, information-based economy of the new century."* (Maskus, 2000, p.2)

TRIPS was drafted with the aim to set minimum standards of IP protection and enforcement worldwide, upgrading principles from those included in the Paris and Berne Conventions as regards protection, enforcement and dispute settlement. On the one hand, TRIPS allows members to provide more extensive protection if they wish to do so. On the other, it includes special transition arrangements for developing countries, especially in areas such as pharmaceutical or agricultural chemical inventions.[9] The minimum standards for patent protection set out in the agreement include a minimum protection term of 20 years from the filing date, non-discrimination among inventions[10] and the possibility to exclude certain inventions from patentability, such as diagnostic, therapeutic and surgical methods, plants and animals (other than micro-organisms) and biological processes for the production of plants or animals.[11]

Domestic laws in several WTO countries have changed to adopt these common standards since then. In the United States measures were taken to set the minimum protection term at 20 years from filing and require the publication of applications 18 months after for those patents only filed domestically.. Country disputes involving IPRs are dealt with at the WTO Dispute Settlement Body, proving that *"TRIPS as a founding component of WTO, elevates recognition and enforcement of IPR to the level of inviolable international commitment."* (Maskus, 2000, p. 2). [12]

In recent years, harmonisation efforts have continued at WIPO with the signature of the Patent Law Treaty (PLT) in 2000 on patent application procedures and with ongoing negotiations on other issues related to the substance of patent law. Since November 2000, discussions towards an agreement on the provisions of a Substantive Patent Law Treaty (SPLT) take place at WIPO with the aim to harmonise patentability criteria and other substantive features of patent law across countries[13]. Negotiations are ongoing as regards grace periods, novelty and industrial applicability and first-to-file versus first-to-invent, but exclusions from patentability, protection of traditional knowledge and genetic resources still represent obstacles for reaching an agreement.[14] Core controversies in SPLT include discussions on whether the invention should belong to a technological field to be patentable, whether the law should contain explicit exclusions from patentability and whether additional patentability conditions to those specified in the treaty should be left at the discretion of member countries.

9. "We recognize that under WTO rules no country should be prevented from taking measures for the protection of human, animal or plant life or health, or of the environment at the levels it considers appropriate, subject to the requirement that they are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade, and are otherwise in accordance with the provisions of the WTO Agreements." (Doha WTO Ministerial 2001, paragraph 6 of the Ministerial declaration).

10. "Patents shall be available and patent rights enjoyable without discrimination as to the place of invention, the field of technology and whether products are imported or locally produced", TRIPS, Article 27.

11. Wherever plant varieties are excluded from patent protection, an effective *sui generis* system of protection should be provided.

12. A dispute arises when a member government believes another member government is violating an agreement or a commitment that it has made in the WTO. Examples of country disputes on IPR issues at WTO include, for instance, three cases involving Canada: The European Commission against Canada on pharmaceuticals (DS114); Canada against the European Commission on pharmaceuticals and agricultural products (DS153); and United States against Canada on the term of protection (DS170).

13. *http://www.wipo.int/pressroom/en/updates/2002/upd164.htm*

14. *http://www.wipo.org/scp/en*

European Patent Office

The EPO was established by the contracting states to the EPC signed in Munich in 1973 (entry into force in 1977) with the aim of increasing co-operation within Europe in the protection of inventions by providing a centralised granting procedure and standard rules for patents granted by this procedure.[15] As explicitly declared in 2001: "*The mission of the EPO is to support innovation, competitiveness and economic growth for the benefit of the citizens of Europe. Its task is to grant European patents for inventions, on the basis of a centralised procedure. By filing a single application in one of the three official languages (English, French and German) it is possible to obtain patent protection in some or all of the EPC contracting states.*"[16]

A patent granted by EPO is a bundle of rights valid within all the designated EPC signatory countries. It significantly simplified application procedures and reduced filing fees for applicants willing to obtain international patent protection in several EPC countries. It also reinforced the rights of patent holders in some countries by introducing examination and opposition proceedings in jurisdictions which had relied solely on registration systems before. EPO is increasingly used by applicants, although national patent offices in EPC countries still grant significant numbers of patents, and tend to attract first filings from domestic applicants.[17]

However, the European system has several limitations. First, once a patent is granted by the EPO, its entry into the national phase gives rise to considerable costs and complicates the management of rights, since translations of the whole text have to be filed with the national patent office of each country where the patent is being validated and renewal fees have to be paid in all of them for the patent to be maintained afterwards. Second, the challenging infringement or asking for revocation are complex processes given that actions have to be brought before the national courts of each country for which the European patent has been granted. Given the absence of a common court, different national patent laws and diversity of interpretations of European patent law by national courts are liable to undermine the value of the European patent.

To overcome these problems EPC countries have taken some initiatives, such as the London Agreement to reduce translation requirements and negotiations for the implementation of an integrated judicial system, including uniform rules of procedure and a common European Patent Court, in what is known as the proposal for the European Patent Litigation Agreement (EPLA). Moreover, as concerns EU countries, a formal proposal for the creation of the European Community patent was presented by the European Commission before the European Council in 2000. A Council agreement on the broad outlines of its regulation was reached in March 2003. The idea is that the proposed Community Patent becomes a unitary Community-wide intellectual property right, which is different from the bundle of rights in designated EPC countries provided by the European Patent granted at EPO.

As stated in the document describing the terms of the common political approach, "the purpose of the Community Patent is to provide for the creation of a single industrial property right for the whole Community, to be granted by the EPO in Munich. It aims at eliminating the distortions of competition created by the territorial nature of national protection rights and ensuring the free movement of goods protected by patents." Despite this step forward in 2003, one year later, at the May 2004 meeting of

15. *http://www.european-patent-office.org/epo/pubs/brochure/general/e/contractstates_e.htm*
The first EPO applications were accepted on 1 June 1978.

16. *http://www.european-patent-office.org/epo/pubs/brochure/general/e/mission_e.htm*

17. National patent offices and courts in EPC countries are not bound by decisions of the EPO although national laws are aligned with the EPC and bound by Community law and jurisprudence.

the Council, disagreements on certain issues were still significant across countries, especially as regards translation requirements and the treatment of infringements arising as a result of mistranslations. Thus, no definitive implementation plan of a community patent has yet been agreed upon and all options remain open.

Centralised IP Courts

In 1982 a new court, the CAFC, was assigned jurisdiction over appeals of patent cases at United States federal circuits. The creation of the CAFC tends to be considered as one of the most fundamental changes the United States patent regime has gone through in the past few years, affecting both directly and indirectly many different dimensions of the system. A number of CAFC decisions have paved the way to the expansion of subject matter observed at USPTO, and CAFC decisions have had an effect on the strength of rights held by patent holders by reducing the rate of invalidation of USPTO decisions.

> *"The Federal Courts Improvements Act of 1982…created a new Court of Appeals for the Federal Circuit (CAFC) to which were assigned appeals from the many district courts of all patent cases. This was described as a procedural reform, designed to standardise patent law across the country and eliminate the incentives for 'forum shopping' in which patentees would try to bring cases in court circuits sympathetic to patents while alleged infringers would seek out circuits believed hostile."*[18]

The percentage of patents held invalid in years prior to the creation of the CAFC followed a cyclical evolution, being a relatively high share of 63.6% in 1944-1946, then decreasing to 46.3% in 1964-1965, increasing again to 63.7% in 1975-1976 and falling again in 1981-1982 to 50%. However, following the concentration of IPR appeals at the CAFC in 1982, the invalidity rate declined to 39.3% in 1984-85 and to only 25% in 1994-1995. Moreover, the share of patents found invalid for obviousness in patent validity decisions has substantially decreased since the creation of the CAFC. While obviousness was the most common reason for invalidity during the pre-CAFC years from 1944 to 1982, held in 40% of the cases during that period, the share dropped to less than 20% in 1984-85 and around 5% in 1994-95 (Lunney, 2001).

> *"The data is not simply a re-affirmation of the Federal Circuit's pro-validity approach. Rather it demonstrates that, for a given number of patents held invalid, obviousness is far less likely to serve as the basis for that ruling under the Federal Circuit than it was during the pre-Federal Circuit era."*[19]

The specialisation of courts in intellectual property issues has also been a priority in Japan and Europe. Between 1997 and 2002, Japan improved its technical settlement system for intellectual property suits by increasing the number of divisions specialised in IP, the number of judges in charge of IP and *chosakan* (court investigators) at Tokyo High Court, Tokyo District Court and Osaka District Court. In 1998 Tokyo District Court and Osaka District Court were allowed concurrent jurisdiction over IP-related proceedings. Apart from the immediate effect of shortening the duration of litigation proceedings for IP-related suits significantly, from 31.9 months on average in 1993 to 18.3 in 2001, it

18. Jaffe (1999), p. 4.

19. Lunney (2001), pp. 373-374.

remains to be seen whether their impact of those measures in Japan has been as pervasive as that of the creation of the CAFC in the United States.[20]

The creation of a centralised IP court in Europe is highly dependent on the project to establish a Community Patent, given that if it moves forward, it would involve setting up a community patent court to secure uniformity of the jurisprudence (to be established by 2010 at the latest, as reads the current proposal). Along the same lines, negotiations on the EPLA have been paused at the moment waiting for some more definitive plans on the Community Patent and its proposed centralised litigation system.

New areas of protection

Expanding subject matter involves the application of long established patentability criteria to new types of inventions, something that often raises difficult problems. Patent laws were put in place during an age of mechanisation, when other kinds of inventions were not readily envisioned. Either explicitly or implicitly in the spirit of the law, patentable subject matter was first restricted to mechanic devices, then to their manufacturing processes and later extended to chemicals and pharmaceuticals. Subject matter now covers biotechnological and software-related inventions in most countries, but changes have not occurred everywhere at the same pace and differences remain in certain dimensions. Japan did not award patent protection for substances such as chemicals and pharmaceuticals until 1975, although their manufacturing processes could be protected before that date (Tamai, 2001). Software-related inventions, including business methods, are largely patented in the United States and to a lesser extent in Japan, where they are subject to the technical content of the invention, and in Europe, where they are excluded 'as such' from patentability and are effectively patented provided they make a technical contribution. A European directive on the patentability of computer-implemented inventions currently under discussion is in accordance with EPO practice.

One of the first differences across jurisdictions in this regard lies on the legal definition of patentability, and in particular the requirement for inventions to be technical in Europe, which reflects its different position with respect to other jurisdictions, especially United States. In the United States, *"whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefore"*[21], and patentable inventions have been described as *"anything under the sun made by man"*[22] which satisfies patentability requirements. In contrast, a patentable invention is defined in Japanese patent law as *"the highly advanced creation of technical ideas utilising natural laws"*[23], and the EPO explicitly requests an invention to be of technical character to be patentable: *"The invention must be of 'technical character' to the extent that it must relate to a technical field, must be concerned with a technical problem, and must have technical features in terms of which the matter for which protection is sought can be defined in the claim."*[24]

20. Japan METI Task Force on Industrial Competitiveness and Intellectual Property Policy, Report, 5 June 2002. *http://www.meti.go.jp/english/information/downloadfiles/cICIPPfulltexte.pdf*

21. United States Patent Act (1952), Title 35, Section 101.

22. United States Congress Committee Reports accompanying the 1952 Act , S. Rep. No. 82-1979 at 5 (1952); H.R. Rep. No. 82-1923 at 6 (1952).

23. Japan Patent Law (1959), Article 2 (1).

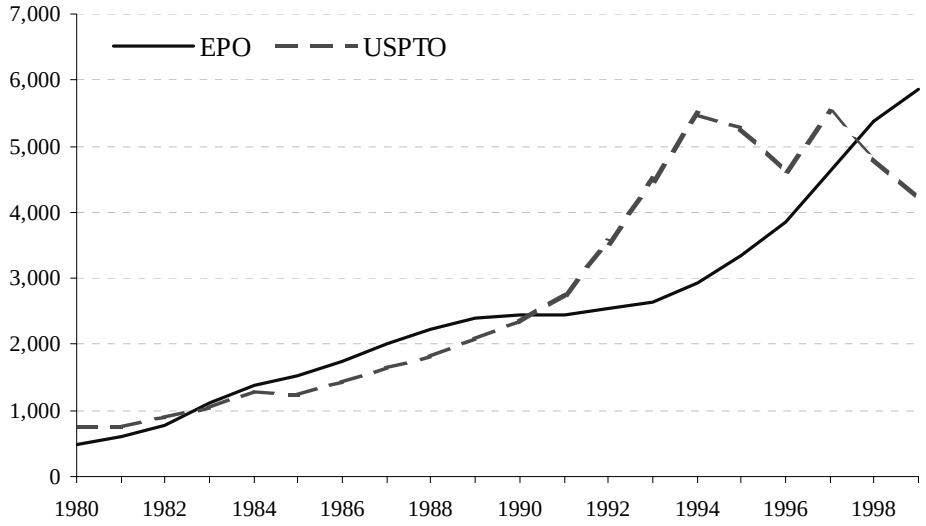
24. EPO Examination Guidelines, Chapter IV. 1.2.ii. makes reference to EPC Rule 27 "content of the description". In 1988 the EPO Board of Appeals Koch decision clarified EPO position saying that EPC does not ask that a patentable invention be exclusively or largely of a technical nature, it does not prohibit the patenting

Patent laws also differ as regards exclusions from patentability. In the United States, only laws of nature, natural phenomena, and abstract ideas have been traditionally excluded from patentability. In Japan the exclusion covers medical methods, laws of nature and discoveries. In contrast, the EPC excludes a long list of items if they are claimed *as such*. This list includes scientific theories, mathematical methods, aesthetic creations, schemes, rules and methods for performing mental acts, playing games or doing business, programs for computers, presentations of information and medical methods.[25] In addition, inventions contravening public order or morality are considered non-patentable in Japanese and EPC law, a feature not present in US law. The rest of the section describes the expansion of patentable subject matter to biotechnology, software and business methods, different measures taken across countries in this respect and the surrounding debates.

Biotechnology

The number of patents for biotechnological inventions has been continuously increasing since the beginning of the 1980s in the United States, when it was made clear by case that they were patentable. Patents for genetic inventions have skyrocketed in recent years. Despite that growth, controversy surrounds patentability in this area were often arguments against patentability are either based on ethical reasons against the provision of exclusive rights over living organisms, the human body or genetic material, or on economic or legal reasons linked to the difficulty of drawing a line between inventions and discoveries of natural phenomena.

Figure 7.3. **Biotechnology patents at USPTO and EPO, priority years 1980-1999**



Source: OECD patent database, May 2004.

of a mix of technical and non-technical features, an invention must be assessed as a whole (X-ray apparatus/ Koch & Sterzel T26/86 [1988] OJ EPO 19).

25. "Methods for treatment of the human or animal body by surgery or therapy and diagnostic methods practised on the human or animal body." *http://www.european-patent-office.org/legal/epc/e/ar52.html#A52*

The United States Supreme Court rendered "new, human-made, single-celled organisms" patentable in 1980 following the *Diamond v Chakrabarty* decision. Further on, in 1985, "multicellular" organisms were considered as proper subject matter by the USPTO board of appeals. The trend towards patentability of superior life forms led to the award of a patent to Harvard University for the "oncomouse" in 1988, the first patent for a genetically modified animal for medical research.[26]

As regards genetic inventions, although genetic engineering processes started to be patented in the United States in 1980, year when the first patent for gene splicing granted to Cohen and Boyer, genetic material in the form of cDNA expressed sequence tags (ESTs) was first patented in 1997. In 2001, the USPTO issued examination guidelines making clear that gene compositions are patentable only when the *"application discloses a specific, substantial and credible utility for the claimed isolated and purified gene"*[27], which has effectively restricted patent applications in the field since then, filtering out applications not reaching those patentability requirements.

The process in Europe has been more complex, mainly due to different legislation across countries. The EC Biotechnology Directive (98/44/EC) adopted in 1998, aimed to clarify the principles of patent law applied to biotechnological inventions and to harmonise patent laws across Europe. The EU directive mandated that member nations adopt new patent laws by 30 July 2000. However, only seven EU countries have implemented it so far (Denmark, Finland, Greece, Ireland, Spain, Portugal and UK) and the legal action has been taken against the others. The principles set out in the Directive are fundamentally the same as those applied in the United States: *i) "inventions which are new, which involve an inventive step and which are susceptible of industrial application shall be patentable even if they concern a product consisting of or containing biological material or a process by means of which biological material is produced, processed or used";* and *ii) "biological material which is isolated from its natural environment or produced by means of a technical process may be the subject of an invention even if it previously occurred in nature."*[28]

Japan has also adopted this common view and excludes the following categories from patentability: *i)* mere discoveries of micro-organisms existing in nature; and *ii)* inventions of micro-organisms *per se* which are incapable of industrial application because their utility is either not described in the application or cannot be inferred.

In summary, the common principle prevailing across jurisdictions is that whereas human inventions with substantial utility (specified in the application) are patentable, biological material as it is found in nature is definitely not patentable. Genetic material that has been isolated or altered from its natural form and for which a useful function has been determined is patentable, but not the mere sequencing of a genome for which no specific utility is identified and claimed in the application. (OECD, 2003*a*). In 1999, USPTO, JPO and EPO agreed not to extend patent protection to gene fragments unless they have specific functions or special utility.[29] However, conclusions in this area are

26. The patent for the OncoMouse was found invalid in Canada by the Canadian Supreme Court in 2002, mainly based on ethical grounds about the patentability of higher life forms, such as mammals.

27. United States Government, "United States Patent Office Utility Examination Guidelines," Federal Register, Vol. 66, No. 4, 5 January 2001.

28. Art.3.1 98/44/EC, Article 4. In addition, the EC Directive stresses the need to disclose the industrial application of a sequence or a partial sequence of a gene in the patent application for it to be patentable, and distinguishes between the "simple discovery of one element of the human body" (including a sequence or partial sequence of a gene) which cannot be patented, and "an element isolated from the human body or otherwise produced by means of a technical process", which may be a patentable invention.

29. *http://www.european-patent-office.org/tws/sr-3-b3b.htm*

still tentative. Many ESTs patents have been challenged and need to be tested in Court to determine the boundaries of patentability for genetic material. Genetic material does not appear to be seen as a special case requiring a different treatment from chemical compounds in most jurisdictions.

Software

A computer programme can be defined as a set of instructions producing a useful effect once it is embodied in a computer, but when it is presented independently from a computer it may appear to be closer to an abstract idea than to a useful invention, and abstract ideas, as seen above, are in principle not patentable. In addition, when there is a fine line between the invention itself and its 'expression', as it is the case for software, inventors can opt for copyright protection and patents and copyright have long been considered to cover mutually exclusive subject matters, with patents protecting functional works of technology and copyright protecting the expression of ideas, such as non-functional works of art, literature and music (Karjala, 2002). They also protect different dimensions of software and they do it in different ways. Whereas patents protect the structure of a computer program and its functionality, copyright protects the source code (which is also usually protected by secrecy, since copyright does not require disclosure).[30] Moreover, whereas copyright allows independent invention, patents give their holders the right to prevent others from implementing an invention in the patented way, regardless of whether they did it independently or by reverse engineering the invention, for example.

Before the 1980s, one of the main reasons for the reluctance to grant patent protection for software was that computer programs were essentially viewed as mathematical algorithms.[31] However, at the beginning of the 1980s United States courts started to give more weight to the effects produced by software in conjunction with hardware, than to the fact that the set of instructions was expressed as a mathematical algorithm and software started to be patented.

Firstly, a mathematical algorithm producing a technical effect in a machine was rendered patentable by the 1981 United States Supreme Court decision in *Diamond v Diehr*. Then, in 1994 the CAFC took a step forward by confirming the patentability of software running on a general-purpose computer in *Re Alappat*, and finally the United States favourable position towards the patentability of software was confirmed in 1995, when USPTO examination guidelines for computer-related inventions requested examiners to concentrate on the novelty and usefulness of the program (sufficient "tangible benefit"), regardless of whether it involved a mathematical algorithm or not. A recent study estimates that USPTO granted over 20 000 software patents each year during the 1990s, accounting for over 15% of all patents granted those years (Bessen and Hunt, 2003).

In Japan, as early as 1971, JPO examination guidelines made clear that the priority as regards patentability was the industrial applicability of an invention, regardless of it being achieved through a law of nature or not. In 1993, revised guidelines were issued confirming that an invention involving software was not excluded from patentability. Currently, JPO examination guidelines establish that software inventions are patentable when they are *concretely* realised by using hardware resources.[32] In

30. Copyright "*extends only to expressions and not to ideas, procedures, methods of operation or mathematical concepts as such.*" WIPO Copyright Treaty, Article 2, scope of copyright protection. *http://www.wipo.org/treaties/ip/wct/index.html*

31. USPTO examination guidelines issued in 1968 explicitly rejected the patentability of computer software, and EPC excludes "computer programmes as such" from patentability.

32. Chapter 1. Computer Software-Related Invention, Part VII: Examination Guidelines for Inventions in Specific Fields of Examination Guidelines for Patent and Utility Model in Japan (December 2001), at: *http://www.jpo.go.jp/tetuzuki_e/t_tokkyo_e/Guidelines/PartVII-1.pdf*.

2002, the provisions of enforcement actions of the Patent Law in Japan were revised to clarify that the Patent Law protects the computer programs themselves and that distribution of programs on networks is within the scope of patent rights.

The situation is different in Europe, where computer programmes *as such* are explicitly excluded from patentability in Article 52 of the EPC. This prohibition is however not as absolute as it may appear, as evidenced by several EPO Technical Board of Appeal decisions validating patents for computer programs "producing effects going beyond a simple interaction with the computer".

With the aim to harmonise national laws in EU countries and reduce the degree of uncertainty prevailing in Europe for the patentability of software inventions, a draft proposal for a EU directive on the patentability of computer-implemented inventions was issued in February 2002. As laid down in the proposal, an invention would be patentable if it makes a technical contribution to the state of the art. In September 2003 the European Parliament finally passed the directive after introducing some amendments, and on 17-18 May 2004, the European Council reached political agreement by qualified majority (with the Austrian, Italian and Belgian delegations abstaining and Spain voting against) on a common position concerning the proposal for a Directive. Once the text has been formally agreed by the Council, it will be submitted to the European Parliament for second reading.

> *"The agreed text makes clear that a computer program as such cannot constitute a patentable invention and that a computer-implemented invention shall not be regarded as making a technical contribution merely because it involves the use of a computer, network or other programmable apparatus. Accordingly, inventions involving computer programs whether expressed as source code, object code or any other form, which implement business, mathematical or other methods and do not produce any technical effects beyond the normal physical interactions between a program and the computer, network of other programmable apparaturs in which it is run shall not be patentable. "Technical contribution" is defined in the text as a contribution to the state of the art in a field of technology which is new and not obvious to a person skilled in the art. The technical contribution shall be assessed by consideration of the difference between the state of the art and the scope of the patent claim considered as a whole, which must comprise technical features, irrespective of whether or not these are accompanied by non-technical features."*[33]

In summary, whereas for software-related inventions to be patentable in the United States it suffices to claim that they produce a tangible benefit, in Europe and Japan their utility has to be explicitly claimed with reference to hardware. In Japan, technical nature has to be asserted for an *invention* as a whole, in Europe the invention is not be patentable if the *inventive step* does not make a technical contribution to the state of the art, judging by EPO practice and the current proposal for an EC Directive. The reference to technical devices and the technicality of the invention is thus at the centre of the debate, but the question remains: why should software running in a computer be considered differently from a machine producing the same effect?

Business methods

Business method inventions can be defined as broadly as "new ways for doing business". However, in the absence of a more appropriate operational definition, they tend to be narrowly identified with inventions classified under patent class 705 at USPTO, entitled as "data processing: financial, business practice, management or cost/price determination".

33. EC MEMO/04/117.

Patents for business methods have been granted in the United States since the 1880s, however, they were until very recently small in number and easily challenged in court. United States courts begun to look at business method patents more favourably in 1982, when the Federal Court validated in *Merrill Lynch v. Paine Webber* a business method patent against claims from a competitor that the invention was not patent subject matter. Remaining legal uncertainty was removed in 1998 when the CAFC explicitly stated in the *State Street Bank* decision that a mathematical algorithm should not be excluded from patentability if it produces a 'useful, concrete and tangible' result. In the past five years, thousands of business method patents have been granted at USPTO to financial inventions on asset valuation, debt management, education finance, mortgages, privatisation, risk assessment, stock picking and working capital finance, among others, but they represent a very low share of the total number of patents granted in the United States (Hall, 2003; Thomas, 2001).

Two recent changes to the US patent system have been targeted to business methods, the first one with the aim to protect prior users from patent infringement (compensating for the lack of databases on prior art in the field), and the second one to increase the quality of examination for business method patents. A special prior use defense in infringement trials was enacted in 1999 in the United States to protect inventors who were using their own non-patented business method inventions before they were subsequently patented by others (first inventor defense). In addition, following concern about criticisms alleging that business method patents granted by USPTO were often too broad and trivial, the USPTO introduced in 2000 a second review for all patents classified under USPC 705 to guarantee the quality of their examination. [34]

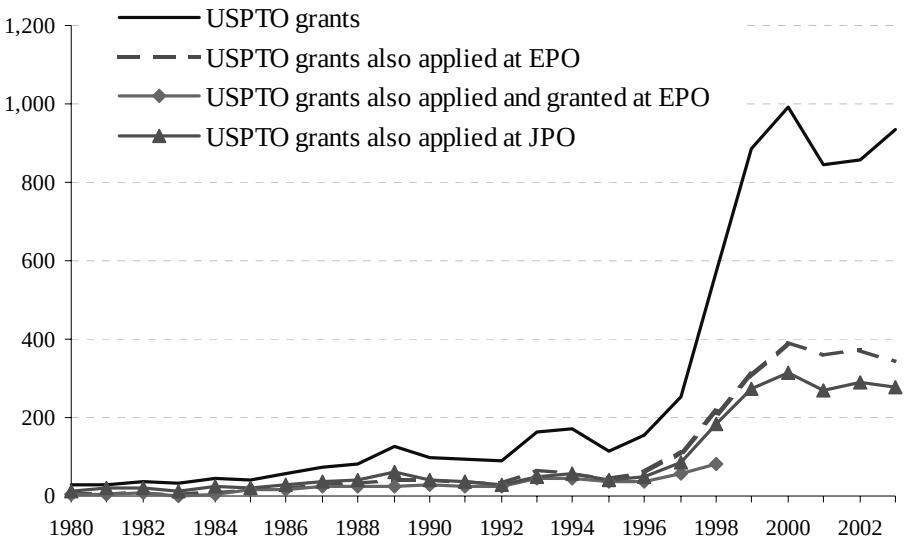
In Japan, JPO clarified the patentability of software-related inventions of new business methods and their examination practice in guidelines issued in 2000. The guidelines state that the inventive step will be denied to software-related inventions of business methods that merely consist on the application of a known technology in one field to another specific field, the automation of manual tasks or a change of design based on artificial arrangements. As a result, software-related inventions of business methods are deemed not patentable in Japan when *"the invention can be easily conceived through combining publicly known means and methods by those having common knowledge on the business field related to the patent application and technological knowledge on the computer technology."*[35]

In Europe, the EPC rejects the patentability of business methods *as such* in Art. 52, as is the case for software. Moreover, the EPO has expressed its negative position towards the patentability of business methods and the proposal for a European Commission Directive on the patentability of computer-implemented inventions clearly excludes business methods from patentability as seen above. Nevertheless, between 30% and 40% of business method inventions for which a patent is granted by USPTO are also applied at EPO. Around 70% of those were also awarded a patent at EPO during the 1980s and early 1990s, however this only represented about 40 EPO grants per year on average in the 1990s.

34. *http://www.uspto.gov/web/menu/busmethp/index.html#executive*

35. JPO Draft revised examination guidelines for computer software related inventions, including business methods published at the end of 2000.

Figure 7.4. **Business method patents at USPTO and EPO, grant years 1980-2003**



Note: Business method patents defined as those classified in USPC 705. Data on EPO grants after 1998 is still partial. Patents are sorted by grant date.

Source: OECD patent database, May 2004.

Differences as regards the patentability of business methods across the trilateral offices became clear in 2001 when they published the results of a comparison of search results using PCT applications for business method related inventions. Whereas USPTO carried out the concurrent search for every claimed invention disclosed in every PCT application, JPO noted that, had it been officially requested, it would have refused to conduct the search for certain claims.[36] EPO was more radical and not only excluded a number of claims in several applications but refused to conduct the search for some inventions up front, arguing that they were either not patentable subject matter or just *"commonplace technological implementations of 'methods of doing businesses'"*.[37]

36. "No International Searching Authority shall be required to search an international application if, and to the extent to which, its subject matter is any of the following: *i)* scientific and mathematical theories; *ii)* plant or animal varieties or essentially biological processes for the production of plants and animals, other than microbiological processes and the products of such processes; *iii)* schemes, rules or methods of doing business, performing purely mental acts or playing games; *iv)* schemes, rules or methods of doing business, performing purely mental acts or playing games; *v)* methods for treatment of the human or animal body by surgery or therapy, as well as diagnostic methods; *vi)* mere presentations of information; *vii)* computer programs to the extent that the International Searching Authority is not equipped to search prior art concerning such programs." PCT Rule 39, Patent Subject Matter under Article 17(2)(a)(i).

37. *http://www.european-patent-office.org/tws/business/business_start_page.htm*

Patentability criteria

Whereas the basic definition of the patentability requirements of novelty, usefulness and non-obviousness is common to most countries, their interpretation and application may differ across jurisdictions. Moreover, even though major patent offices examine patent applications and grant protection based on those requirements since the end of the 19th century, examination has not always been central to patent regimes. When countries have relied at some points in time on registration systems, the validity of patents have been completely determined in court. In particular, more than half of EPC contracting states had not examination procedures within their jurisdictions before joining the convention, something that was probably one of the main reasons for them to join it.[38]

Differences across jurisdictions may be illustrated by different grant rates. A recent study has noted that whereas average grant rates were respectively around 67% and 64% at EPO and JPO for the period 1995-1999, at USPTO the grant rate was found to be between 87% and 97% during 1993-1998 when continuation applications were included in the calculations (Quillen and Webster, 2001). Continuation applications are only found at USPTO and consist of new filings based on earlier applications that may contain different claims.

> *"A unique feature of the US patent system is the ability to file continuing applications which claim filing dates of earlier applications and start the examination process all over again. There is no limit on the number of such "refilings" and the only way the Patent Office can rid itself of a determined applicant is to allow his or her patent application. The Annual Report statistics published by the USPTO do not mention continuing applications, so it is not possible from the published Annual Report statistics alone to determine the effect of such continuing applications on the USPTO workload or its application acceptance rates."*[39]

An estimation of grant rates for a subset of applications, those first filed at USPTO for which there is a subsequent filing at EPO, enables to use the OECD patent database (which combines information from EPO, USPTO and JPO patent databases) for a direct comparison between EPO and USPTO grant rates for such a selection of filings. The calculation of EPO grant rates using the information in the patent database is quite simple given that EPO publishes both applications and grants. EPO grant rate is the result of dividing the number of applications for which a grant date is showed in the EPO database by the total number of applications (including grants, refusals and withdrawals), sorted by year of priority.

However, the USPTO patent database only contains information on grants (applications only started to be published in November 2000), which makes the calculation of USPTO grant rates more complicated. The approach taken to obtain USPTO grant rates for US priorities that subsequent led to filings at EPO consists of the following steps: *i)* select all EPO applications with at least one US priority in the EPO database; *ii)* track the corresponding patent number for the US priority in the USPTO database on grants; *iii)* divide the number of US priorities in EPO applications for which the

38. *http://www.dkpto.dk/en/eu/conf/doc/29_kober.doc*

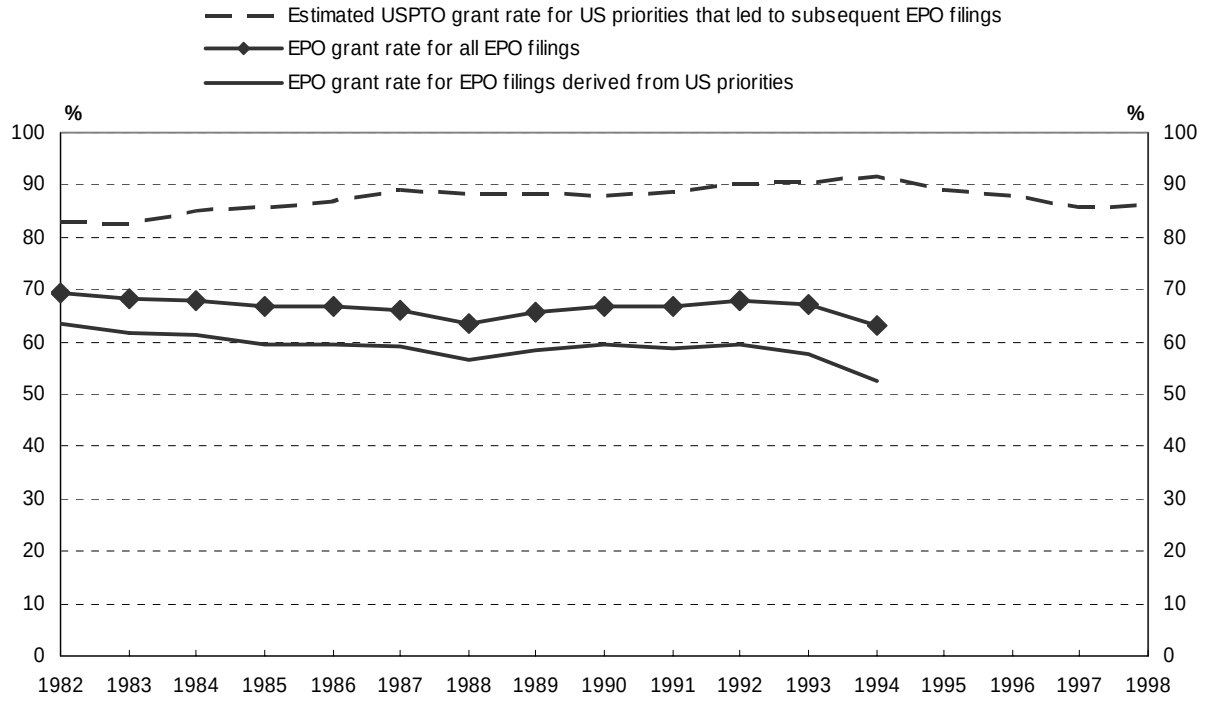
39. *http://www.ftc.gov/opp/intellect/020319cecilquillen.pdf*

USPTO database shows a grant date by the total number of US priorities in EPO applications, sorted by year of priority.[40]

The estimated USPTO grant rate for US priorities that led to subsequent filings at EPO was around 30 percentage points higher than the estimated EPO grant rate for filings derived from US priorities between 1982 and 1994. Moreover, the grant rate at EPO for filings derived from US priorities was 6-8 percentage points below the average grant rate at EPO during that period. Applicants' strategies, patentability of inventions and differences in the practice regarding amendment of applications having regard to examiners reports at USPTO and EPO might have contributed to these differences, but in any case, this is a question worth exploring further.

Figure 7.5. **Comparison of USPTO and EPO grant rates for a selection of filings**

Priority years: 1982-1998



Note: EPO grant rates are defined as number of applications with grant date divided by total number of applications, sorted by year of priority (data on EPO grants is still partial for recent years). The methodology to estimate the grant rate at USPTO for US priorities that led to subsequent EPO filings consists of the following steps: 1. Select all EPO applications with at least one US priority in the EPO database; 2. Track the corresponding patent number in the USPTO database on grants; 3. Divide the number of US priorities in EPO applications with a grant date at USPTO by the total number of US priorities in EPO applications, sorted by year of priority. Priority year corresponds to the initial date of filing of a patent application worldwide, regardless of subsequent filings in other countries; it normally corresponds to the date of filing in the applicant's domestic patent office.
Source: OECD Patent Database, May 2004.

40. Priority year corresponds to the initial date of filing of a patent application worldwide, regardless of subsequent filings in other countries; it normally corresponds to the date of filing in the applicant's domestic patent office.

Novelty, utility and non-obviousness

Novelty, utility and non-obviousness are the three standard patentability requirements used at USPTO and other offices around the world. However, the terminology may vary slightly across regions, with the last two requirements being known as industrial applicability and inventive step in Europe.

An invention has to be novel to be patentable by definition, which means they have to make a contribution to prior art. An appropriate definition of prior art is thus crucial to determine whether this requirement is satisfied or not, but difficult in areas with a short patent history, especially where there is no tradition of collecting prior art as for business methods. The main difference in the application of the novelty requirement between the United States and other jurisdictions comes from the fact that the USPTO is the only major patent office in the world following a first-to-invent rather than a first-to file system. Another difference relates to the availability of 'grace periods' enabling applicants to file applications for previously disclosed inventions within a specific a period of time. Grace periods for any type of disclosure are available in the United States for one year and in Japan for six months, but in Europe only in two specific cases: when the disclosure is done by a third person in abusive that harms the applicant's interest or when the applicant has disclosed the invention at an official international exhibition. Implementation of a general grace period in Europe, following the United States model, is currently under discussion.

The third patentability criterion is non-obviousness of the invention (inventive step in Europe), in particular, non-obvious differences between the invention and the prior art to a Person Having Ordinary Skills in the Art (PHOSITA). The main difference across jurisdictions, as noted above, is that the inventive step at EPO needs to be technical. In other words, inventions need to make a technical contribution to prior art to be patentable in Europe, something that is not necessarily required explicitly in other jurisdictions. Non-technical secondary considerations, such as commercial success, have gained relevance at USPTO to determine non-obviousness, which appears to be especially important for business methods. However, the application of this requirement is not always consistent (Hunt, 1999b; Lunney, 2001).

> *"The Federal Circuit has not always been consistent in applying its non-obviousness doctrine to particular cases. The holder of a patent on an e-commerce invention can usually expect that so long as the claimed invention (1) represents some advance over the prior art and (2) becomes a commercial success, her invention will satisfy the non-obviousness requirement. But demonstrating the presence of some technical advance plus commercial success has not always been enough to establish non-obviousness even under the Federal Circuit."*[41]

In the context of a booming number of applications in the late 1990s-early 2000s while examining staff was not expanding at the same pace, concerns have raised regarding the quality of granted patents, meaning the depth of novelty search and examination. The ability of patent offices to actually implement high quality standards while their resources have not followed the demand has been subject to public debate (FTC, 2003; Hagel, 2004)

41. Lunney (2001), p. 419.

Disclosure and enablement

Patent applications, which include a detailed description of the invention, are published 18 months after filing. The obligation to publish applications before grant was introduced as a minimum requirement in TRIPS, although it was already the practice prevailing in most countries before, with the notable exception of the United States where the publication of applications was only requested in 1999. All USPTO applications dated on or after 29 November 2000 are published 18 months after filing, unless the applicant guarantees that he will not seek protection for the same invention in a foreign country.

Including a description of the invention in the patent application serves two objectives: support what is claimed, as a means to prove that the inventor has effectively developed the invention; and enable a PHOSITA to carry out the invention based on such information (enablement requirement). In the United States, in addition, a patent application has to disclose the *best mode to implement the invention*, a requirement that is not explicit in other jurisdictions.

Disclosure requirements seem to differ largely across sectors, especially in new areas, and they appear to be effectively lower for software than for biotechnology. As regards software, it suffices to describe the structure of the computer program in the patent description. The essence of the program, its source code, need not be disclosed. Moreover, source code is usually protected against literal copying by copyright which does not require disclosure, and often by trade secrecy as well.[42]

As regards biotechnological inventions, when the written description is not enough to replicate the invention, disclosure of the biological material itself becomes essential to attain the enablement requirement. To that end, the Budapest Treaty on Deposit of Micro-Organisms for Patent Procedures came into effect in 1980 under the aegis of WIPO.[43] The objective of the treaty, signed by most WIPO members, was to require the deposit of a micro-organism with an international depositary authority whenever the written description included in the patent application does not suffice to enable a PHOSITA to perform the invention involving such micro-organism. In 1996, EPO extended the deposit requirement from micro-organisms to biological materials, the latter being defined as "*any material containing genetic information and capable of self-reproducing or being reproduced in a biological system.*"[44] The extension of the deposit requirement to cover all biological materials also appears in the EC Biotechnology Directive 98/44.

Opposition and re-examination

Prior to litigation, the validity of a patent can be challenged administratively at the patent office. Post-grant opposition procedures have been available at JPO since 1996 - before then, pre-grant opposition procedures were available - and at EPO since its creation at the end of the 1970s. In turn,

42. Source code and object code refer to the 'before' and 'after' versions of a computer program that is compiled before it is ready to run in a computer. The source code consists of the programming statements that are created by a programmer with a text editor or a visual programming tool and then saved in a file […] The object code file contains a sequence of instructions that the processor can understand but that is difficult for a human to read or modify. For this reason and because even debugged programs often need some later enhancement, the source code is the most permanent form of the program.
http://searchwebservices.techtarget.com/sDefinition/0,,sid26_gci213030,00.html

43. *http://www.wipo.org/about-ip/en/budapest/guide/part_i_introduction.htm*

44. New Rule 28(6)(a). [1996] OJ EPO 390.
http://compendium.european-patent office.org/cbc/Comp_LEGAL/anc_reg/en/ap_i_a33_e2.htm

USPTO introduced re-examination procedures in 1980. Opposition procedures have several advantages with respect to re-examination, such as the need to be filed within a few months from grant, which reduces uncertainty about the validity of a patent, and the fact that they give a more significant role to third parties, such as the challengers themselves or other interested parties. Allowing the intervention of third parties in opposition proceedings permits the patent office to consider a larger amount of private information and enables a final 'examination' of the validity of patents on better grounds than during the pre-grant examination proceedings. A further advantage of opposition procedures at EPO is the fact that it is the only centralised system to challenge a patent in Europe at present. Challenges to opposition decisions of the EPO Board of Appeal and infringement litigation cases are dealt with within each designated national jurisdiction, with the inherent risk of discrepancies among decisions taken by courts in different countries.

A recent comparative study of opposition procedures in Europe and re-examination procedures in the United States has found that re-examination is initiated by patent holders in more than 40% of the cases, which is in contrast with the adversarial conception of opposition procedures. According to this study, the rate of opposition at EPO is more than thirty times higher than the rate of re-examination at USPTO and *"opposition leads to a revocation of the patent in about 35% of the cases and to a restriction of the patent right in another 33% of the cases. Re-examination results in a cancellation of the patent right in only 10% of all cases."* As regards costs, results also show that opposition proceedings at EPO may sometimes take as long as litigation to be resolved in the United States, although it is a less costly process than litigation in the United States (Graham, Hall, Harhoff and Mowery, 2002).

More flexible and less costly patenting procedures

Patent regimes have increasingly gained in flexibility following the introduction of a number of mechanisms that enable applicants to postpone filing and examination at PTOs while keeping priority rights (*i.e.* later filings by the same applicant will be treated as if they were filed on the same day as the first application). These mechanisms constitute a sort of 'option to patent'. One of the main advantages of increased flexibility at the initial stages of the application process is that it provides applicants an opportunity to revise expectations on the costs and benefits of patenting a specific invention, and enable them to withdraw applications before the examination is initiated. On the other hand, longer periods of time spent at the initial phases of the application process increases the legal uncertainty associated with 'pending' patents, which might be harmful for competition. In this respect, the longer the delay between the initial application and the final decision at the PTO, the more important becomes the publication of documents and transparency of proceedings in order to reduce legal uncertainty and involuntary infringements.

Alternative filing procedures as an 'option to patent'

Different paths are offered to applicants across countries to better manage the information and risk involved in their patenting decision. At the international level, applicants can either use the PCT system and take advantage of lower costs and retain the right to patent their inventions in foreign countries for longer, or file their applications directly in the national (or regional, in the case of EPO) patent offices of their choice. At the national level, several options to defer filing and effective examination by PTO officials may be further available, notably in the form of provisional and continuation applications in the United States, and by deferring examination requests for several years in Japan. In summary, at present, applicants are faced with a number of alternative filing procedures and other mechanisms they can use as an 'option to patent', retaining priority rights over the invention for a longer period of time before its validity is effectively examined at the patent office.

Continued evolution in the PCT system has eased the process of international filing for inventors by substantially reducing the costs of patenting abroad and conferring greater flexibility to the system. Under the 1883 Paris Convention a standard patent application enables an inventor to delay filing in other countries for one year while keeping priority rights; with a PCT application an additional delay of eight months is allowed (18 months since April 2002), giving applicants more time to revise expectations as to whether to pursue applications in the countries initially designated. In the meantime, PCT applicants may obtain official international search results and preliminary reports about the potential patentability of their inventions. The number of PCT applications has substantially increased since mid-1980s, passing from 2 600 in 1979 to 104 000 in 2001, mainly because, as stated by WIPO, *"the PCT system consolidates and streamlines patenting procedures and reduces costs, providing applicants with a solid basis for important decision-making."*[45] The introduction of automatic designation of all PCT member countries for a single fee as of January 2004 is expected to further increase the use of the PCT system. [46]

At the national level, United States also provides applicants several 'options to patent'. Since 1995, inventors can file *provisional applications* at USPTO, which allow filing without a formal patent claim or prior art search and enable an extension of the patent term when a non-provisional application is filed for the same invention within one year of the provisional filing. They not only provide the means to establish an early effective filing date in a non-provisional patent application and allow the term "patent pending" to be applied, but are also less costly than non-provisional applications. 80 000 provisional applications were filed in 2000.[47]

In addition, as seen in the previous section, the United States is the only country to allow the filing of *continuation* and *continuation in part applications*, which allow applicants to change their initial application while keeping the priority date of the earliest application. The former enables the applicant to file a new application for the same invention, when the first application is disallowed, but the applicant wishes to revise the claims. The latter allows the applicant to file an improvement for an invention for which there is already an ongoing application.

Finally, at EPO and JPO applicants need to *request examination* of their applications and pay a corresponding fee within the required time limit in order for them not to be deemed as withdrawn. In 2000, 16 788 applications were awaiting request for examination at EPO, compared to 2 152 416 at JPO.[48] At EPO, the request for examination has to be filed not later than six months after publication of the search. Japan offers the most flexible system in this respect by large, since applicants have three years from the date of the patent application to request examination (seven years before 2001).

In contrast, examination has always been automatic at USPTO, although the system may soon change to adopt a system with some of the characteristics described above. The 2002 version of the USPTO *21st Century Strategic Plan*[49] included a draft proposal to adopt examination request proceedings (and corresponding fees) at USPTO, but finally, a less radical change called 'multi-track examination process', described as an accelerated examination path, was included in the final version

45. *http://www.wipo.org/about-wipo/en*

46. However, Germany, Korea and the Russian Federation have notified that the 'flat' international filing fee will not apply to them and require explicit designation, at least until their national laws are revised accordingly.

47. *http://www.oblon.com/Pub/display.php?SignoreMIParticle1101.html*

48. USPTO Business Plan, 2002.

49. GAO-02-907 USPTO's Past and Future Operations.

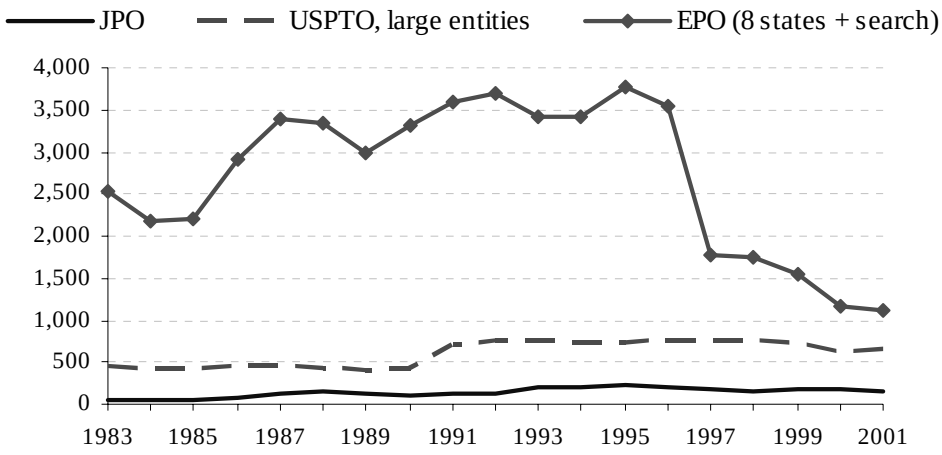
released in February 2003: "*An administrative alternative to deferred examination has been included that achieves most of the benefits of the original legislative proposal for deferral of examination. As a result, legislation will no longer be necessary*.[50]

Administrative costs of patenting

EPO has recently introduced substantial reductions in the administrative costs of patenting for applicants, bringing costs more in-line with those in the United States and Japan and making patents a more affordable means of protecting intellectual property in Europe. The administrative costs of obtaining patent protection in Europe have been traditionally much higher than in the United States and Japan. Patent fees for a standard EPO application (including eight designated states) were about three times higher than for standard applications at JPO or USPTO, until 1997, and the difference between EPO and USPTO fees was even larger for small firms, universities or individuals, who enjoy a 50% reduction at USPTO.

Figure 7.6. **JPO, USPTO and EPO standard application fees**

1996 prices (USD)



Note: EPO standard application costs include designation fees for 8 states and search fees, in addition to filing fees. USPTO and JPO comprise filing fees only.

Source: JPO, USPTO and EPO.

But application fees are a small part of total patenting costs in Europe. Efforts to reduce total costs of patenting in Europe are one of the main reasons behind the proposal of the creation of a Community Patent discussed above. Large part of the cost differential between a standard EPO patent and USPTO or JPO patents depends on renewal fees and translation costs. After a patent has been granted by the EPO, the patentee needs to translate his/her patent into the national languages of all states where he/she wants to validate, and pay renewal fees. Patent attorney's and agent's fees also count for a large part of the differences in total costs of patenting across jurisdictions and are difficult to estimate.

50. USPTO 21st Century Strategic Plan, February 2003.

Reducing the administrative costs of patenting is indeed one of the priorities in European patent policy agenda, and some recent developments reflect these efforts. First, a number of EPC countries signed the London Agreement in 2000 eliminating the obligation to translate EPO applications into their national languages.[51] However, the London Agreement has not been implemented yet due to lack of ratification by a number of states. Second, the common political approach on the Community patent reached on 3 March 2003, proposed several cost-reducing measures, in particular, as regards translation costs. However, as seen earlier, no definitive agreement has been reached yet on the Community Patent.

As regards litigation costs, available data indicates that they have significantly increased, at least in the United States, going from USD 300 000 per case in 1997, to USD 400 000 in 1999 and around USD 500 000 in 2001 for cases where the amount at stake was less than USD 1 million, where litigation costs include legal services, fees and costs for court reporters, living expenses, copying charges, expert witnesses, surveys, jury advisors and translators.[52] In Europe, the situation is aggravated by the fact that cases have to be dealt with at the national level, although this might change in the future if negotiations related to EPLA or the implementation of the Community Patent move forward.

Extended term of protection

The current term of 20 years of patent protection from filing, adopted in all jurisdictions, was one of the minimum standards of protection agreed upon in TRIPS and leading to changes in the patent laws of several countries, notably the United States, where the term had been 17 years from grant date until 1995.

In addition, most countries have provisions to extend the protection term for a maximum of an additional period of five years to compensate for regulatory approval delays for drugs and for prosecution delays. It has been argued that patent term extensions for pharmaceuticals are a means used by pharmaceutical companies to delay generic competition, a problem that has been tried to be solved through experimental use exemptions for the development of generic drugs to be marketed once the patent term of the branded drug expires, as described below.

Broader scope of protection

Patent scope or breadth determines the value of a patent by setting the boundaries between what is protected and what is not: *"The economic significance of a patent depends on its scope: the broader the scope, the larger the number of competing products and processes that will infringe the patent."*[53] The number of claims and, more importantly, the breadth of the claims determine the overall breadth of a patent, a concept very difficult to quantify.

Whereas EPO and USPTO do not impose any direct restriction on the number of claims, they charge extra fees when the number of claims in a patent application exceeds a certain threshold (10 for EPO, 20 for USPTO) – a mechanism which might be used to limit the number of claims if the increase in fees was sufficiently steep, which is not the case currently. Both at EPO and USPTO, the number of claims per filing has increased sharply over the past decade, by about 50%, aggravating the heavier

51. Denmark, France, Germany, Liechtenstein, Luxemburg, Monaco, Netherlands, Sweden, Switzerland and the United Kingdom are among the signatory countries, but remaining EPC states have not yet agreed to sign it. *http://www.european-patent-office.org/news/info/2001_12_07_e.htm*

52. AIPLA Economic Reports.

53. Merges and Nelson (1990).

workload of patent offices. In contrast, Japanese patents could only include one single independent claim until 1988. That year Japan abandoned its 'single-independent-claim' system to adopt the 'multiple independent claims' system existing in most other countries. One of the effects of the reform, as noted in a recent study, was an increase in the breadth of the claims themselves, since JPO started to accept claims for broad classes of products, rather than only for specific cases of products as it was the case before (Sakakibara and Branstetter, 2001).

As regards case law, the explicit application of the *doctrine of equivalents* by courts in infringement cases might have contributed to the expansion of the scope of patent protection in some countries. Based on this doctrine, an invention that performs the same function, in the same way, with the same result, as a patented invention, would be judged to infringe, regardless of literal differences with what is claimed in the patent. The doctrine of equivalents, first developed by German Courts has been now adopted across Europe and in the United States.

In the United States, the extent of application of the doctrine of equivalents was clarified with the Supreme Court decision on the *Hilton Davis* case in 1997, which emphasised that infringement under the doctrine of equivalents occurs when any differences between the patent and the alleged infringement involve elements that people skilled in the art knew were interchangeable. At EPO, the doctrine of equivalents has been long treated, without naming it as such, in the protocol interpreting EPC Article 69. Nevertheless, a explicit reference to the doctrine of equivalents was included in the protocol in the revision of EPC in 2000, however, given that infringement cases are dealt with nationally in EPC countries, there is no jurisprudence at EPO Board of Appeals regarding the doctrine of equivalents.

Nevertheless, against the trend towards broadening patent scope, it is worth noting that the conditions for the application of the doctrine of equivalents seem to have been limited recently in the United States with the Supreme Court decision in the *Festo* case.[54] In 2000, the CAFC ruled that when a claim is amended during the course of the patent application process, courts should be later precluded from finding an equivalent of the amended term in case of infringement allegations. In 2002, the Supreme Court rejected the absolute bar proposed by the CAFC decision, and stated instead that 'the patentee should bear the burden of showing that the amendment does not surrender the particular equivalent in question'.[55] The application of the doctrine of equivalents was effectively limited by the Supreme Court decision in the *Festo* case, but not as much as it would have been the case if the CAFC decision had been upheld. This case is considered as one of the few developments against the general trend towards broadening the rights of patent holders, at least in the United States. It has raised the issue of equivalents in the general debate about patents, noting the need for clear boundaries between what is protected and what is not. In this context, the director of IP at the Biotechnology Industry Organisation stated shortly after the Supreme Court decision that:

> *"Had the Supreme Court affirmed the CAFC's ruling, rights under the doctrine of equivalents would have been eliminated altogether if a patent claim was changed in response to a question from the Patent Office for any reason related to patentability [...] the decision of the CAFC would have made biotech and other patents less valuable by creating too wide an opening for competitors to develop near-identical products. In its decision, the Supreme Court upheld the concept that a narrowing amendment could be presumed to create and stopped but also suggested that a patent's owner should have the*

54. CAFC, 2000, Festo Corp. v Shoketsu Kinzoku Kogyo Kabushiki Co. Ltd.

55. USPQ 2nd, 1705 at 1713.

opportunity to recover any equivalents that were unforeseeable at the time of the change in claims."[56]

As regards other countries, the doctrine of equivalents was apparently only explicitly adopted in 1998 in Japan[57], and it is also applied in some European countries (*e.g.* UK and Germany). However, the question of infringement remains a factual one to be determined in court, and as a consequence, it differs across jurisdictions. Differences between patent regimes in the United States, Japan and European countries would depend on the standards used to define equivalents and their application, such as the entitled range of elements, the technical evidence used, relevant dates, and limitations.[58]

Looking at specific issues related to patent breadth in biotechnology, typical examples of broad claims are those that *"generalise one or a few experiments without providing evidence or support that the whole range of the claimed compounds or processes exhibits the effects that are the basis of the patentability."*[59] This would be the case for example when a drug is found to be effective against a disease in one particular animal and the patent claims cover effectiveness in all animals. The patent granted to Johns Hopkins University in 1990 for a device to treat cancer discovered by one of his researchers provides an example of a broad claim. Whereas Kurt Civin, claimed the My-10 antibody and other antibodies that recognise the antigen CD34, research leading to that patent had only shown effects with respect to the My-10 antibody (Bar-Shalom and Cook-Deegan, 2002).

> *"The Hopkins patents illustrate the difference between what a patent claims and what a scientific symposium or publication claims and what a scientific symposium or publication claims. If Civin had claimed at a conference of molecular immunologists that he had discovered all monoclonal antibodies that bind to CD34, his reputation would have been permanently damaged for claiming findings beyond his own data."*

The use of *product per se* claims in biotechnology patents, a traditional practice in the chemical industry, may be also seen as a factor increasing the scope of protection in this field, especially as regards patents for genes. Product patents confer absolute protection to the *product per se*, regardless of its use known or unknown at the time of filing (OECD, 2003a). Should genes be treated by patent law like chemical compounds? The question becomes especially relevant when patents for genes have consequences for follow-on innovation, in particular when they involve research tools in biomedical research.

EPO manifested its support to product per se patents in a 1990 decision, confirming that *"It is generally accepted as a principle underlying the EPC that a patent which claims a physical entity per se confers absolute protection upon such physical entity, that is wherever it exists and whatever its context (and therefore for all uses of such physical entity, whether known or unknown)."*[60] Likewise, the 2001 examination guidelines of USPTO reflected the United States favourable position towards

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56. *http://www.biotechnology-investor.com/bioweb/22002/23-24.pdf*
'Prosecution history stoppel' is a judicially crafted principle limiting the enforceable scope of patents based on acts occurring during their application process.
57. Japanese Supreme Court decision on Tsubakimoto Seiko.
58. Matsumoto, S. and K. Blochlinger, "A Proposal for Harmonisation of Claim Interpretation under the Doctrine of Equivalence in the United States, Britain, Germany and Japan"
http://www.law.washington.edu/Casrip/
59. *http://www.wmrc.com/businessbriefing/pdf/pharmatech2002/book/hermann.pdf*
60. EPO Enlarged Board of Appeal Decision G02/88, 1990, MOBIL/friction reducing additive, OJEPO 4/1990, pp. 93-113.

product patents for genes. In particular, USPTO did not adopt public comments complaining that "anyone who discovers a gene will be allowed a broad patent covering any number of possible applications even though those uses may be unattainable and unproven", arguing that genes patents should be treated as traditional patents for chemical compounds, aimed at encouraging others to invent around the patented compound and develop (and patent) new and non-obvious methods to use it.[61]

Finally, the increasing use of *reach-through claims* (claims to future inventions based on currently disclosed inventions) in patents protecting biotechnological inventions is another source of controversy at EPO and USPTO, especially as regards patents for research tools. USPTO, JPO and EPO have shown their concern by issuing a comparative study on reach-through claims in 2001, where it was noted that *"the Offices are seeing an increasing number of applications that include claims drawn to include all the possible pharmaceutical candidate compounds identified by assaying, and claims to methods of using such candidate compounds that might be considered to be beyond the scope of the subject matter contributed by the inventor."*[62]

In contrast, in the area of software and business methods, broad patents tend to be those including 'function claims', that is, patents claiming 'problems' rather than 'solutions', which implies that any solution developed for that problem would infringe the patent. Examples of overly broad business method patents seem to be Internet-related, claiming rights on the definition of existing business practices, where the novelty lies only on the use of computers to implement them (Gandal, 2002).

Exceptions and compulsory licensing

Limitations to the exclusive rights conferred by patents can take the form of exceptions and conditions under which compulsory licensing may be applied. Experimental use exceptions are often associated with experiments related to clinical trials for regulatory approval in the pharmaceutical sector and with research undertaken at universities and other public research organisations (also known as research exemptions in the latter case). Conditions for compulsory licensing tend to be related to working requirements, public interest, public health, competition law, national and energy security.

As stated in Article 30 of the TRIPS agreement, three conditions have to be fulfilled for an exception to be granted: it must be limited, it should not provide unreasonable conflict with normal exploitation of the patent and it should not unreasonably prejudice the legitimate interests of third parties. However, these conditions remain vague and there has not been, up to now, harmonisation as regards the definition, scope or implementation of exceptions to patent rights across countries.

The situation is particularly diverse regarding the experimental use exception.[63] Depending on the patent law and practice of the country, an experimental use exception may cover experiments to verify the truth and sufficiency of a disclosure in a patent specification; experiments conducted in preparation for licensing; experiments aimed at acquiring data about a product to satisfy regulatory agencies; and experiments aimed at finding a new use for a patented invention.

61. US Government, "US Patent Office Utility Examination Guidelines," Federal Register, Vol. 66 No. 4, 5 January 2001.

62. *http://www.uspto.gov/web/tws/B3b_reachthrough.pdf*

63. See "Patenting and the Research Exemption" at the EU IPR Helpdesk for an overview of the current situation in the United States and European countries.

The United States has a narrow common law experimental use exception which permits experimental uses of any patented invention, as long as it is merely to satisfy intellectual curiosity and has no commercial purpose (solely for amusement, to satisfy idle curiosity, or for strictly philosophical inquiry), a definition first used in a US court in the 19th century. However, the broad interpretation of "commercial purpose" in a recent court decision has raised concerns about a possible narrowing of common law research exemptions in the US which excludes universities from eligibility. The US Federal Circuit refused an exemption to Duke University in 2002 on the grounds that its research activities *"unmistakably further the institution's legitimate business objectives, including educating and enlightening students and faculty participating in these projects."*[64] Additionally, there is a statutory experimental use exception restricted to pharmaceuticals in the United States: The 1984 Hatch-Waxman Act allows manufacturers to experiment with patented pharmaceutical and medical inventions, as long as the use is 'reasonably related' to obtaining regulatory approval. A recent US court decision seems to have limited the scope of the interpretation of research exceptions in this field too, by restricting it to marketing approvals for generic drugs only, which excludes any new drug development.[65]

The situation is different in other countries. Although patent laws in most European countries include a statutory non-sector specific experimental use exception, their scope is not the same across countries. Moreover, related case law is almost solely developed in the pharmaceutical area and does not always provide a clear and robust answer on the application and limits of these statutory research exemptions. However, the interpretation of research exemptions in Europe seems to have been less restrictive than in the United States so far, as judging by case law. For example, the definition of experimental use exception by courts in the United Kingdom seems to have relied more on the nature of the experiment and less on its commercial or non-commercial purpose, and German case law allows experimental use exceptions in pharmaceuticals for both new drug development (finding new indications of patented substances) and market approval for generic drugs.

Japanese law also includes a statutory broad experimental use exception, which has developed in case law to include both experiments for the advancement of technology with no commercial purpose, and experiments for obtaining information required for a regulatory approval. However, the interpretation of "technology advancement" and "commercial purpose" will depend on the future development of case law as new cases arrive, and in particular, the eligibility of universities and other PROs remains unclear, as in other countries.

In turn, compulsory licensing provisions are quite limited and very rarely applied.[66] TRIPS includes provisions related to *working requirements* that have been often translated into national legislation, at least in some technological fields. In addition, the Bayh-Dole Act includes a provision for 'march-in rights' which amount to a working requirement for publicly funded inventions, but apparently it has not been exercised so far (Bar-Shalom and Cook-Deegan, 2002). The most important issue as regards *public health* is the possibility to request compulsory licensing (or exhaustion) of patent rights in public health crises in developing countries, including those relating to HIV/AIDS, tuberculosis, malaria and other epidemics. This need was recognised at the Doha WTO Ministerial in 2001, where it was agreed that TRIPS should not prevent members from taking measures to protect public health.[67] Finally, in the context of *competition law*, compulsory licenses are envisaged as a

64. *Madey v. Duke University*, 307 R.3d 1351 [Fed. Cir. 2002].

65. *Integra Life Sciences I, Ltd v Merck KGaA*, 2003 US App. LEXIS 11335 [Fed. Cir. 2003].

66. Examples of compulsory licensing programs in the United States at *http://www.cptech.org/ip/health/cl/United States-misc.html*

67. *http://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_trips_e.htm*

remedy to be implemented whenever the anticompetitive effects caused by the exclusive rights conferred by patents are too detrimental to competition. There are several examples mergers or cases involving the abuse of dominant positions where compulsory licensing of patents has been used to remedy anticompetitive effects, but courts use this solution only in exceptional occasions (Shapiro, 2002).

Conclusions

This overview of recent trends and comparison of patent regimes in Europe, United States and Japan reflects a generalised trend towards strengthening patent protection and highlights differences in patenting practices in the United States, Europe and Japan. Patent strength indexes indicate a strengthening of patent protection within OECD countries in recent years, but their explanatory value is restricted and mainly limited to changes in the law, such as upward harmonisation of patent regimes to comply with international treaties, extension of subject matter, increased duration of protection and scarcity of exemptions. Other dimensions described throughout this paper are more difficult to quantify, but are equally important in conferring broader rights to patent holders. These comprise changes in the practice of patent offices and the interpretation of case law, the impact of international and national reforms on increasing the flexibility and costs of patenting, etc. Further research should attempt to take into account these other dimensions in order to make a full appraisal of recent changes in patent regimes and try to better understand their impact on innovation and economic performance using, as much as possible, empirical evidence.

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ANNEX: COMPARISON AMONG PATENT REGIMES ON SELECTED ISSUES

	United States	Japan	Europe
Patent subject matter	"Anything under the sun made by man" **Congress Committee Reports accompanying the 1952 US Patent Act.** "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." **US Patent Act, Title 35 (1952), Sec. 101, Inventions patentable** When used in this title unless the context otherwise indicates (a) The term ''invention'' means invention or discovery. (b) The term ''process'' means process, art or method, and includes a new use of a known process, machine, manufacture, composition of matter, or material." **US Patent Act, Title 35 (1952), Sec. 100, Definitions**	"Invention in this Law means the highly advanced creation of technical ideas utilising natural laws." **Japan Patent Law (1959), Article 2 (1)**	"The invention must be of 'technical character' to the extent that it must relate to a technical field, must be concerned with a technical problem, and must have technical features in terms of which the matter for which protection is sought can be defined in the claim." **EPO Examination Guidelines, Chapter IV, 1.2.ii**
Patentability criteria	Novelty, usefulness, non-obviousness for a person skilled in the art	Novelty, industrial applicability, non-obviousness for a person skilled in the art	Novelty, industrial applicability, inventive step

	United States	Japan	Europe
Exclusions to patentable subject matter			Not regarded as inventions: "(a) discoveries, scientific theories and mathematical methods; (b) aesthetic creations; (c) schemes, rules and methods for performing mental acts, playing games or doing business, and programs for computers; (d) presentations of information. (3) The provisions of paragraph 2 shall exclude patentability of the subject-matter or activities referred to in that provision only to the extent to which a European patent application or European patent relates to such subject-matter or activities as such. (4) Methods for treatment of the human or animal body by surgery or therapy and diagnostic methods practised on the human or animal body shall not be regarded as inventions which are susceptible of industrial application within the meaning of paragraph 1. This provision shall not apply to products, in particular substances or compositions, for use in any of these methods."[68] **European Patent Convention (1973), Article 52 (2), (3), (4), Patentable inventions**.
Non-patentable inventions	No exclusions in the Patent Act, but the **1981 US Supreme Court Diamond v Diehr** decision confirms the traditional exclusion of "laws of nature, natural phenomena and abstract ideas"	"The inventions liable to contravene public order, morality or public health shall not be patented, notwithstanding Section 29." **Japan Patent Law (1959), Article 32.**	Not patentable inventions: "(a) inventions the publication or exploitation of which would be contrary to "ordre public" or morality, provided that the exploitation shall not be deemed to be so contrary merely because it is prohibited by law or regulation in some or all of the Contracting States; (b) plant or animal varieties or essentially biological processes for the production of plants or animals; this provision does not apply to microbiological processes or the products thereof. "[69] **European Patent Convention (1973), Article 53, Exceptions to patentability.**

68. See decisions of the Enlarged Board of Appeal G 1/83, G 5/83, G 6/83, G 1/98.
69. See decisions of the Enlarged Board of Appeal G 3/95, G 1/98.

	United States	Japan	Europe
Patentability of software	The patentability of software (mathematical algorithm producing a technical effect in a machine) was first established in 1981 with the **US Supreme Court decision Diamond v Diehr**, and confirmed and extended since then.	Software inventions are patentable when they are concretely realised by using hardware resources. **JPO Examination Guidelines.** Japan patent law protects computer programs themselves. **2002 provision of enforcement actions of Japan Patent Law**	Excluded from patentability 'as such', **European Patent Convention (1973), Article 52.** *Ongoing legislative process:* EC Directive on the patentability of computer-implemented inventions / current proposal limits patentability to software inventions making a technical contribution to prior art.
Patentability of business methods	The patentability of business methods was confirmed by the **CAFC State Street Bank 1998 decision,** stating that a mathematical algorithm is not excluded from patentability if it produces a "useful, concrete and tangible" result.	Business method patents are granted only for business models that have technological aspects / pure business methods unrelated to software are not granted patent protection.	Excluded from patentability 'as such', **European Patent Convention (1973), Article 52.** *Ongoing legislative process:* EC Directive on the patentability of computer-implemented inventions / current proposal will exclude patentability of business methods.
Patentability of biotechnology	**1980 US Supreme Court decision Diamond v Chakrabarty** patentability of biotechnological inventions (new human-made organisms). **USPTO Examination Guidelines 2001:** Gene compositions are patentable when the "application discloses a specific, substantial and credible utility for the claimed isolated and purified gene."	**1979 introduction of microbiology patents.** Extension to other biotechnological inventions such as genetically engineered pharmaceuticals, plants and animals since then.	**1998 EC Biotechnology Directive (98/44/EC)** [not implemented in all EC countries yet]. i)"inventions which are new, which involve an inventive step and which are susceptible of industrial application shall be patentable even if they concern a product consisting of or containing biological material or a process by means of which biological material is produced, processed or used" ii) "biological material which is isolated from its natural environment or produced by means of a technical process may be the subject of an invention even if it previously occurred in nature."

* In 1999, USPTO, JPO and EPO agreed not to extend patent protection to gene fragments unless they have specific functions or special utility.

	United States	Japan	Europe
Filing and examination	- *First to invent* - *One year grace period* (earliest public disclosure allowed before filing, otherwise novelty lost) - *Filing options:* Provisional application, standard application, continuation and continuation in part applications. - *Examination:* Automatic / Alternative deferred examination path introduced in February 2003.	- *First to file* - *6 months grace period:* If the disclosure was made by the applicant or someone under his control. - *Filing options:* Standard patent application - *Examination request*, not later than 3 years after filing.	- *First to file* - *6 months grace period*: Only for public disclosure in certified international exhibitions and in unlawful breach of confidentiality or secrecy agreements. - *Filing options:* standard patent application - *Examination request*, not later than 6 months after publication of search.
Challenges to validity at PTOs	Re-examination at USPTO: no time limit, does not allow same level of participation of third parties as opposition. Third parties tend to rely on litigation to challenge validity.	- *Post-grant opposition,* within 6 months from publication of grant.	*Post-grant opposition,* within 9 months from grant, centralised process at EPO (litigation subject to national court decision in each designated country).

Chapter 8

RECENT CHANGES AND EXPECTED DEVELOPMENTS IN PATENT REGIMES: A EUROPEAN PERSPECTIVE

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The background for the recent changes and expected developments in the European patent system is twofold. On the one hand, European policy makers begin to realise that patents play an ever-increasing role in managing economic risks in the emerging global knowledge economy, not only for applicants and their competitors, but also for financial markets and national as well as regional economies. On the other hand, it has become clear that the European "bundle" patent could not remain Europe's only answer to the global challenge. This chapter presents four major projects for the development of the patent system in Europe addressing those issues: 1) *the year 2000 EPC revision;* 2) *the London Agreement of October 2000;* 3) *the draft European Patent Litigation Agreement (EPLA); and* 4) *the Community patent as outlined in the Common Approach of March 2003.*

Introduction

The background for the recent changes and expected developments in the European patent system is twofold. On the one hand, European policy makers begin to realise that patents play an ever-increasing role in managing economic risks in the emerging global knowledge economy, not only for applicants and their competitors, but also for financial markets and national as well as regional economies. By 1998, 85% of stock market value was related to intangible assets. It was only 38% in 1982. As far as patents alone are concerned, EUR 120 billion was paid as licensing fees in 2001 on a worldwide scale, representing 11% of the net earnings of the world's quoted companies. And yet, only 13% of patent portfolios are actively licensed. The remaining 87% are used in various ways to secure the market positions of their owners. Even in the absence of precise economic data, experts in large companies estimate the yield of that portion of patents to be five to eight times higher than revenues from licensing fees. On that basis, the total revenue generated directly or indirectly by patents would amount to EUR 700 to 1 100 billion per year. This huge amount is almost exclusively shared between Japan, Europe and the United States which, together, hold over 90% of applications filed and patents granted on an international scale.

Far beyond what classical patent theories have ever conceived, patents portfolios not only determine access to market for products and services, but to financial markets as well. Their role in market capitalisation of companies is ever increasing, which, by the way, explains the explosion of filing figures in the world's leading patent offices since the mid-1990s. Higher market capitalisation thanks to strong patent portfolios provides further strategic benefits such as privileged access to external financial resources, including risk capital as well as a superior position in friendly and unfriendly dealings between competing industries.

On the other hand, it also became clear with the 1989 Luxembourg Agreement on Community Patents failing to enter into force that the European "bundle" patent could not remain Europe's only answer to the global challenge. Legislative action was thus concurrently initiated at both the EPC intergovernmental level and by the European Community. On invitation of France, an intergovernmental conference was convened in Paris in June 1999. The four key objectives approved by the conference were to reduce patenting costs, to create a system for litigating European patents, to streamline the European patent granting procedure and to create, within the EPC, the basis for a Community patent to be instituted by an EC regulation.

Intergovernmental initiatives

At the intergovernmental level, three major legislative projects were undertaken:

- The EPC year 2000 revision.
- The London Agreement on translation requirements of October 2000.
- The draft European Patent Litigation Agreement (EPLA).

The EPC 2000 revision

The Diplomatic Conference held in Munich in November 2000 considered amendment proposals affecting some 100 articles of the Convention. Apart from bringing the EPC into line with the TRIPS Agreement and the new WIPO treaty for harmonisation of formal requirements, signed in Geneva in May 2000, the thrust of the revision was to improve the efficiency and reliability of the grant

procedure, to update substantive European patent law and to strengthen the institutional framework within which the European Patent Organisation operates.

Substantive patent law

To begin with a significant failure, the conference turned down the Administrative Council's proposal to delete computer programs from the list of non-patentable subject matter under Article 52(2) EPC. In taking this position, the conference took account of the consultation process on the future shape of protection of software inventions, launched by the Commission in the autumn 2000 -- for which the results are still awaited as of today. Nevertheless, it was noted in the conference proceedings that the current practice of the EPO and its Board of Appeal was not affected by the position taken by the conference. As a result, software-related inventions may be patented as before, provided that they are associated with a new and inventive technical contribution to the state of the art -- a modest but still appreciable result.

The issue of biotechnological inventions was not even on the conference's programme since the EC directive of 1998 had already been incorporated into the EPC Implementing Regulations by decision of the Administrative Council one year earlier - a very wise decision if one sees that the directive is still awaiting implementation at the level of national law in several EU member states.

Thirdly, substantive progress has been achieved concerning the patentability of second and further medical uses of known substances. Instead of the uneasy "Swiss type" use claim, developed by the Board of Appeal, Article 54(5) EPC as revised now allows use bound product claims for this type of inventions.

Last but not least, the revised protocol on interpretation of Article 69 EPC now explicitly includes "equivalents" in the definition of the extent of protection of European patents. Even if a closer delimitation of equivalents proposed by the EPO did not meet with sufficient support, this constitutes a further step in the harmonisation of European patent law, in particular with regard to continental and British court practice.

Institutional provisions

On the institutional front, Articles 33 and 35 have been amended so as to give power to the Administrative Council to amend the EPC by unanimous decision to bring European patent law into line with either Community law (such as the biotechnology or the expected computer technology directives) or international treaties. The idea behind these amendments, as initially proposed, was to avoid the lengthiness and uncertainties of EPC revisions in matters in which full agreement among all member states, including ratification if required, had already been reached in different fora, be it at the international (WIPO, WTO) or Community level.

Unfortunately, last-minute objections made by one delegation led to watering down this concept to a point of complexity at which classical treaty revision remains a chanceful competitor, even with a timeframe of ten years or more.

Still on the institutional front, a new Article 4a EPC provides for regular meetings of a conference of ministers of EPC member states. The conference has no institutional powers but is meant to give the organisation strategic direction, as had been achieved by the Intergovernmental Conference convened by France in June 1999. Whether or not EPO ministerial conferences will in the future have any effective bearing on European patent policies remains to be seen in the context of the Communities projected membership in the European Patent Organisation.

The procedure for granting European patents

There have been a series of amendments to the patent-granting procedure.

Legal consequences of missed time limits will be alleviated with further processing replacing on a large scale the cumbersome procedure of re-establishment of rights, while that latter procedure will also be available in respect of missing the priority period. And there will be a new central procedure allowing for the limitation of the scope of claims, which until now was only possible under national law. Last-instance decisions of the Boards of Appeal will be subject to further appeal to the Enlarged Board of Appeal, but only in extreme cases of missing due process or natural justice.

The common strategic direction of all the changes in the EPC brought about by the year 2000 revision is to further improve the service rendered to the system's users, so as to help applicants as well as their competitors to better manage their economic risks and thereby provide higher value to the European economy at large. By far the most important progress brought about by the year 2000 EPC revision is "Bringing Examination and Search Together" (BEST). That change is to be implemented right now, even before ratification of the revision act. By now BEST has reached a degree of penetration of 70%, it will be fully completed within the coming three years. The same examiners at the Hague and in Munich will complete the whole procedure, from search to grant. The leap in procedural efficiency that BEST will bring about, in conjunction with a host of supporting changes, will enable the EPO to be in full control of its workload in all fields of technology by the year 2007 at the latest. That means that European patents will be granted within 36 months of the filing date on the EP-filing route and, in the case of Euro-PCT applications, within 24 months after their entry into the European grant procedure which, as a rule occurs 31 months after the priority date.

The BEST reform has one particular feature that must be mentioned when talking about management of economic risks by both applicants and their competitors.

As from 2000 onwards, the search report, to be published 18 months after the priority date which, as a rule, means six months after the actual filing date, will be supplemented by an opinion on patentability, that will be a full equivalent of the first examiner's communication in current Euro-direct practice (the famous "B10"), or, in Euro-PCT cases; of the first preliminary examination communication provided for in Article 33 PCT.

This means that at the earliest possible moment in the grant procedure, applicants and third parties will be in possession of a set of information on which they can rely to build their prosecution and business strategies. That feature will make the European patent granting procedure second to none in terms of effectively managing economic risks.

The London Agreement of October 2000

An important first result of the 1999 Paris Intergovernmental Conference was the signing of the agreement on the application of Article 65 EPC by 10 EPC contracting states (Switzerland, Germany, Denmark, France, United Kingdom, Liechtenstein, Luxembourg, Monaco, Netherlands, Sweden) in London in October 2000. These states represent 66% of the EU's total GNP.

The parties to the agreement commit themselves to require no more than the translation of the claims in a European patent. This constitutes a major breakthrough, rendering the European patent system considerably more attractive and affordable. Translation costs will be cut by more than 50% if the agreement enters into force. All EPC member states can opt in to the agreement. For cost reasons the London Agreement will further encourage concentration of European patent protection on only a

few member states. This will be of no benefit to countries that are left out, since their industries will nevertheless have to respect the patents that are in force in the larger countries where the bulk of their market is, without even the translation of the claims being available in their national language.

The European Patent Litigation Agreement

To fulfil Part 2 of the mandate of the 1999 Paris Conference, the conference's Working Party on Litigation agreed in December 2002 to the concept of a "European Patent Litigation Agreement" (EPLA) to be concluded between those EPC contracting states ready to move forward to a system for litigation concerning infringement and validity of European patents. The EPLA would be a self-contained international treaty setting up a new European organisation, the European Patent Judiciary, comprising a European Court of First Instance and a Court of Appeals. The draft of that Agreement is now available in a form that would allow to convene a diplomatic conference, unless "friendly fire" from the EU were to stop the project altogether.

The key features of the draft EPLA are the following:

1. Accession to the system is optional. It may enter into force among at least six member states, hopefully comprising the three largest EU/EPC member states. Very unfortunately, however, France seems to have problems of a constitutional order preventing it from fully participating in the system.
2. The Patent Court of First Instance would comprise regional panels on which the most experienced judges of each country would sit besides judges of other member states who have a sufficient command of the language of proceedings. That language would be the national language of the country in which the regional panel is sitting.
3. The central Court of Appeal would have its seat in Luxembourg. It guarantees harmonised interpretation of both procedural and substantive patent law and would guide EPO practice as far as patentability is concerned.
4. The European Patent Judiciary shall be financially self-supporting. This is substantially facilitated by the fact that regional panels will be composed of a majority of national judges who are at the same time acting within their national judicial competences.
5. Regional panels may be instituted by any state or group of states that is willing to bear the costs thereof. It is therefore to be expected that these panels will be formed only in circumstances where a sufficient number of cases will enable efficient and cost effective case management.
6. The draft EPLA comprises a sufficiently developed procedural law, including the taking of evidence and efficient provisional measures such as, for example, the French *"saisie contrefaçon"*.

In summary, the draft EPLA promises to offer an efficient system for litigating European patents that rests on the best of traditions and capabilities available in the member states while offering all the benefits of a central court system.

If it were to become a reality, it would be a European equivalent to the Common Appeal Court for the Federal Circuit (CAFC) in the United States. It is with the creation of the CAFC some 20 years ago that the US patent system was able to become one of the pillars on which the success of the US economy is built.

The Community Patent

The Common Approach of 3 March 2003 (CA 2003)

Efforts to create a Community patent have continued for over 40 years. The idea that a "common market" must encompass a common patent goes back to the late 1950s when the European Community came into existence with the Treaty of Rome.

In actual fact, the key features of a Community patent have never been questioned in principle. It must be unitary, autonomous, cost-effective and supported by a common court system with exclusive competence concerning validity and infringement of Community patents. However, often "the devil is in the details", particularly when unanimous decision is required.

The issues at stake

The Common Approach in its final version of 7 March 2003 (No. ccon. prop. 10786/00/PI49), hereafter referred to as CA 2003, addresses six issues that, so far, have been controversial. Only three of these issues relate to the concept of a Community patent properly speaking:

- The translation of Community patents.
- Jurisdiction on the validity and infringement of Community patents.
- The amount of maintenance fees for Community patents.

The three other subjects belonging to the realm of the EPC are:

- The "mutualisation" of the costs for translating European patent applications filed in a language other than one of the three EPO official languages.
- The "role" of national offices (NPOs) in the procedure for the granting of European patents.
- The sharing of fees paid for the maintenance of CPs between the EPO and NPOs.

In the CA 2003, the 50/50 mix of issues that fall within EC competence and those that do not is easily explained: under Community law unanimity is required, and it therefore seemed advisable, on the one hand, to broaden the ground for compromise, even at the expense - as we will see - of fundamental principles enshrined in the EPC. On the other hand, once the compromise has been reached within the EU and becomes binding on each and every member state as a matter of Community discipline, it can be easily imposed in the EPC framework dueto the fact that for EPC revision, a majority of only three-quarters is required.

The key features of the Common Approach are presented below in some detail.

The system of jurisdiction

Litigation concerning CPs will exclusively be dealt with by a unitary court for the Community patent. At first instance, it shall take place before a judicial panel, called Community Patent Court (CPC), which is to be established according to Article 225a EC Treaty. It shall be attached to the European Court of First Instance (CFI) and have its seat in Luxembourg. Appeal against decisions of the CPC shall lie with the CFI.

This concept rejects the idea of regionalisation of the first instance, which is so essential to the EPLA. No way is shown how to benefit from the judicial experience existing in national courts. Instead, Community patent judges shall be appointed by *unanimous decision of the EC Council*. With 25 EU member states, this is bound to mean that nationality will prevail over experience and competence in selecting judges.

The CPC shall sit in sections of three legally qualified judges; however, "technical experts will assist the judges throughout the handling of the case". The question whether these experts are to be employed on a permanent or on an ad hoc basis remains open. In the first case, a large number of experts would have to be employed to adequately cover the various fields of technology; in the second it is difficult to imagine how the experts could "assist the judges throughout the handling of the case".

The language of proceedings will be the "official language of the member state in which the *defendant is domiciled*", unless otherwise agreed by the parties with the consent of the court. Proceedings can thus take place in any of the 21 languages spoken in the EU, depending on the domicile and will of the infringer. This promises both Babylon in court proceedings, and Paradise for professional infringers, settling in countries whose national language is hardly spoken outside their borders, and most certainly not by the judges hearing the case.

Understandably, other issues of equal importance such as costs, length and rules of procedure, provisional remedies and the like are not addressed in the CA 2003.

The CA 2003, however, states that the Community Court shall be established at the latest by 2010. Until that time "each member state shall designate a limited number of national courts to have jurisdiction" in the matters of exclusive competence of the future CPC. Given the unitary character of the Community patent, that means that during this period Community patents may be revoked with Community-wide effect by any national court, a perspective that has kept shuddering European industries for the last 30 years.

Translation of claims

The CA 2003 has the indisputable merit of making the standard set by the London Agreement of October 2000 binding on all (future) 25 EU member states, as far as the Community patent is concerned. Only claims must be translated, not the entire patent specification.

This should provide a competitive edge to the Community patent over the European bundle patent, at least if it is assumed that an average European patent is granted for eight member states and that the London Agreement shall not enter into force, even among its ten signatory states. Depending on these assumptions, estimated translation costs are as follows:

Average EP **8 designations** **6 translations**	**Average EP + London,** **8 designations** **6 translations**	**CP 25 member states,** **18 translations of claims**
EUR 11 520	EUR 5 500	EUR 5 350

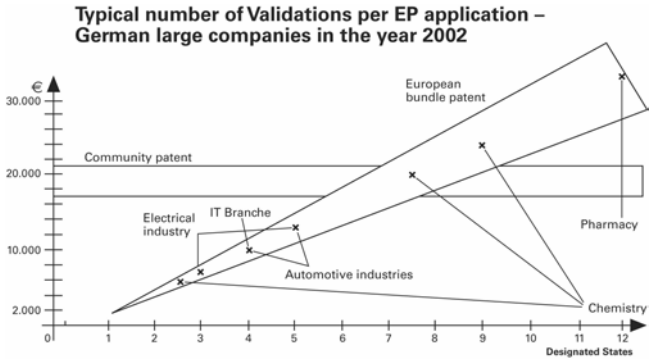
The table shows that in comparison with the average European patent as of today, the Community patent cuts translation costs by more than 50%, while offering protection in 17 more member states. With the London Agreement, the cost advantages disappear almost entirely, but the territorial benefit is unaffected.

However, this calculation is flawed in a number of respects.

Firstly, the average number of eight designations was reported by the EPO in 1993, at a time when high designation fees had to be paid at the very beginning of the grant procedure. However, as a consequence of the fee reforms of 1997 and 1999, broad initial designation has become common practice. Selection of states in which protection is sought now takes place after a patent has been granted, when translations must be filed. That brings down the average figure of eight designations to five or six member states in which, on average, European patents actually take effect.

Secondly, statistical averages are of no bearing on the applicant's decisions in individual cases. Applicants and patent owners want to secure their markets and they do so taking into account the competitive structure of their respective industrial sectors. In automotive industries, for example, the entire EU market can be controlled by patents effective in just three member states - Germany, France and the United Kingdom. Of course, Italy is also an important market, but no carmaker will envisage producing a car with features that infringe rights in the three countries that represent more than 50% of the Community's GNP. An example of the opposite is the pharmaceutical sector. The cost of putting a new curative or diagnostic molecule on the market is estimated at more than EUR 500 million, but the cost of imitating it is almost insignificant. This is why the pharmaceutical industry needs broad geographical coverage.

In a Forum discussion on 18 July 2003, Wilhelm von Lieres, Head of the Siemens patent department, after consultation with his peers in other industrial sectors, presented the following diagram, which suggests that in terms of translation costs, the Community Patent does not present any cost benefits, except for the pharmaceutical industry and to a much more limited extent, parts of chemical industries.



The role of national patent offices (NPOs) in the European patent granting procedure

The CA 2003 provides that "on behalf of the EPO and on the request of the applicant, national offices of member states having an official language other than the three official languages of the EPO, may carry out any task up to and including novelty searches in their respective languages".

The tasks referred to may comprise both formal examination and search. However, for practical and procedural reasons, only carrying out searches can become an issue in actual practice.

In 2002 a total of 7 723 European patent applications were filed by applicants from the 15 member states having an official language other than the three EPO official languages, of which 2 241 by Italian applicants whose national office does not carry out searches at all.

The CA 2003 specifies that the search fee shall be the same whether the search is carried out by a national office or the EPO. With the exception of the Swedish and the Spanish patent offices, which already act as international searching authorities under the PCT, none of the national offices in question satisfies PCT minimum standards. Under these circumstances there hardly seems to be any reason for an applicant to opt for the European search to be carried out by his national office. This will be even more the case from 2004 when EPO search reports will start to be supplemented by a substantive examiner's opinion (EESR). The very rationale of the CA 2003 on this point thereby becomes unintelligible.

There is, however, the so-called "Austria clause" in the CA 2003 which provides that "patent offices of member states having as their official language one of the three EPO languages, which have experience of co-operation with the EPO and which need to maintain a critical mass may, if they so wish, carry out search work on behalf of the EPO". This clause is of a different dimension and nature, putting into question the central European grant procedure in its very principle. All the more, free choice of applicants must apply as a controlling feature in this context as well.

Renewal fees

The CA 2003 provides that renewal fees for a Community patent "must not exceed the level of the corresponding renewal fees for an average European patent".

As is the case with translation costs, the costs of maintaining an average European patent are taken as a benchmark. One more opportunity to give the Community patent a chance is thereby lost. No thought seems to have been given to the idea that procedural and maintenance fees together should reflect no more than the actual costs related to the service rendered to the user community. In the case of Community patents, that service is rendered by the EPO alone.

Instead, the current distribution of 50/50 for European patent maintenance fees is cast in stone for the Community patent, despite the fact that the costs for publicising translations and administering Community patents shall be borne by the EPO alone. In addition, the "mutualisation" of the costs for translating European patent applications that are filed in a non-EPO procedural language will create a new financial burden that, in the last instance, will again be borne by the system's users.

Conclusions and outlook

This paper has presented four major projects for the development of the patent system in Europe:

- The year 2000 EPC revision.
- The London Agreement of October 2000.
- The draft EPLA.
- The Community patent as outlined in the Common Approach of March 2003.

Quite understandably, Community institutions give absolute priority to the Community patent. Work on the EC regulation for the Community patent is progressing under high pressure and a new diplomatic conference for arranging the EPC for the purposes of the Community Patent is planned to take place in first half of the year 2004. That revision shall build on the EPC, as revised in 2000. The entry into force of that revision and its benefits can thus be considered secure.

The entry into force of the London Agreement is subject to the uncertainty of its ratification by France. The uncertainty increases with the shadow that the London Agreement throws on the comparative cost efficiency of the Community patent.

Should the 2004 revision of the EPC enable the Community patent to come into being, the EPLA would pass into the deadwood of European patent legislation initiatives. The European Commission has already made it known that, thanks to the exclusive competence in matters of jurisdiction conferred to the Community by the Council regulation (EC) N° 44/2001, it will oppose the EPLA by any means.

The unique opportunity to create a European litigation system for all European patents, including the 600 000 European patents currently in force, would be missed out on forever. Instead, as from the year 2010 at the earliest there would be a Community Patent Court of yet unknown composition that will hear a limited number of cases related to a limited member of industrial sectors. There would never be a common judiciary for all European patents. That is not what the European economy needs, or deserves.

PART 3

PATENTS, ENTREPRENEURSHIP AND TECHNOLOGY DIFFUSION

Chapter 9

ENABLING INNOVATION, ENCOURAGING INVESTMENT: INTELLECTUAL PROPERTY AND GENOMIC ENTREPRENEURSHIP

Thane Kreiner
Senior Vice President, Corporate Affairs, Affymetrix

This paper presents a case study, the story of Affymetrix, whose GeneChip technology leverages techniques from the semiconductor industry to package genetic information onto a chip, or array, about the size of a thumbnail. Patent systems have served the economy remarkably well over the years, and the success enjoyed at Affymetrix is certainly an example of that. So the question is not whether patents are right or wrong, but how high the bar is set in the granting of patents for naturally occurring gene sequences, because where that bar rests in the stream of research determines how great a benefit we as a society will derive from the genome.

Affymetrix: an innovative company

One of the great affirmations coming from the Human Genome Project is that in genetic terms, all human beings are 99.9% the same. However, with more than 3 billion base pairs in any one person's genome, that means there are still 3 million base pair differences between any two people. What does that variability mean? And how do our 30 000 to 40 000 genes work in concert and interact with the environment? Helping scientists answer these questions is the core of business at Affymetrix.

This presentation is a case study, the story of Affymetrix, whose GeneChip technology leverages techniques from the semiconductor industry to package genetic information onto a chip, or array, about the size of a thumbnail. Affymetrix uses DNA sequence information from public genome databases, and then creates a series of photolithographic masks like those found at Intel or National Semiconductor to fabricate computer chips. But instead of etching circuits, Affymetrix builds hundreds of thousands or even millions of unique DNA sequences on the chips.[1]

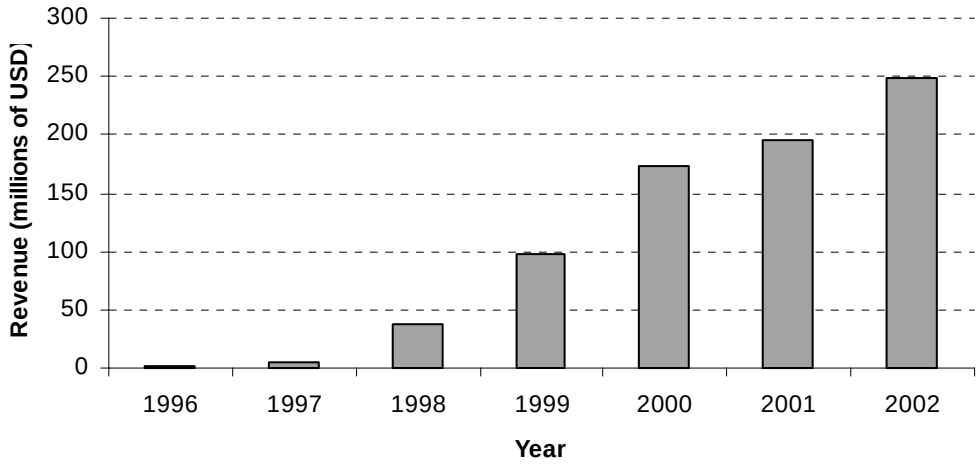
In the late 1980s, Steve Fodor, Affymetrix Chairman and CEO, had the idea to use light to build arrays of biological polymers such as peptides and oligonucleotides. His landmark paper published in *Science* in 1991 described massively parallel synthesis of arrays and marked the genesis of what is now the DNA chip or microarray industry.[2] Of course, he patented his innovations.

After Steve Fodor's paper was published and patents issued, Affymetrix raised private equity, developed and launched its system, and began marketing to scientists. In 1999, a factory was built in West Sacramento. Then a couple of acquisitions were made, and a company called Perlegen was spun off. More recently, Affymetrix introduced whole genome analysis products and now, through a partnership with Roche, is moving genomics into the diagnostics market. The economic success based on Steve Fodor's inventions has been remarkable, as can be seen from the company's product revenue growth. Affymetrix grew from essentially zero revenue more than seven years ago to nearly USD 250 million in 2002. Without question, intellectual property has played a critical role in this growth. The company currently holds about 250 patents on various aspects of its technology, and has about 400 patent applications pending. Last year, an MIT publication cited Affymetrix as having the strongest patent portfolio in the industry.

1. To give you a sense of the power of these tools, a chip this size generates a 50 MB data file.

2. Fodor, S.P.A., J. Read, M. Pirrung, L. Stryer, A. Lu and D. Solas (1991), "Light-directed, Spatially Addressable Parallel Chemical Synthesis", *Science*, 251 (4995): 767-73.

Figure 9.1. **Affymetrix product revenue growth**



Tools to understand genomes

GeneChip technology allows researchers to ask two basic questions: how does the genome function, and how do genomes vary? Function is a measure of which genes are expressed or turned on to make mRNA and then proteins under different conditions. Variability is analysis of the DNA itself: identifying the base pair differences among different individuals.

Pharmaceutical companies were among the first to adopt genomics tools because the drug development process is long, risky and expensive. It takes 12-15 years to bring a new chemical entity to market and costs between USD 500 million and USD 800 million. Less than $1/10^{th}$ of a percent of all compounds proceed all the way from early R&D to approval.

By understanding the underlying biological pathways, pharmaceutical companies can find new therapeutic targets, validate their mechanisms of action, and generate toxicity profiles for preclinical and clinical studies, thereby improving the probability of success in drug development. Ultimately, patterns of gene expression can be used in the clinic for example to identify new classes of cancer, predict patient outcome, and help to make therapeutic choices.

Today, hundreds of academic centers around the world and essentially all of the top 40 pharmaceutical companies are Affymetrix customers.

Multiple uses of array technology

The range of applications of GeneChip technology is tremendous. While the power of genetic analysis tools for improving health is indisputable, these same tools can also be used for grading of livestock, testing foodstuffs for purity or the presence of pathogens, environmental impact analysis, or forensics applications related to human rights. And it is this range of both customers for and uses of Affymetrix technology that has given the company its perspective on intellectual property issues, and caused great concern about what it sees as a growing conflict between the needs of the modern research community and the trend to assign “property rights” along the genome.

A recent, real world example of that conflict is SARS. We probably all recall this headline or one very much like it from this past March: *"Hundreds of people in Vietnam, Hong Kong and mainland China, many of them hospital workers, have come down with a mysterious respiratory illness that has killed at least six people…"*[3]. A new human pathogen, SARS, had emerged. Very quickly, scientists around the world set to discovering the cause of this disease in the hopes that they could identify treatments. But first, they had to sequence the SARS genome. Very shortly after the DNA sequence of the SARS virus was put in the public domain databases, Affymetrix designed and manufactured a chip that enables scientists to read through the entire 29 000 bases of the SARS virus. The tool is useful for epidemiological studies as well as basic virology associated with the development of therapies. But another question emerged very quickly, stimulating another headline: would intellectual property rights on the sequence of the SARS virus itself slow research, and impede the development of diagnostic tests and therapies?

Intellectual property policy issues

Our patent systems have served us remarkably well from an economic perspective over the years, and the success enjoyed at Affymetrix is certainly an example of that. So the question is not whether patents are right or wrong, but how high the bar is set in the granting of patents for naturally occurring gene sequences, because where that bar rests in the stream of research determines how great a benefit we as a society will derive from the genome. The genome is enormously complex and the only thing we can say about it with certainty is that we have much more to learn. The tools are now available to allow researchers to access to the whole genome as we presently know it. Moreover, research shows that the common, complex diseases like cancer and cardiovascular disease are not caused by the action of single genes, but by the interplay among many genes.

Box 9.1. **Intellectual property policy issues**

- Can patents on DNA sequences continue to be justified in the current research context?
  - Scientists look at many genes
  - Tools available
- Are gene patents necessary for successful innovation in healthcare?
- Should the government or other entities mediate between commercial interests and public access to gene sequences?

Source: Genomics & World Health, Report of the Advisory Committee on Health Research, WHO 2002.

But what happens when the technical ability to access the whole genome collides with the legal ability to, in effect, wall off significant portions of the same genome through patents? What do scientists do when they receive letters demanding that they stop important research unless they pay fees and obtain licenses from the patent holders of genes? It is unclear. One option is to negotiate a license, but that can be time consuming, complicated and costly. These complications can increase exponentially if the scientist is looking at multiple genes or the same genes covered by multiple patents.

In other worlds of R&D, someone can invent around a patent, that is, find another way of doing the same process that does not infringe on the original patent. But with genomics, that is not so easy since nucleic acids are the only way to encode genetic information.

3. "Mysterious Respiratory Illness Affects Hundreds Globally", *New York Times*, 15 March 2003.

Some lawyers advise their clients that as long as the research is non-profit in nature, the patent holder is more likely to ignore the technical infringement rather than to suffer the adverse public relations of going after a non-profit entity like a university. But in the United States, this research exemption does not exist in law, made all the more clear by the recent decision by the US Court of Appeals in the Madey case. It exists only as a gentleperson's agreement, which means it exists only as long as the patent holder wants to be "gentle".

The commercial value of a gene sequence per se in today's marketplace is debatable. Investors are more interested in understanding if the company seeking funding can successfully bring real products to market. Perhaps the best example of this trend away from monetizing gene sequences is that the companies attempting to commercialize gene sequence databases — Celera and Incyte for example— have changed their business models, and are repositioning themselves as drug development companies.

In this regard, gene patents stifle competition. It is not just the universities and other non-profits who have to contend with a thicket of gene patents when they do research; it is the private sector as well. But in the private sector, licensing agreements are far more arduous, patent litigation is egregiously expensive, and, rightly so, no one assumes a research exemption. Considering both the expense and the risks of bringing new therapeutics to market, this does not appear to be an efficient allocation of the private sector's resources. Society might be better served by enabling multiple companies to compete to develop the highest quality, most cost effective diagnostic test or therapeutic.

Further, clinical testing in labs has been impeded by gene patents. Jon Merz of the University of Pennsylvania and Mildred Cho of Stanford, among others, published a paper in Nature showing that 30% of the respondents to a survey about testing for hemochromatosis reported discontinuing or not developing genetic tests after exclusive licenses were granted on the associated gene patents.

In France, the Institute Curie is attempting to block issuance of European patents for the BRCA genes because the monopoly holder, Myriad Genetics, charges over USD 2 000 for a test that uses common laboratory equipment. Myriad insists that they must run all the samples themselves. In situations like these, clinical researchers are not able to conduct epidemiological studies to identify rarer mutations that could further their understanding of diseases like breast cancer and help them search for cures.

This debate and these patent thicket issues concern only 2% of the DNA in the genome: that which encodes genes. Numerous other aspects of genome structure and function are only now being catalogued, such as transcription in non-coding regions, patterns of SNPs (called haplotypes), and so forth. It is hard to imagine setting a legal standard when we do not even understand how these naturally occurring elements function.

Framework for biomarker patents

A good analogy is the kind of public domain cataloging that has taken place in other scientific disciplines, such as the periodic table of the elements, or anatomy texts. No one presumes or advocates that these discoveries should be patentable, and for good reason. Here we propose a framework for biomarker patents that distinguishes functionality from basic catalogue knowledge. Functionality patents would require demonstrated data, a specific test method, and claims which are limited to the specific function or response that the scientist has studied. Catalogue knowledge would remain in the public domain and encompasses a broad base of pre-competitive, common understanding that empowers many individuals and firms to come up with novel ideas for applying this knowledge. And

as we understand the complexity of the genome, these catalogues will extend to SNPs, haplotypes, and the other 98% of the genome.

Box 9.2. **Framework for biomarker patents**

Functionality (patent)	**Catalogue (no patent)**
• Demonstrated data models for testing – Specific test method • Drug target with specific data – Claims limited to specific function or response demonstrated by biological studies • Specific diagnostic application and method	• Genes • Proteins • Haplotypes • SNPs • siRNAs • Expressed Sequence Tags (ESTs) • "Transcriptome"

Building a commerce clause for the genome

We now understand that our common diseases result from the interactions of many genetic elements with the environment. Enabling innovation and encouraging investment require us to set the patent bar in the right place, where it will foster socially useful innovation. Restricting patents on naturally occurring gene sequences and catalogue knowledge going forward would encourage invention and complement the desirable patenting of new tools, new processes, new drugs and new diagnostics derived from understanding the genome rather than the genetic elements themselves. We also need to codify the research exemption so that non-profit research that expands public domain knowledge can continue. Pools of existing gene patents, especially those derived through publicly funded research, would ensure that these fundamental genetic discoveries are widely available to fuel innovation in both the public domain and the private sector. And finally, competition and economic development based on the genome could be enhanced by ensuring that the many discoveries made in the public domain are available to all via non-exclusive licenses.

> *"Aren't we, by awarding limited time monopolies to this mindless genetic 'innovation', discouraging the investment in the hard stuff — in function — and isn't that a bad social bargain?"*
>
> Eric Lander, Whitehead Center for Genome Research and MIT

Chapter 10

TECHNOLOGY LICENSING[1]

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Licensing agreements have tended to follow aggregate alliance trends. Manufacturing and service sectors have accounted for the bulk of both the recorded surge and the subsequent slowdown in licensing agreements in the past twenty years or so. Companies are found to engage in licensing agreements the closer their technological and market profiles, the more familiar they are with each other through prior agreements, the higher their experience with licensing, and the stronger the intellectual property protection in the primary line of business of the licensor. Licensing now occupies a central position in intellectual property asset management (IPAM); large and small companies as well as universities have developed increasingly sophisticated IPAM strategies. Still, significant differences remain between countries in terms of intellectual property protection practices, the cost of such practices, and the pursuit of licensing as an IPAM mechanism. While there is a widespread impression that the benefits of moving toward a global patent system will be quite substantial, such a development is fraught with complications.

1. This is an abridged version of a longer report with the same title prepared by Nick Vonortas for the OECD (Vonortas, 2003). This project has also benefited from long-term support by the US National Science Foundation and by the Center for the Study of Globalization of the George Washington University. We are indebted to Dominique Guellec from the OECD for excellent comments and general guidance regarding the underlying research project. Ashish Arora, Wes Cohen, Wally Mullin, David Ribar, and Chris Snyder have commented and helped clear our thinking on this issue. Participants in the 1st Annual Meeting of the Industrial Organization Society (April 2003) and the OECD conference on "IPR, Economic Growth and Innovation" (August 2003) have offered valuable suggestions. Special thanks go to eight experts on issues of intellectual property protection and licensing who agreed to be interviewed for the purpose of this work. Their names are listed in the section on "practitioners' views on technology licensing" in this paper. Koichiro Okamura, Karen Zhang, and Nick Vivio, graduate research assistants at the Center for International Science and Technology Policy of the George Washington University, worked skillfully in preparing the underlying data. Remaining misunderstandings and/or misrepresentations are solely our responsibility.

Introduction

In the context of the contemporary economic environment featuring more intensive international competition, networked corporate governance, and strengthened intellectual property protection, licensing has arguably become a more visible mechanism of knowledge transfer. Its presence has been more noticeable in technology intensive sectors such as chemicals, pharmaceuticals, computers, electronics and software. Cross-sectoral differences have also been reported in the nature of technology licensing contracts, including the importance of ex ante contracts and exclusive contracts, the proportion of contracts among parties with past relationships, and the incidence of cross-licensing (Anand and Khanna, 2000).

This paper presents the main results of an empirical study of technology licensing in the OECD area. The aim of the study was to analyze the international technology licensing market including *1)* market size and recent evolution, *2)* the profile of agents involved and their incentives, and *3)* the role of licensing in the dissemination of technology. This paper concentrates on the latter two.

The study was based on quantitative appraisal on the basis of a large dataset of international technology licensing specifically compiled for this purpose and on qualitative evidence drawn from interviews with practitioners in the field. The next section summarizes the aggregate data. We then show the core of the econometric analysis on company incentives to license out technology. The final section summarizes the qualitative evidence.[2]

Licensing in numbers

A firm has several alternative sources for technical knowledge, including both internal and external sources. Internal sources of technical knowledge include own research and development (R&D) activities, serendipitous discoveries by employees, and knowledge transfer from one division to another. External sources include government agencies, universities and other public research institutes, other companies (customers, suppliers, competitors, consulting firms, collaborators), and individuals (customers, experts, inventors). The knowledge involved can be embodied in physical products or services or can be disembodied in the form of blueprints, scientific articles, patents, copyrights, etc.

This paper relates to external sources of disembodied knowledge flows. It concentrates on only one mechanism of disembodied knowledge flows, that is, technology licensing. Other mechanisms include: collaboration; contract work; access of the intellectual property of others via open publications, stealth means, or informal contact; mobility of scientists and engineers; membership in scientific communities; and education and training. Given the importance of all these transfer mechanisms (Caloghirou, Constantelou, and Vonortas, 2001), it must be stressed that this report deals with a narrow piece of technology transfer and its results must be perceived in such a context.

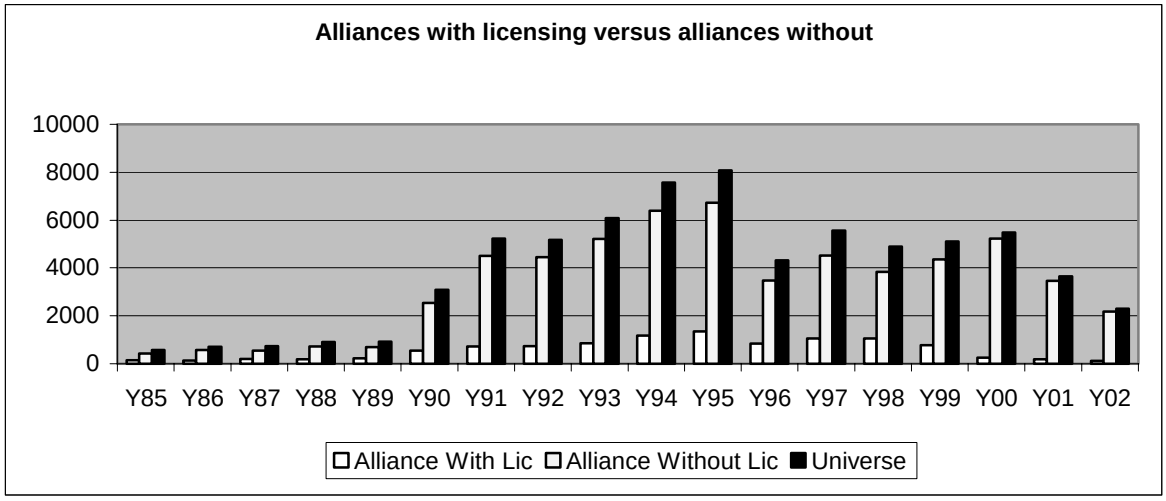
2. The reader should consult the original report (Vonortas, 2003) for a discussion on international trends and a more extensive survey of the available literature on technology licensing.

We have used Thompson Financial's SDC database to capture cross-sectoral aggregate trends of alliances with licensing content around the world during 1985-2002. The SDC database records all publicly announced alliances worldwide tracked down in the Security Exchange Commission filings in the United States, newswires, press, trade magazines, professional journals, and the like. This database provides information on contract type (licensing agreement, marketing agreement, joint venture, joint development or production, etc.), description of the deal, the date of announcement, identities of participant firms (primary SIC code, name, nation, parent companies, etc.), and the industrial classification of the alliance. In addition, the SDC identifies different kinds of licensing agreements (*i.e.* exclusive, non-exclusive, cross-licensing) and the roles of the participants in them (licensor, licensee).

The date of data download from SDC was February 25, 2003. In total, 11 839 alliances with licensing content were reported to have been announced between January 1, 1985 and December 31, 2002. From these, 10 540 alliances with "completed/signed" deal status were selected for this exposition. These alliances registered a total of 21 785 participants, corresponding to 10 923 ultimate parents (unique participants after the elimination of duplicates). The number of participants in an alliance ranged from two to 15.

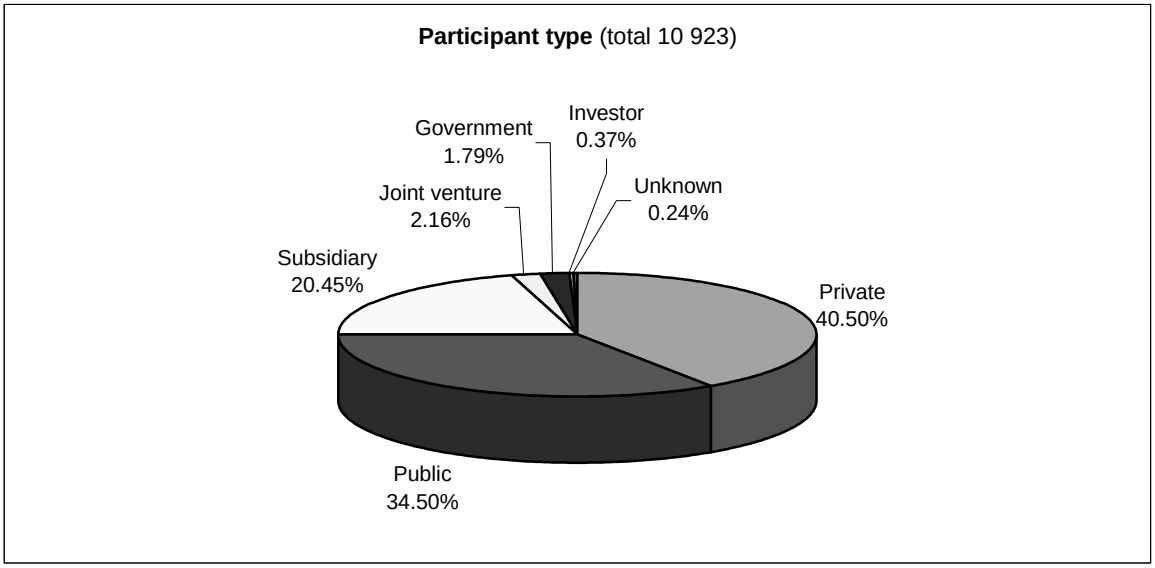
Licensing activity has tended to follow aggregate trends of alliance formation in terms of time evolution and in terms of broad sectoral allocation. Following a rapid increase of reported alliance agreements with technology licensing content between mid-1980s and mid-1990s, such agreements have spiraled downward the past few years (Figure 10.1).

Figure 10.1. **Alliances with licensing content**



The vast majority of entities participating in alliances with licensing content were from the private sector (more than 98% of the total) (Figure 10.2).

Figure 10.2. **Licensing alliance participants**

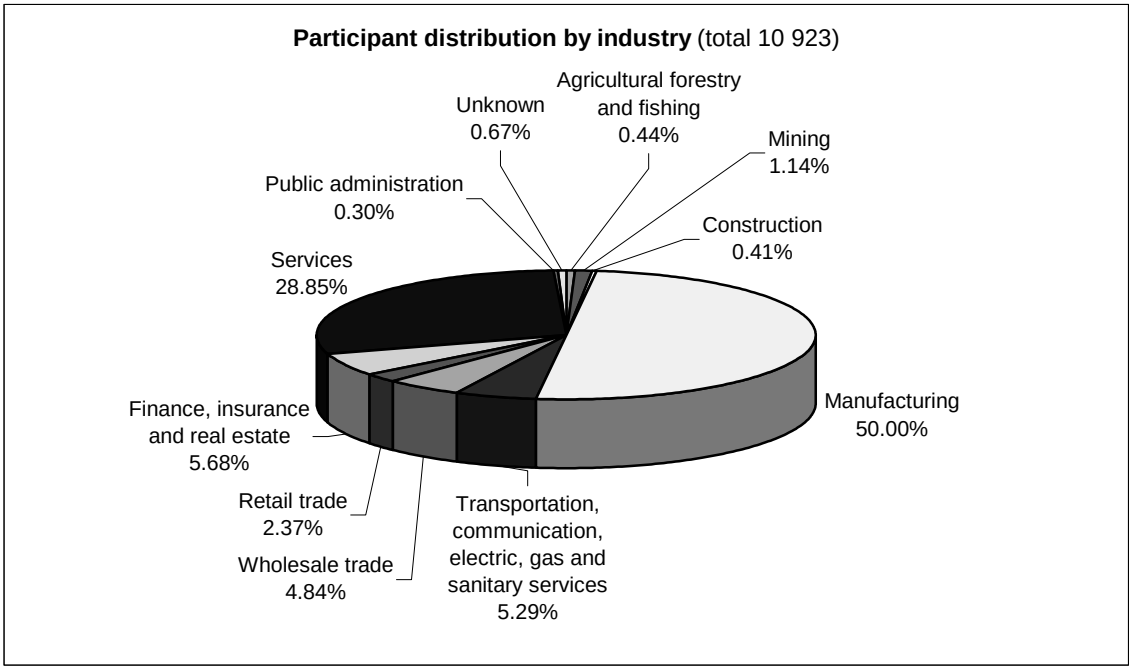


Public: Entity traded publicly on a stock exchange. **Private**: Entity not traded publicly or owned by another company. **Subsidiary**: Entity at least 50% owned by another company. **Government**: Entity at least 50% owned by the government. **Joint venture**: Entity jointly owned by two or more partners. **Investor**: Individual. **Unknown**: Entity's status unknown.

Manufacturing and service sectors have accounted for the bulk of the surge in recorded licensing agreements in the 1990s.[3] Chemicals and pharmaceuticals, electronics and electrical equipment, and business services (including software) have been particularly active sectors. Wholesale trade and finance and insurance have followed at some distance. Manufacturing and service sectors have also experienced the brunt of the significant drop off in the number of recorded licensing agreements during 2001-2002. This sectoral distribution in also reflected in the population of participating companies (Figure 10.3).

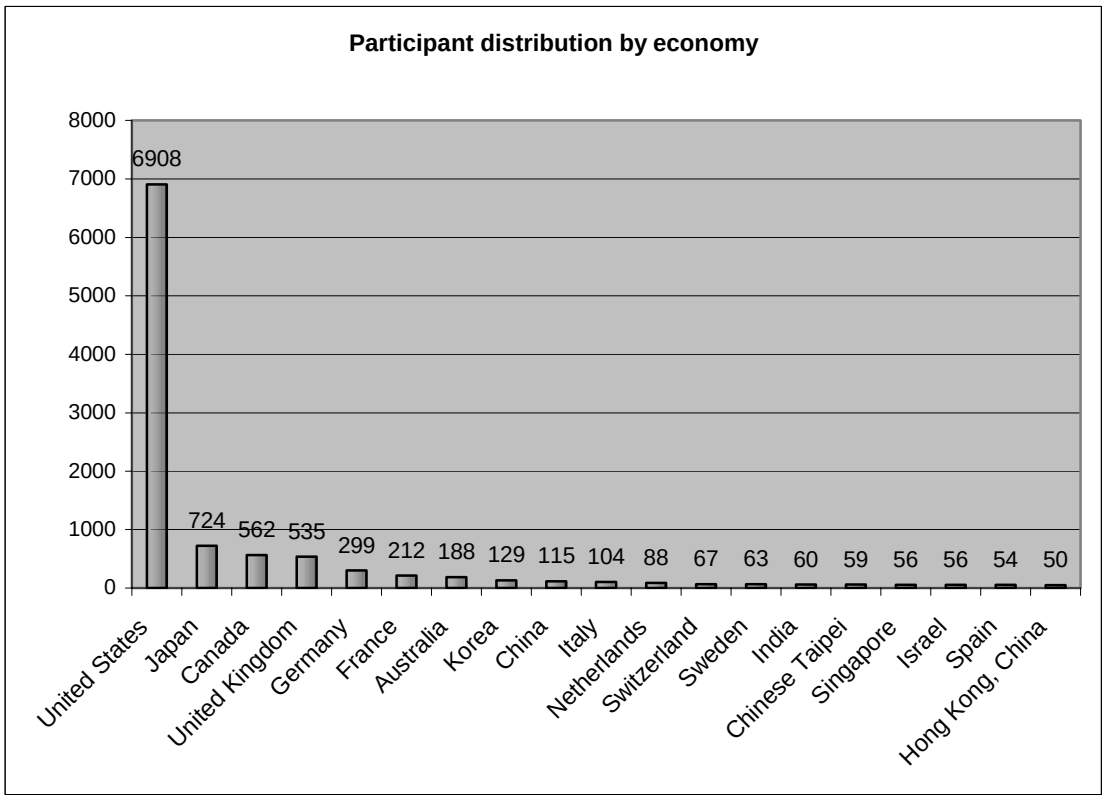
3. We used the classic breakdown of broad economic sectors suggested by the US SIC code manual (1997): Agriculture Forestry and Fishing: SIC 01, 02, 07, 08, and 09; Mining: SIC 10, 12, 13, and 14. Construction: SIC 15, 16, and 17; Manufacturing: SIC 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, and 39; Transportation, Communication, Electric, Gas and Sanitary Services: SIC 40, 41, 42, 43, 44, 45, 46, 47, 48, and 49; Wholesale Trade: SIC 50 and 51; Retail Trade: SIC 52, 53, 54, 55, 56, 57, 58, and 59; Finance, Insurance and Real Estate: SIC 60, 61, 62, 63, 64, 65, and 67; Services: SIC 70, 72, 73, 75, 76, 78, 79, 80, 81, 82, 83, 84, 86, 87, 88, and 89; Public Administration: SIC 91, 92, 93, 94, 95, 96, and 97.

Figure 10.3. **Industry distribution of licensing alliance participants**



The advantages of SDC include its large size, broad coverage of all types of alliances, reporting of all different agreements under each deal, the identification of participants and linkage to ultimate owners, and the provision of a link to the original source of information. However, this database also has several disadvantages. These include the lack of consistency in data presentation. We strongly suspect that the disadvantages also include significant coverage biases in terms of language (favoring alliances announced in English), geography (due to the tracked publications), and alliance "importance" (favoring large deals and large firms). This limitation is largely the result of the data collection methodology. The outcome is a heavy concentration on US-based entities (Figure 10.4). While US companies are probably still dominant as technology licensors and reporting requirements differ between countries, the observed skewness is beyond what had been anticipated initially. Such problems limit the utility of the SDC database for investigating international longitudinal trends without extensive further treatment of the data.

Figure 10.4. **National distribution of licensing alliance participants**



Determinants of technology licensing

There is evidence – much of it anecdotal – that the market for technology is less efficient than most product markets and that it operates at a suboptimal level. A recent survey (Arora, Fosfuri and Gambardella, 2001) surveyed extensively the available evidence that large companies in the United States, Western Europe, and Japan have, on average, tended to ignore the potential benefits from licensing their patented technologies.[4] The inefficiency has been attributed to a number of factors related to the nature of the good for exchange (knowledge), the features of the industry or product market affected by the technology in question, and the characteristics of the parties involved in the transaction.

Forty years ago, Arrow (1962) described in an eloquent paper the problems of appropriability, indivisibility, and uncertainty that hamper the markets of technology. Once an idea is disclosed to a potential buyer, it was argued, the buyer could use the information without paying for it. Subdividing a set of technical knowledge necessary to perform a task into its components is not always straightforward. Uncertainties, both relating to the technology in question and to the relevant product market(s), are rife. Continuing evidence of continuing licensing in technology-intensive industries has, nonetheless, helped maintain analytical interest in the subject, summarized by Caves (1982, 1996), Baldwin and Scott (1987) and Arora, Fosfuri, and Gambardella (2001).

4. The section of this paper on "practitioners' views on technology licensing" will stress that such practices are changing fast.

This section empirically investigates the incentives of firms to license out their technology in the face of so many uncertainties and impediments to technology transfer. The explanatory factors include the characteristics of the organizations involved in the transaction, the characteristics of the industry, the characteristics of the technology, and the nature and strength of the relationship between the licensing partners.

Data

The data used in this analysis originate in the *Innovation Network Databank (INNET)* of the Center for International Science and Technology Policy (CISTP) at the George Washington University. *INNET* features longitudinal information on various types of strategic alliances, US patents, and business performance for many thousands of companies since 1985. For this paper we have used the section on licensing agreements. The basic information has been drawn from the SDC database, described in the section on "licensing in numbers" above and enhanced with longitudinal business performance and patent and patent citation information for each identified company. The analysis relates to licensing agreements announced during the 1990s (1990-1999) between companies traded in US stock markets.

There were 10 069 licensing agreements announced worldwide from 1 January 1990 to 31 December 1999, involving 20 840 participants, corresponding to 8 193 different organizations. Standard & Poor's CompuStat was used to cross-identify companies, thus limiting our sample to companies traded in the United States. Further cleaning and decreased our set to 1 071 licensing agreements with at least two identified participants (a licensor and a licensee) for a total of 2 295 identified participants, corresponding to 985 different companies.

We have concentrated our analysis on the ten most active industry sectors in this dataset, that is, the sectors accounting for the largest number of identified companies (total 786). We have subsequently linked this sample to the NBER patent database to obtain the patenting histories of 552 firms for the period of 1968-1999, also including all patent citations to each patent obtained in the examined time period. For each of these companies we also have business performance indicators from CompuStat. These 552 companies make up our final sample of licensors and licensees.

Table 10.1 provides a full picture of the licensing deals underlying this empirical analysis. It breaks them down by sector (licensor main line of business) using "point-to-point tabulation", counting deals between pairs of companies (a licensor and a licensee). That is to say, a license agreement is counted as many times as there are identified licensees.

This data sample was used to construct a panel in which the unit of observation is the unique firm i – firm *j* pair (dyad). For each year, the dyad data is constructed as follows: f*1*~f*2*, f*1*~f*3*,…, f*1*~f*n;* f*2*~f*1*, f*2*~f*3*,…, f*2*~f*n;* f*n-1*~f*1*, f*n-1*~f*2*, …, f*n-1*~f*n;* f*n*~f*1*, f*n*~f*2*,…, f*n*~f*n-1*, where f*1*=firm *1*,…, f*n*=firm *n*. There are $n \times n\text{-}1$ dyads in each year. Given our n=552 firms, this gives us 304,152 dyads in each year or 3,041,520 year-dyads across the whole time period of 1990-1999.

Table 10.1. **Total number of licenses sold in sample, by industry, 1990-1999**[a]

Industry[b]	All licenses[c]	Non-exclusive licenses	Exclusive licenses	Cross-licenses[d]
SIC 20	9	8	1	1
SIC 28	158	128	30	18
SIC 35	151	147	4	35
SIC 36	182	171	11	49
SIC 37	16	14	2	3
SIC 38	64	53	11	9
SIC 48	12	10	2	2
SIC 73	222	214	8	19
SIC 80	9	9	0	0
SIC 87	27	21	6	1
Total	850	775	75	137

[a] Point-to-point tabulation. A license from one firm to another is counted as one deal. A license agreement is counted as many times as there are identified licensees, *e.g.* nine licensees bought technology from food companies, including an exclusive license and eight non-exclusive licenses.

[b] SIC 20 = Food; SIC 28 = Chemicals; SIC 35 = Industrial Machinery & Equipment; SIC 36 = Electronic & Other Electronic Equipment; SIC 37 = Transport; SIC 38 = Instruments & Related Products; SIC 48 = Communications; SIC 73 = Business Services; SIC 80 = Health Services; SIC 87 = Engineering and Management Services.

[c] Includes non-exclusive, exclusive, and cross-licenses.

[d] Cross-licenses may be either non-exclusive or exclusive.

Model specification

We use a random effects probit model to estimate the probability that firm *i* will license its technology to firm *j* in specific year. Let:

$$P_{ij} = F\,[Z(i,j),\ Y(i),\ L(I),\ Y(j)]\ , \qquad (1)$$

Where:

P_{ij} = probability that licensor *i* will license its technology to firm *j* in year t.
F = cumulative probability function.
I = primary industry of firm *i*.
Z (i,j) = vector of variables describing the relationship between firms *i* and *j*.
Y (i) = vector of characteristics of firm *i*.
L (I) = vector of market and technological characteristics of industry *I*.
Y (j) = vector of characteristics of firm *j*.

Dependent variable

LICENSE$_{ij}$ = 1 if firm *i* licenses one or more technologies to another firm *j* in period t;
= 0 otherwise.

Independent variables

(a) Relationship between firms i and j, Z(i,j).

TECHPROXIMITY$_{ij}$ = degree of similarity in the technological profiles of firms *i* and *j*.

The technological proximity between two firms can be measured by their 'distance in technology space', approximated here by the degree of similarity in their patent portfolios, used as a proxy for technological profile. We borrow from Jaffe (1986) and Branstetter and Sakakibara (2002) to calculate

the technological proximity of two firms using an angle between the firms' patent class portfolios.[5] The anticipated sign of $\boldsymbol{TECHPROXIMITY_{ij}}$ is ambiguous. Firms with similar technological profiles will tend to incur lower transaction costs in technology licensing (Gomes-Casseres, 1993): the transferred technology is easier to master by the licensee, requires fewer modifications by the licensor, and can be implemented faster. On the other hand, similarity in capabilities dampens the incentives of the licensor to go through with the transaction – to avoid creating additional competition – and may result in the imposition of special clauses in terms of exploitation of the technology, which make it less attractive to the licensee.

$\boldsymbol{MARKETPROXIMITY_{ij}}$ = degree of similarity in the market profiles of firms *i* and *j*.

Market proximity can be calculated the same way to technological proximity, save for using the firms' industry portfolios (primary and secondary SIC codes) instead of patent portfolios. Prospective licensors are typically loath to license their technology to firms with similar market profile due to the high potential for creating strong competitors (Gomes-Casseres, 1993). On the other hand, market profile similarity implies lower transaction costs. The expected sign for $\boldsymbol{MARKETPROXIMITY_{ij}}$ is ambiguous.

$\boldsymbol{FAMILIARITY_{ij}}$ = 1 if licensor firm *i* has licensed one or more technologies to firm *j* up to period *t-1*,
= 0 otherwise.

Familiarity between supplier and customer through prior deals typically lowers the costs of the exchange in terms of gathering information about the licensee and about bargaining, writing a contract, and enforcing it. Trust displaces a lot of these costs (Gulati, 1995). Repeated contracts with same partner will build confidence in each partner for the other and will lower the transaction costs of the licensing agreement. A positive sign for $\boldsymbol{FAMILIARITY_{ij}}$ is expected.

(b) Characteristics of firm i, Y(i)

$\boldsymbol{SALES_i}$ = sales of firm *i* in period *t*.

Sales figures have been used as proxy for firm size. Research-oriented startup firms often earn their profits through licensing arrangements with more established, incumbent firms, in commercializing a new technology (Gans and Stern 2000). Indeed, small firms are usually under severe cash flow constraints. In certain industries such as pharmaceuticals the costs of fielding products is very high (clinical trial costs may run into the hundreds of millions of dollars). Small firms (*e.g.* biotechnology companies) often cannot even attempt to market their inventions without assistance from larger established pharmaceutical companies. It may be hypothesized that small firms are pressured to license technologies more frequently than larger companies. On the other hand, large companies may also license a lot because of strategic incentives created by both technology and product market competition. The expected sign for $\boldsymbol{SALES_i}$ is ambiguous

$\boldsymbol{SELEXPERIENCE_i}$ = 1 if firm *i* had sold a license up to period *t-1*.
= 0 otherwise.

Seller (licensor) experience is used as yet another proxy for the transaction cost of licensing. Experience in gathering information about prospective licensees, negotiating, writing contracts and enforcing them will lower the cost of licensing for the seller. This variable allows controlling for unobserved firm level factors. A positive sign for $\boldsymbol{SELEXPERIENCE_i}$ is expected.

5. See Kim and Vonortas (2003) for elaboration regarding the construction of this variable.

(c) Characteristics of industry I, L(I)

CONCENTRATION$_I$ = concentration of industry *I* at *t.*

The 4-firm concentration ratio is used (US Census Bureau, 1992). Low concentration implies that the firms already have many competitors (lower market power) in their primary product market (Caves, 1970). Low concentration can be associated with more homogeneous products among licensors which increases the incentive of a licensor to create another licensee since this action will dissipate this licensor's profit less than it would in a less competitive market. In reverse, high concentration would be associated with higher market power and more differentiated technologies and products among incumbents and, according to theory (Kim and Vonortas, 2003), relatively lower incentives to license out by any one of them. A negative sign is expected for ***CONCENTRATION$_I$***.

GROWTH$_I$ = growth rate of industry *I* at *t*.

The higher the growth rate of industry output, ceteris paribus, the less an entrant's supply will depress industry price and output (Orr, 1974). Accordingly, firms will have a better incentive to license in rapidly growing sectors since rent dissipation due to increased competition with new entrants will be minimized by high growth. A positive sign for ***GROWTH$_I$*** is expected.

INDUSTRY PATENT$_I$ = *Patent / R&D expenditures* of industry *I* at *t* (propensity to patent).

The stronger the intellectual property protection (IPR), the better the ability of the licensor to capture a larger share of the rents generated from the licensed technology, ceteris paribus. Strong IPR protection can be considered as the remedy for the well-known "appropriability problem" in the market for technology. Further, Merges (1998) argues that transaction costs of technology licensing are negatively related to the strength of patent protection. To counteract the licensee's incentive to shirk payment in the case of weak IPR protection the licensor's costs for monitoring and enforcement will increase. Strong IPR protection, then, would seem to enhance the efficiency of technology transfer and the incentives to license (Anand and Khanna, 2000). Patent-intensity is used as a proxy of the strength of intellectual property protection as perceived by the members of an industry (ratio of the total number of patents in a firm's primary two digit SIC industry divided by total R&D expenditures in that industry). The expected sign for ***INDUSTRY PATENT$_I$*** is positive.

COMPLEXITY$_I$ = 1 if *I* is a complex product industry;
= 0 otherwise.

Cohen *et al*. (2000, 2002) distinguish between "complex" and "discrete" product industries on the basis of whether a new product is comprised of numerous separately patentable elements or relatively few. For example, electronic products typically are comprised of a relatively large number of patentable elements, and are thus characterized as complex. In contrast, new drugs or chemicals are comprised of a relatively discrete number of patentable elements (often a single formula) (Rycroft and Kash, 1999). As a result, simple technologies can be better protected (strong IPR) whereas complex technologies may be easier to invent around (weak IPR). We use SIC 35 as a crude cut-off point between complex product industries (35 and above) and simple product industries (below 35). As defined, simple product industries include ferrous and non-ferrous metals, chemicals, petrochemicals, drugs, food, tobacco, and so forth. Complex product industries include machinery, computers, electrical equipment, scientific instruments, and all kinds of services. Better IPR protection – meaning easier enforceable, *i.e*. less expensive per product – raises the prospects of licensing. A negative sign for ***COMPLEXITY$_I$*** is generally expected.

$\boldsymbol{GPT_I}$ = 1 if industry *I* can be described as ICTs, biotechnology, or advanced materials;
= 0 otherwise.

Information and communication technologies (ICTs), biotechnology, and advanced materials have "infrastructural" characteristics. They have penetrated the economy during the past two to three decades, dramatically altering the basic meaning of high technology. Rather than referring to the output of R&D-intensive industries, high tech now refers to a style of work applicable to just about any business (Branscomb and Florida, 1998; Porter, 1998). The penetration of these so-called general purpose technologies has gradually shifted the locus of high technology production from exclusively manufacturing to a combination of manufacturing and service industries. Technology is rapidly transforming the nature of the products of both sectors (Hauknes, 1998; Leech, *et al.*, 1998; OECD, 2000). We would, as a result of widespread use, expect these technologies to be licensed more widely than others. A positive sign of $\boldsymbol{GPT_I}$ is anticipated.

We have used the classifications from the database CorpTech (Corporate Technologies, 1999) which classifies industries by functional sector (*e.g.* energy, biotechnology, advanced materials) as well as by SIC and maps one into the other.

(d) Characteristics of firm j, Y(j)

$\boldsymbol{SALES_j}$ = sales of firm *j* in period *t*.

Large firms typically have substantial production, marketing, and organizational capabilities. They thus present higher risks in terms of becoming strong competitors with the licensor once they get access to the technology. This clearly dampens the incentive to the licensor. On the other hand, there is evidence that a significant share of licensing takes place between small licensors and much larger licensees (*e.g.* biotech, pharmaceuticals). The expected sign for $\boldsymbol{SIZE_j}$ is ambiguous.

$\boldsymbol{BUYEXPERIENCE_j}$ = 1 if firm *j* had bought a license up to period *t-1*.
= 0 otherwise.

Licensee experience is used as another proxy for the transaction cost of licensing. Experience in gathering information about technologies and their proprietors, negotiating, writing contracts and enforcing them will lower the cost of licensing. This variable allows to control for unobserved firm level factors. A positive sign for $\boldsymbol{BUYEXPERIENCE_j}$ is expected.

Tables 10.2 and 10.3 below provide descriptive statistics of the variables and the correlation matrix respectively.

Table 10.2. **Descriptive statistics of variables**

Variable	Mean	Standard deviation	Minimum	Maximum
<Dependent variable>				
$LICENSE_{ij}$	.0003092	.0175825	0	1
<Independent variables>				
(Relationships between firms)				
$TECHPROXIMITY_{ij}$	.1397481	.2472855	0	1
$MARKETPROXIMITY_{ij}$	.0605045	.1724845	0	1
$FAMILIARITY_{ij}$	.0005379	.0231875	0	1
(Characteristics of firm *i* and industry *I*)				
$SALES_i$	4690.829	15033.41	0	174694
$SELEXPERIENCE_i$	.5013513	.4999983	0	1
$CONCENTRATION_I$	33.14979	15.94718	3.9	69.4
$GROWTH_I$	5.330143	5.555488	-7.78342	15.54192
$INDUSTRY\ PATENT_I$	.2397743	.1184148	.0386	.6134
$COMPLEXITY_I$	.7553365	.4298876	0	1
GPT_I	.5731234	.4946242	0	1
(Characteristics of firm *j*)				
$SALES_j$	4690.829	15033.41	0	174694
$BUYEXPERIENCE_j$	.4188691	.493374	0	1

Table 10.3. **Correlation matrix**

Variables	*1.*	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*	*8.*	*9.*	*10.*	*11.*	*12.*	*13.*
1. $LICENSE_{ij}$	-												
2. $TECHPROXIMITY_{ij}$	.044	-											
3. $MARKEPROXIMITY_{ij}$	.038	.316	-										
4. $FAMILIARITY_{ij}$	.063	.047	.038	-									
5. $SALES_i$	.012	.1	-.03	.006	-								
6. $SELEXPERIENCE_i$	.02	.036	.067	.047	.133	-							
7. $CONCENTRATION_I$	-.004	.011	-.053	-.009	.268	-.02	-						
8. $GROWTH_I$	.005	.034	-.004	.009	.108	.022	.172	-					
9. $INDUSTRY\ PATENT_I$	.003	-.008	-.026	-.004	-.191	.054	.154	.272	-				
10. $COMPLEXITY_I$	-.006	-.066	.009	-.005	-.022	.066	.095	.19	.128	-			
11. GPT_I	.004	-.014	.04	.007	-.064	.05	-.423	-.067	-.327	-.206	-		
12. $SALES_j$	.016	.1	-.035	.028	-.004	-.001	-.001	.002	.0008	-.000	.003	-	
13. $BUYEXPERIENCE_j$	.024	.078	.043	.055	-.002	.005	.001	-.028	.0006	-.002	-.001	.27	-

Estimation

Table 10.4 presents the estimation results. Three different models are presented with different sets of explanatory variables. Model 1 uses the variables indicating the relationship between firms *i* and *j* (*Z(i,j)*). Model 2 adds the characteristics of firm *i* and industry *I* (*Y(i)+L(I)*). Model 3 adds the characteristics of firm *j* (*Y(j)*) (complete model).

Table 10.4. **Random effects Probit estimates of the likelihood of firm *i* licensing to firm *j* in period 1990-1999**

$LICENSE_{ij}$	*Model 1*	*Model 2*	*Model 3*
$TECHPROXIMITY_{ij}$	.977** (.112)	1.087** (.137)	1.084** (.159)
$MARKETPROXIMITY_{ij}$	.692** (.137)	.739** (.163)	.818** (.19)
$FAMILIARITY_{ij}$	1.232** (.243)	.99** (.255)	.658** (.272)
$SALES_i$	_	7.01e-06** (2.29e-06)	7.96e-06** (2.49e-06)
$SELEXPERIENCE_i$	_	.345** (.087)	.36** (.096)
$CONCENTRATION_I$	_	-.819* (.462)	-.981* (.517)
$GROWTH_I$	_	.009 (.009)	.007 (.009)
$INDUSTRY\ PATENT_I$	_	1.357** (.502)	1.454** (.558)
$COMPLEXITY_I$	_	-.083 (.137)	-.019 (.164)
GPT_I	_	.094 (.103)	.122 (.115)
$SALES_j$	_	_	5.07e-06** (2.37e-06)
$BUYEXPERIENCE_j$	_	_	.439** (.1)
Constant	-3.738** (.06)	-4.159** (.262)	-4.764** (.386)
N	3041520	3041520	3041520
Log likelihood	-517.577	-412.492	-349.896

** Significant at the 5% level; * significant at the 10% level; Standard errors are in parentheses.

Nine out of the twelve explanatory variables are statistically significant. Specifically, three of the four sets of explanatory variables are fully statistically significant, including all those that describe the relationship between the contracting firms and their characteristics (*Z(i,j), Y(i), Y(j)*). All three non-significant variables belong to the set describing the characteristics of the primary industry of the licensor (*L(I)*). Moreover, eleven out of the twelve explanatory variables have the anticipated signs. No signs reverse across models and the size of the coefficients remain relatively stable.

The most important explanatory factors of the probability that two firms will engage in a technology agreement as a licensor and a licensee relate to the relationship between the two companies (*Z(i,j)*) and the characteristics of each *((Y(i), Y(j))*. All seven variables in these three sets are highly statistically significant (5% level). According to Table 10.4, companies engage in licensing agreements the closer they are in terms of both technological and market profiles and the more familiar they are with each other, that is, the larger their past interaction in terms of technology licensing ($TECHPROXIMITY_{ij}$, $MARKETPROXIMITY_{ij}$, $FAMILIARITY_{ij}$). The implication here is that the effect of lower licensing transaction costs dominates the more strategic consideration of creating additional competition in one's own business area. While such a result may cause game theorists to pause for a minute, case study and anecdotal evidence has indicated for a long time that licensors are loath to sell their latest technologies. They will typically sell one or two generations-old technologies

(*e.g.* Caves, 1982). If so, the competition disincentive loses a lot of its power as an explanatory factor of licensing while cost factors gain.

The cost incentive for licensing is further reinforced by the significant and positive influence of prior experience with licensing agreements for both the licensor and the licensee ($SELEXPERIENCE_i$, $BUYEXPERIENCE_j$). Company size is also found a statistically significant factor ($SALES_i$, $SALES_j$): the chances for two firms to meet in a licensing agreement increases with their size.

The explanatory power of the characteristics of the primary industry of the licensor was somewhat of a disappointment. Of the five variables in this set, one was highly statistically significant ($INDUSTRY\ PATENT_I$) and a second was significant at the 10% level ($CONCENTRATION_I$). We interpret these results to mean that the most important factor at the industry level in determining the probability of two firms to meet in a licensing deal is the patent intensity in the main line of business of the licensor. Patent intensity is used here as a proxy for the strength of intellectual property protection perceived by the company. If the link between patent intensity and the strength of IPR protection in an industry is strong – as the literature has tended to imply (Anand and Khanna, 2000; Levin *et al.*, 1987) – then, this result further reinforces our cost findings above: the strength of patent protection lowers the transaction cost of technology licensing, thus raising the incentive to sell technology, enhancing the set of candidate technologies for sale, and raising the probability that two firms meet in licensing deals.

A second important industry-level determinant is the extent of competition: lower concentration levels in the licensor's primary sector are associated with higher probabilities that two firms meet in a licensing agreement. To the extent that larger numbers of competitors can be associated with more technological homogeneity, this result reflects theoretical predictions of higher incentives that more technological homogeneity among technology owners will raise the incentives of each one of them to license out technology (Arora and Fosfuri, 2003; Kim and Vonortas, 2003).

Finally, the rate of growth of the primary sector of the licensor ($GROWTH_I$), the degree of technological complexity in that sector ($COMPLEXITY_I$), and the classification of that sector into the so-called general-purpose technology category (GPT_I) did not produce statistically significant results. Still, all estimated coefficients for all of them come with the anticipated signs, indicating that the higher the growth rate, the better the ability to appropriate technology, and the reference to a general-purpose technology increase incentives to license and the probability that two firms meet in the market for technology.

Practitioners' views on technology licensing

It will come as no surprise to argue that numbers cannot tell the full story. In an effort to identify important strategic and policy issues affecting technology licensing, we embarked on a series of interviews with eight experts on intellectual property protection and licensing, including patent attorneys and representatives from industry and universities. At least one of the interviewed experts has held top public office related to intellectual property protection in his respective country. Others have had extensive exposure with public sector agencies, quasi-public organizations and think tanks. Five OECD member countries were represented: Belgium, France, the Netherlands, the United Kingdom and the United States.[6]

6. The interviewees included: Bert Bohlander (Netherlands), Gilles Capart (Belgium), Laura MacDonald (United Kingdom), John Mack (United Kingdom), Gerald Mossinghoff (United States), William Player (United States), Thierry Sueur (France), Paul van Grevenstein (Netherlands). These experts were interviewed

The interviewed experts addressed a large number of issues that can be broadly grouped into *i)* broad effects, *ii)* universities, *iii)* legal issues/costs, and *iv)* systemic features/costs - harmonization. Their views are presented below in an edited and condensed form.

- Licensing has become a strategic activity in intellectual property asset management (IPAM). Patents have emerged as a very important IPAM tool.
- IPAM practices vary between sectors, especially between sectors where patents have traditionally played an important role, such as pharmaceuticals, and sectors where they have not, such as electronics.
- IPAM success critically depends on the professionalization of the activity and of the personnel involved in it. The system is still characterized by a certain degree of amateurship, reflected in lack of widespread appreciation of the value of IPR management, frequent inability to appraise the true value of knowledge for sale/exchange, and hasty agreements on detrimental licensing contracts such as "pipeline deals".
- In recent years, a good number of European universities have gotten more interested in actively managing their intellectual property. They have also tried to be more organized in terms of targeting customers and selling technologies.
- Still, there seems to be a wide chasm in the mindset of Europe and the United States. Skeptics have influenced much more European policy makers than US policy makers. With the exception of large corporations, European firms are still largely unaware of the value of patenting and, especially, patenting as part of a consistent strategy for revenue/profit enhancement.
- Established companies will tend to avoid licensing out their core technologies. They will also feel very protective of their later-stage research. Licensing out for such companies may be confined to either the results of early-stage research or to relatively peripheral (small expected market or older generation) technologies.
- Patents assist small companies to obtain financing. They also assist established companies to strike collaborative agreements. Similarly for universities whose technologies will typically need additional work before being licensed out.
- Larger companies have, on average, been the preferred customers for universities. They are considered more reliable, less costly to deal with, and able to take faster decisions regarding university collaboration. Small and medium-sized enterprises (SMEs) are considered more of a gamble for the licensing university due to uncertainty regarding the market they will be willing/able to reach. Moreover, SME motivation for licensing may be complex, driven by financial considerations rather than a genuine interest in developing a technology.
- It is critical for the organization (university) to clearly know what it wants to get out of the technology transfer activity. If income is it, then start-ups may be a reasonable bet. If maximizing the chances of commercializing the technology is it, licensing out to larger companies may be preferable. Available evidence indicates that, if you have the mass, equity has higher long-term returns than licensing.

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as individuals rather than as representatives of their respective organizations: these comments only reflect are their own views and experience. Possible misunderstandings and/or misrepresentation of their opinion are fully our responsibility.

- From industry's point of view, the Bayh-Dole Act and other legal obligations imposed on universities in the United States have made them more difficult as partners: they have lost some of their flexibility when dealing on intellectual property. More assertive (some say aggressive) attitude could prove detrimental in the longer term as it may limit company interest in university research. European universities reportedly still take a more flexible approach to collaborating with industry, but this may be disappearing as formal IPAM techniques are introduced.
- US patent litigation tends to be very expensive and difficult for foreigners. US companies also face complications abroad. Enforcement of IPRs in Europe is, for example, complicated there due to market/legal fragmentation.
- Seen from abroad, a first-rate innovation system in the US is coupled with a seemingly daunting intellectual property protection system. The potential rewards of participating are high: some of the best research is undertaken that country. The costs are also high, driven by frequently overly aggressive technology owners, an aggressive and litigious legal profession, and very expensive procedures for resolution of IP disputes. Even the largest foreign companies may occasionally feel intimidated. Smaller companies, especially foreign ones, are reportedly at a disadvantage.
- Complications of internationality include the cost for achieving worldwide protection, enforceability, apparent bias against smaller companies (due to uncertainties and high aggregate costs for achieving a satisfactory degree of protection), and cultural differences in negotiating and executing. International intellectual property system harmonization could assist technology licensing by decreasing transaction costs.
- The establishment of the Community patent will be a significant step in the direction of harmonization. It reportedly costs more than Euro 100,000 to patent across Europe (all signatory countries of EPO). This cost is excessive for small firms – they must be selective. A US patent may cost as little as one-fifth of a (pan-)European patent. Thus, for a company with a strategy to make money from (selling) intellectual property, it makes sense to file for patent and license only in the United States, with the exception of blockbusters.
- There is a widespread impression that the patent systems around the world supporting technology licensing are currently in crisis:

  a) The number of patent applications is rising fast. In fiscal year 1981, for example, 114 710 patent applications were filed and 71 010 patents were granted in the United States. Twenty years later the number had more or less trebled. In fiscal year 2001, 344 717 patent applications were filed and 187 822 patents were granted in the United States. Similar problems afflict the European Patent Office which was originally designed to handle something like 30 000 patents per year and it is currently handling five or six times that number.

  b) Rising volumes and less than proportionate rise in operating budgets (diversion of funds) has strained the system resulting in increasing pendency time and, under pressure to avoid that, falling quality of granted patents.

  c) The cost of obtaining and enforcing worldwide patent protection has risen to levels that can only be afforded by the largest multinational corporations. The senior counsel of a major pharmaceutical company estimated the cost to obtain comprehensive worldwide protection for an important chemical compound between USD 750 000 and USD 1 million in 1997, growing at a rate of 10% per year.

- The benefits of moving to a global patent system notwithstanding, such a change requires the prior resolution of significant problems. One problem is the first-to-invent vs. first-to-file controversy. Another is the definition of patentable subject matter affecting important activities such as software and business methods. A third is enforceability of intellectual property rights.

Conclusion

We conclude that licensing agreements have tended to follow aggregate alliance trends in terms of time evolution and in terms of broad sectoral allocation. Manufacturing and service sectors have accounted for the bulk of both the recorded surge and the subsequent slowdown in licensing agreements in the 1980s, 1990s and later years. Wholesale trade and finance and insurance followed at some distance. The vast majority of entities participating in licensing agreements are from the private sector.

The most important explanatory factors of the probability that two companies will engage in a technology licensing agreement relate to the relationship between them and to the characteristics of each. Companies will tend to engage in licensing agreements:

- The closer their technological profiles.
- The closer their market profiles.
- The more familiar they are with each other through prior agreements.
- The higher their prior independent experience with licensing.
- The stronger the intellectual property protection in the primary line of business of the licensor.

All these factors affect licensing transaction costs. While theoretical work in industrial economics has instead tended to concentrate on strategic, competition-related factors operating on within-industry licensing, this analysis shows that transaction cost factors tend to weigh in more heavily in explaining licensing behavior across sectors.

Licensing has occupied a strategic position in intellectual property asset management (IPAM). IPAM practices vary between sectors, especially between sectors where patents have traditionally played an important role, such as pharmaceuticals, and sectors where they have not, such as electronics. In recent years, universities in OECD countries have become more interested in actively managing their intellectual property. They have also tried to be more organized in terms of targeting customers and selling technologies. Companies large and small have developed increasingly sophisticated IPAM strategies.

Yet significant differences remain between countries in terms of IP protection practices, the cost of such practices, and the pursuit of licensing as an IPAM mechanism. There is a widespread impression that the patent systems around the world supporting technology licensing are currently in crisis and that the benefits of moving toward a global patent system will be quite substantial. Such a development will, however, require the prior resolution of significant complications.

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Chapter 11

COMMENTS ON PATENTS, ENTREPRENEURSHIP AND TECHNOLOGY DIFFUSION

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This paper provides comments on seven of the issues discussed at the sessions of the conference focusing on patents, entrepreneurship and technology diffusion: 1) *technology diffusion and access;* 2) *converging technologies;* 3) *changing environment for information production and dissemination;* 4) *potential clash of IP cultures and practices;* 5) *working solutions;* 6) *new S&T complexity; and* 7) *new paradigm for innovation.*

Technology diffusion and access

Until recently, technology diffusion and access have received less attention and less empirical study than the standards for whether certain inventions merit patent protection. We have focused disproportionately on the first prong of the patent social contract from the economic perspective of public goods – that without appropriate patent incentives, we will underinvest and too little information will be produced. We have tended to lose sight of the second prong of the traditional social contract – that, in exchange for the right to use the power of the state to prevent others from making, using, selling or offering to sell the invention, the patentee must provide a detailed description of the invention available to all, plus all the information necessary to reproduce the invention and the best means of using it. As our economic friends remind us, if the innovations that result from patent incentives are not widely disseminated or adequate access is denied, it may result in a situation that is less socially beneficial than one where there are fewer patentable inventions but they are distributed more broadly.

Technology diffusion, access and dissemination merit the same intensive policy attention that we have been paying to questions about the patentability of gene sequences or software business methods or the implications of the quality of patents and patent litigation on innovation and economic performance. As Thane Kreiner made clear in describing Affymetrix's success in the life sciences (see Chapter 9), the issues related to diffusion, access and dissemination are every bit as important for the business community as they are for other stakeholders.

Converging technologies

Much of the cutting-edge research that will provide the economic and social drivers for the future – such as biotechnology, nanotechnology, alternative energy sources, new security technologies, and advanced IT and cyberinfrastructure – increasingly occurs at the borders of disciplines and business sectors where they interface each other. Revolutionary advances at the interfaces between previously separate technological and economic spheres, combined with the increased blurring of traditional roles among universities, government, and industry, will transform traditional disciplines, business models and government policies. And, in some cases, such as nanotechnology or the revolution in the life sciences that Thane Kreiner described so well these interfaces create new and emerging fields. They, in turn, forge entirely new strategies and models for discovery-based inquiry, for creating patentable inventions or other forms of intellectual property, and for generating new products, services and markets that propel economic growth and meet evolving social needs.

Intellectual property rights will play a critical role not only with the development of each new technology but also with the convergence among them. As a result, it is essential that we get "ahead of the curve" and prepare policymakers for the changes made possible by converging technologies and for the legal and regulatory framework of IPRs required to realize their enormous promise.

Changing environment for information production and dissemination

Intellectual property rights do not operate in a vacuum. The dynamics of information production and dissemination are context-dependent, and those contexts are shifting rapidly. We lack empirical evidence about what policy frameworks and measures best promote the interface between discovery and translational research and innovation and economic performance, especially in fields marked by multi-disciplinary and multisectoral approaches. In the life sciences, for example, the growing shift from primarily discovery-oriented inquiry by individual investigators to "big biology" that tackles

larger, more complex problems with multiple teams using a range of new tools and approaches has important consequences for the appropriate role of IPRs as an enabling mechanism for innovation.

Potential clash of IP cultures and practices

The emergence of these potentially revolutionary new technologies and the importance of the interface between them also raises a related set of interesting questions about the possibility of an increasing clash of IP cultures and practices. The life sciences revolution related to human health now includes the pharmaceutical industry, the biotechnology sector, a growing number of information technology firms (software, hardware, cyberinfrastructure and data), producers of sophisticated enabling equipment (such as mass spectrometers, arrays, and molecular imaging), research universities and academic medical centers, and a range of service sectors such as contract research organizations.

Many of these converging sectors traditionally have employed different approaches to IPRs, licensing or technology diffusion than some of the others. In addition, the life sciences, in many ways, have become an information science. The IPR experience, corporate strategies, and policies of innovative leaders like IBM Life Sciences, Affymetrix and General Electric Healthcare are likely to be very different from those of the leading pharmaceutical and biotechnology companies focused on new therapeutics and diagnostics. And, as others papers at this workshop have shown, there also are very large differences among the larger firms and many small start-up companies in the life sciences whose principal current asset and attraction for raising capital may be their intellectual property portfolio.

Of course, when we add the full range of public entities, universities and non-profit organizations to the mix of life science innovators, the potential for IPR "cultural clashes" increases even further. Now, therefore, is the time to anticipate the full range of likely IPR policy issues created by these developments and to plan an integrated, forward-looking approach that will yield optimal results for innovation and for society.

Working solutions

We also need to pay closer attention to changing institutional relationships and the evolving roles of different intellectual property rights, individually and collectively, in an increasingly complex innovation system. It no longer is just an issue of the scope, quality and effectiveness of patents, though they remain critical issues. Increasingly, what drives innovation is the bundle of intellectual property rights, including trade secrets and tacit knowledge.

Wes Cohen and John Walsh's presentation at this conference provides us with a rich and nuanced understanding about "working solutions" with a wealth of empirical evidence.[1] Its insights and scope suggest that, despite many of the legitimate theoretical concerns about the "tragedy of the anticommons" for intellectual property and the potential adverse effects on follow-on research and diffusion in cumulative technologies when broad patents are granted too early or too upstream, the current evidence reveals remarkably few current obstacles that cannot be overcome without exacting burdensome transaction costs or other negative offsets to the incentives and other benefits provided by the patent system.

1. Available at *www.oecd.org/sti/ipr*. Presentation based on J.P. Walsh, W.M. Cohen and A. Arora. (2003), "Patenting and Licensing of Research Tools and Biomedical Innovation", pp. 285-340 in S. Merrill, R. Levin and M. Meyers, eds., *Patents in the Knowledge-Based Economy*, Washington, DC: NAP.

Cohen and Walsh have provided a number of helpful explanations for why this occurring. I would suggest that another important explanation rests with the complex and changing web of relationships among universities, non-profits, companies, private firms and government ministries and laboratories. Our knowledge-based economy increasingly depends on the collaborative creation, transmission and use of new inventions for a variety of public and private purposes. Research universities, business and governments all begin the 21st century in a very different knowledge, economic and social context from what existed even ten years ago. Some have called it the "triple helix" in which each institution, to some extent, can play certain roles traditionally associated with one of the others and the traditional boundaries between them continue to blur.

Interdependence, multi-disciplinary research and a nonlinear innovation system mark the new approach. The interface between science and innovation is being transformed. Innovation increasingly depends on the intensity and effectiveness of the interactions and information flow among universities/non-profits, industry and governments – as well as across disciplines, traditional sectors and national boundaries. The growing mutuality of interest helps to foster an atmosphere of "let's work it out". A few years ago, a favorite management consulting buzzword was "co-opetition" – a combination of cooperation and competition. We are seeing a lot of co-opetition with respect to intellectual property rights.

New S&T complexity

Rapid developments and shifts in the underlying science and technology in the life sciences, nanotechnology, advanced IT and energy are creating what I will call "the new complexity" that complicates traditional views about the IPR/technology innovation policy framework.

Dr. Kreiner made a number of insightful and critical points about the changing landscape for the life sciences that merit particular attention. Many of the questionable patent applications for gene fragments, probes and the like were filed at a time only a few years ago when most scientists still thought in terms of the "one gene-one protein" dogma in molecular biology and believed a straight-forward linkage would exist between knowing the gene, finding "the" protein it encoded and linking it to targets and disease. We've learned it is a lot more complicated, and the current dogma focuses much more heavily on systems biology and complex networks and pathways.

Our evolving understanding about the complexity of protein switches, genetic-environmental interactions, molecular signaling networks, and metabolic pathways – including the critical "second order of discovery" issues described by Dr. Kreiner – demonstrate these trends. Like old generals, to some extent the intellectual policy debate is fighting the last was and not keeping up with the pace of scientific and technological change, or with the rapid shifts in business and organizational models to take advantage of what we now are learning.

New paradigm for innovation

Innovation today is a nonlinear process. Much of our current policy discussions about intellectual property and innovation remains wedded to the outdate notion of a linear model of innovation that no longer fits current realities. Prof. Cohen has noted this trend in some of his other research. A growing body of evidence confirms that innovation increasingly is the outcome of a complex, non-linear and highly uncertain process that requires collaboration among multiple parties across disparate fields.

As a result of this ongoing shift in the prevailing paradigm, the focus of policy attention and empirical investigation need to shift much more extensively to what I will call the "soft IPR infrastructure" surrounding dissemination and access. By this I mean context, informal linkages, the intersection of patentable inventions tacit knowledge and other types of IPR, knowledge clusters and the role of informal or ad hoc networks.

Innovation now is best viewed as a process rather than a product, and this view has profound implications for developing appropriate IP policies. We continue to focus on input-output indicators because that is what we can measure more easily and we are more used to dealing with them. The OECD and others need to help us develop new empirical methodologies to understand and to explain the full range of factors, including: *1)* patents and the diffusion of technology; *2)* knowledge transfer mechanisms and new organizational structures; *3)* capacity-building tools for enabling truly multi-disciplinary approaches to problem-solving and for promoting economic development; and *4)* the creation of ad hoc and informal networks that serve as innovative agents and ways to connect cumulative technologies.

For example, some recent research suggests that we need to be concerned not only about how intellectual property policy affects incentives and transaction costs of combining fragmented rights but also how this affects organizational modes and structures. In multi-inventor contexts with cumulative technologies and downstream innovation or collaborations that cut across disciplines, the policy implications of intellectual property rights cannot be analyzed independently from organizational considerations. Some, like Somaya and Teece, even have suggested that strong patent rights in emerging technologies may be desirable as a means to shift organizational approaches and to increase the range of strategic collaborations or relationships that are available for voluntarily and efficiently overcoming some of the transaction costs we have been discussing.[2]

2. D. Somaya and D.J. Teece (2000), "Combining Inventions in Multi-Invention Products: Organizational Choices, Patents and Public Policy", Haas School of Business CCC Working Paper No. 99-4.

PART 4

INTELLECTUAL PROPERTY RIGHTS FOR SOFTWARE AND SERVICES

Chapter 12

THROUGH THE LENS OF INTANGIBLES: WHAT PATENTS ON SOFTWARE AND SERVICES REVEAL ABOUT THE SYSTEM

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The expansion of the patent system to embrace intangible inventions, including software and business methods, provokes continued controversy, even in the United States where the specialized patent appeals court has left few if any limits on the scope of patentable. Yet while software and business method patents overlap to some degree, they embody two distinctly different deviations from the more optimal conditions that prevail for pharmaceuticals and chemicals.

The software problem can be described as the extreme functional complexity that results from the ease and dispersion of software creation. Although software appears to be an extreme case because of the way it is produced and distributed, the FTC/DOJ hearings in California show that phenomena associated with software actually pervade the IT sector: patent thickets, independent invention, inadvertent infringement, and hold-up.

The business method problem by contrast is associated with broad abstract patents that preempt all implementations. They therefore look more like formidable monopolies rather than discrete pieces of technology-based property that can be circumvented with other technology. As such, US-style business methods have engendered opposition in Europe and among other WIPO members.

The expansion of patentable subject matter to embrace intangible inventions highlights the dangers of the one-size-fits-all ideology that is at least partially embedded in TRIPS. While one-size-fits-all is superficially appealing for administrative reasons, it is likely to lead to divergence in application, practice, and results. Because there is no economic monitoring of the patent system, there is lack of transparency and accountability. In particular, there is no official accounting of the rise of strategic patenting and its effects on market entry and competition.

In the United States, the problems of software and business methods are commonly portrayed as part of a general "quality" problem that could be resolved if more resources were available for examinations. However, the difficulty of locating prior art is only one aspect of the larger problem of overpatenting, which is driven by institutional and market forces that push for lower standards, expanded scope, and greater volume, independent of results and against social, economic, and political considerations that have no role in the mechanics of the patent system.

Introduction

The problem of intangibles has been described in terms of the growing discrepancy between the market value of firms and the book or replacement value of tangible assets. It is commonly estimated that intangible assets now account for around two-thirds of stock market value, although it is nearly impossible to measure them directly. In the absence of quantitative information, investors must turn to qualitative information.

The analogous problem for public policy is that as knowledge becomes increasingly central to the creation of economic and social value, we know relatively less and less about how this works since we cannot measure knowledge directly. Patents are a primary policy tool for creating new knowledge, and their role appears to be growing in many ways, but we still have little information on how patents work in practice, or indeed whether they work productively or counterproductively in different situations. Patent policy is shaped by legal and political argument with no institutionalized economic oversight.

While patents have always been about knowledge, it has been knowledge about material things. The system grew up under very different circumstances – in an industrial economy in which new knowledge was relatively scarce and concentrated within a manageable universe of firms and institutions. Within the last two decades, patents have expanded into the realm of intangibles: software, financial instruments, business processes, information formats, diagnostic information, business models, and services. Patents have become intangible rights in intangible knowledge about intangibles – in a globalized economy in which intangibles can be delivered, accessed, and manipulated instantly to and from anywhere.

In the United States, there are no longer any practical limits to patentable subject matter beyond the utility test (Thomas, 1999*a*). Nonetheless, debate continues on the advisability and scope of software patents and "business method" patents, with continual quarreling as to how these terms are defined.[1] The European Commission's proposed directive speaks of "computer-implemented" inventions rather than software patents, and much of the debate in Europe is focused on how the technicity requirement should be formulated. Software patents and business method patents overlap since most new business processes are implemented in software. For example, the Amazon one-click patent[2] can be characterized as a broad, high-level software patent or as a business method patent.

Despite this confusion and overlap, software and business methods present two distinctly different structural problems for the patent system. While the two problems are not unique to these areas of activity, they reach extreme manifestations that reveal the inherent weaknesses and contradictions of a monolithic system. They illustrate the gap between rule-based legal practice within an isolated problem/solution framework and the results-oriented economic analysis and policymaking characteristic of other forms of market intervention.

1. See Brian Kahin, presentation entitled "Patentable Subject Matter – Business Method and Software Patents" FTC/DOJ Hearings, 11 April 2002, transcript at 12-20, available at:
   www.ftc.gov/opp/intellect/020411trans.pdf
   (Slides available at *www.ftc.gov/opp/intellect/020411briankahin.pdf*).

2. US Patent No. 5,960,411 (issued 28 September 1999).

The software problem

Contrary to views of some lawyers, the "software problem" is not about the difficulty of distinguishing between software and hardware implementations of a particular solution. Rather it is a practical problem of granularity and numbers. The creation of software is not an industrial process but the authoring of text that defines and implements functionality, and this hybrid character underlies a longstanding debate over appropriateness of copyright versus patent – or the desirability of some *sui generis* form of protection (Samuelson *et al.,* 1994). From a practicing lawyer's perspective, this debate is a false dilemma, easily resolved by allowing copyright and patent to cover different aspects of software. In this view, protection is positive and additive, but it does not account for costs or possible conflict with the economic processes of software production and distribution - especially given that patentable subject matter is created at an intensely prolific level by tens of millions of developers and programmers working around the globe.

The ease of writing software results in an extreme degree of aggregate functionality, perhaps tens of thousands of claimable processes in a marketed product. With its delays and resource-intensive processes, the monolithic patent system cannot readily assimilate functional output on this scale, especially without searchable documentation and metadata.[3] This leads to divergence between the expressed knowledge of patent disclosures and claims - and vast undocumented flows of both tacit knowledge about software and explicit knowledge encoded in software.

As the recent hearings held by the US Federal Trade Commission (FTC) and the Department of Justice (DOJ) show, these problems may be extreme for software, but they actually pervade the ICT sector.[4] As Frederick J. Telecky of Texas Instruments (TI) put it: *"TI has something like 8000 patents in the United States that are active patents, and for us to know what's in that portfolio, we think, is just a mind-boggling, budget-busting exercise to try to figure that out with any degree of accuracy at all."*[5] If a company with TI's resources cannot assess what they have in-house, it is difficult to expect a small company entering a market to evaluate what claims they may be facing.[6]

Other hearing participants point to the systemic failure of the disclosure function. Robert Barr of Cisco describes the problem: *"[T]here are too many patents to be able to even locate which ones are problematic. I used to say only IBM does clearance … but IBM tells me even they don't do clearance searches anymore."*[7] This may seem surprising given the increased power of patents, but by applying for patents and building large portfolios, companies hope to be able to counter patent threats and address unexpected patent problems as they arise. This avoidance of patent information is justified in

3. Most of this lost in source code compilation, and in conventional published software, the vendor normally seeks to restrict access to the source code.

4. Federal Trade Commission, *Competition and Intellectual Property Law and Policy in the Knowledge-Based Economy*, available at *www.ftc.gov/opp/intellect/index.htm*.

5. FTC/DOJ hearings, 28 February 2002, transcript at 743, available at *www.ftc.gov/opp/intellect/020228ftc.pdf*

6. See, for example, comments of James Pooley, partner, Milbank, Tweed, Hadley & McCoy, at FTC/DOJ hearings, 27 February 2002, transcript at 380, available at *www.ftc.gov/opp/intellect/020227trans.pdf*:

   …in my experience in the software industry we have a kind of business that's easy to enter, but where you enter with sometimes an overwhelming sense of dread because you don't know how many pieces of IP you will need in order to operate.

7. Robert Barr, Remarks at the FTC Roundtable, "Competition, Economic, and Business Perspectives on Substantive Patent Law Issues: Non-Obviousness and Other Patentability Criteria" (30 October 2002), at 81, available at *www.ftc.gov/opp/intellect/021030trans.pdf*.

part by the need to avoid charges of willful infringement, which can adversely influence juries and expose an infringer to treble damage awards.[8]

There is too much information in part because there are presently too few opportunities and incentives to correct information deficiencies in the system, including a largely unrecognized free rider in invalidating patents (Thomas, 2001). Strong incentives to settle mean that prior art is suppressed so that questionable patents can remain in force.[9] Early publication is now required for most patent applications, which gives competitors the opportunity to submit prior art, but the Patent and Trademak Office (PTO) receives very little prior art in response to published applications.[10]

Paradoxically, the patent information problem in software is mitigated in part by the fact that so much software functionality is in the public domain, either because it was developed before patenting was permitted and became common practice – or because in many cases developers do not find it worthwhile to patent every possibly patentable function.[11] However, the sheer scope of functionality that can be defined in software combined with ease of creation means that independent invention is likely. The probability that prior art exists somewhere further limits the value of software patents as a source of information.

The granularity problem also presents potential liability for users. In the case of hardware components, a product is typically sold by a sizable company able to indemnify users against inadvertent infringement of third-party process patents. While the same may be true of some of the larger software companies, indemnification presents a major problem for small developers and for open source software. Hardware components are sold into commerce and disappear from view, but software is licensed and remains visible in use. Users bear a high risk for using software such as operating systems that may be exposed across the Internet or reported in the press. Even though SCO's threats against Linux users are based on copyright, many in the open source community see the SCO case as a harbinger of more commonplace attacks by patent owners on major users of open source software.

The foregoing discussion has emphasized low-level granularity – such as that measured by code-level "function points."[12] However, it is not only the fineness of granularity but the number of overlapping layers of claimable functionality that make software uniquely complex. Although granularity is coarser at higher levels, the numbers problem is further compounded by the multiple levels of abstraction and the need to sort the overlap and interaction of patents at different levels.

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8. See FTC (2003), "To Promote Innovation: The Proper Balance of Competition and Patent Law and Policy" (Executive Summary) 16-17, available at: *www.ftc.gov/os/2003/10/innovationrptsummary.pdf* (recommending legislation to require actual notice from the patentee as a predicate for liability for willful infringement).

9. For example, a settlement of threatened litigation between a patentee and a competitor, can work to the benefit of both if the discovery of prior art it suppressed by agreement, allowing the patentee to pursue other competitors in the market.

10. E-mail from John Love, 22 August 2003. The PTO does not keep statistics on the submission of prior art.

11. The decision to patent faces not only high costs in preparing and prosecuting the application but also the uncertainty that the patent will stand up to a well-funded challenge. There is a high likelihood that there is prior art out there somewhere, so patenting will not only be costly in itself but probably ineffective against those with resources to seek out prior art and present compellingly it in court.

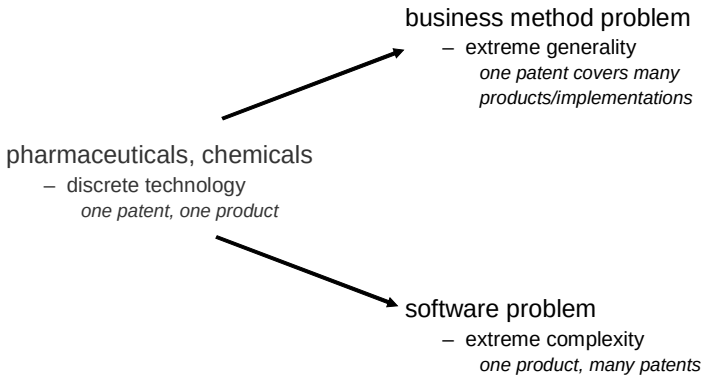
12. "Function points" are considered a more accurate measure of software scope and productivity than lines of code. See International Function Point Users Group, About Function Point Analysis, at: *www.ifpug.org/about/about.htm*.

(In addition to the granularity problems discussed above, a number of other practical objections are often raised against software patents. These are beyond the scope of this paper but include the history of rapid advance in software before patent protection; the success of open source software; the availability of other forms of protection, including copyright, contract, and technological measures; the incremental nature of innovation; the importance of interoperability and the dangers of strong protection in network industries; short product cycles relative to patent processing cycles; and the high cost of integration and testing relative to code creation.)

The business method problem

At higher levels of abstraction software blurs into business methods, characterized by preemption of lower level implementations. As IBM argued in comments on substantive harmonization: *"[W]ith the advent of business method patenting it is possible to obtain exclusive rights over a general business model, which can include ALL solutions to a business problem, simply by articulating the problem."*[13]

This can be understood more clearly in contrast to the software problem and in comparison with pharmaceuticals. One reason that the patent system seems well suited to pharmaceuticals is the close identity between patents and products characteristic of discrete technologies. From this perspective, the business method problem and the software problem diverge from the pharmaceutical ideal in starkly different ways as shown below:



Whereas there is a close correspondence between a marketed drug and a basic underlying patent, a software product may be assembled from tens of thousands of patentable embedded processes. Conversely, a patented business service may preempt all software implementations, each of which may be patentable at many different levels.

13. IBM response to 19 March 2001 USPTO Request for Comments on the International Effort to Harmonize the Substantive Requirements of Patent Law, available at: *www.uspto.gov/web/offices/dcom/olia/harmonization/TAB42.pdf*

Thus, the apparent blurring of software and business methods actually hides a spectrum that extends from extreme particularity to an extreme generality. There is nothing new about the tension between particularity and generality as manifest in the problems surrounding enablement and breadth (Merges and Nelson, 1990). However, the CAFC believes that specific enablement is less important for high-level software and business methods because it is trivial for a person skilled in programming to implement the claims (Burk and Lemley, 2002). This thinking allows the patent reward to relatively abstract ideas as self-enabling inventions and minimizes the contribution of R&D investment. IBM's comments reflect concern that its commitment to costly research will be jeopardized by the Walker Digital model of generating broad preemptive patents by brainstorming.[14]

However, it is often claimed that such patents are necessary to support the boom in electronic commerce, inasmuch as small entities, especially agile, motivated, and highly focused startups are better than large companies in promoting innovation and creative destruction. First mover advantages may not be enough against vastly superior resources that enable large companies to quickly emulate, deploy, and outmarket. Although not a traditional rationale for patent protection, Professor Merges comments favorably (Merges, 2003):

> *"To a large extent, a long-time observer of the patent system cannot help notice that the best justification – and sometimes, to be truthful, the only one – for the system appears to be to promote the financing of dynamic new entrants."*

The rationale of financing for startups in the face of large competitors looks like a kind of inverse competition policy: special treatment for small business designed to level the competitive playing field. In fact, within the software industry, this argument has had particular appeal in the face of Microsoft's propensity to incorporate new features and functions into existing products and thereby preempt opportunities for small competitors.

The rationale is stronger with respect to business method patents than lower-level software patents, since broad business method patents can function as market monopolies rather than mere property. Low-level software patents are not likely to be worth much relative to the value of the marketed product,[15] and the firm will need licenses from others, including large portfolio holders, to get to market. A patent-protected business service enjoys broad protection with much less exposure to the patents of others.[16]

Political impact of business method patents

The judicial embrace of software and business method patents in the United States has taken place in adversial proceedings without regard to the views of the professions and industries affected. The little research that has been done on the views of software professionals indicates that patents are viewed with disfavor.[17] At a National Academy of Sciences forum, Martin Konopken of Autodesk

14. The Priceline patent is the most famous of the company's patents. See Mark Gimein, Jay Walker's patent mania, Salon, 27 August 1999, *www.salon.com/tech/feature/1999/08/27/priceline/*

15. The argument for the limited value of patents in complex products is made in Kash and Kingston (2001).

16. A startup offering a new business service is not so likely to be focused on developing new software and may well rely on third-party software, which will give it some protection in the event of infringement.

17. See Pamela Samuelson & Robert J. Glushko, *Legally Speaking: Survey on the Look and Feel Lawsuits*, 33 Comm. of the ACM 483 (1990), available at *http://delivery.acm.org/10.1145/320000/316058/p483-samuelson.pdf*; see also Bradford Friedman, Remarks at the FTC/DOJ Hearing, 27 February 2002, transcript

reported, "I speak with my fellow in-house counsel in the software industry frequently. There is an amazing degree of unanimity about software patents. We all hate them."[18] Of course, this is not the position of the patent bar. Patents on business methods have played a particularly prominent role in reshaping international politics of the patent system. Unlike patents on lower level software processes, patents on business methods have attracted criticism in the general press because the subject matter is familiar to general audiences and often appears conspicuously obvious or laughable – for example, the IBM toilet reservation patent.[19] While industry outcry has on rare occasions resulted in PTO-initiated reexaminations of software patents, only in the case of business methods has the PTO undertaken specific steps to intensify the examination process. As reported by the PTO Director, these steps have cut the acceptance rate dramatically from 75% to 25%.[20]

Business method patents impact huge swaths of economic activity that had hitherto operated free from the demands and liabilities of the patent system (Thomas, 1999*b*). Significantly, none of those affected was petitioning Congress to do away with the longstanding rule against patents on business methods when the State Street case was decided by the CAFC in 1998 (Merges, 2003). Yet the effects of the CAFC snowballed onto the international stage. The eager embrace of business method patents by the US patent community and then by the US government through the USPTO, paved the way for what has become a broad divergence of policy and political perspective around patents at the heart of knowledge economy (Kahin, 2003).

European Commission and United Kingdom consultations in 2001 both reported a near consensus against "American-style" business method patents. Despite this clear sentiment against business method patents in Europe, the US government pressed for patents in all fields of activity, not just technologies. In WIPO negotiations for a new Substantive Patent Law Treaty (SPLT), the US delegation threatened to withdraw from the deliberations if this demand was not met. However, in the May 2002 meeting, the United States found itself alone in this position, joined only by the US-based patent organizations, who were there as observers.[21]

Public controversy over software and business method patents in the United States has been cast by practitioners and the PTO as a quality problem rather than a matter of policy. In key documents, business methods are presented as technology-implemented data processing not fundamentally

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at 355, available at *www.ftc.gov/opp/intellect/020227trans.pdf*: "As I'm sure this committee is aware, there is a general animosity to pure software patents within and outside of the industry…."

18. STEP Board Conference, "Intellectual Property Rights: How Far Should They Be Extended?" National Academy of Sciences, 2 February 2002, transcript at 199, available at:

    www7.nationalacademies.org/step/Conference_Day1.pdf

19. US Patent No. 6,329,919 (issued 11 December 2001). One of the most widely circulated critiques is James Gleick's article for the New York Times Magazine, 12 March 2000, archived at the Gleick's Web site: *www.around.com/patent.html*. According to a note on the website, the Commissioner of Patents and Trademarks sought to block publication of the article.

20. David Streitfeld, "Note: This Headline is Patented", *Los Angeles Times*, 7 February 2003, available at *www.chicagotribune.com/technology/local/chi-0302,0,7319176.story*. Despite the director's remarks, there are no official PTO figures on the impact of enhanced examination for these applications and other figures cited by USPTO officials are less dramatic. It should be noted that some practitioners view this exceptional scrutiny of patents in Class 705, "Electronic Commerce," as violative of the TRIPs principle of technological neutrality, discussed below.

21. World Intellectual Property Organisation, "Report of the Seventh Session of the Standing Committee on the Law of Patents", ¶¶ 159-173 (2002), available at *www.wipo.org/scp/en/documents/session_7/pdf/scp7_8.pdf*

different from a cash register.[22] By contrast, the debate in Europe is viewed universally a policy matter, in part because subject matter is still explicitly limited by the European Patent Convention.[23] Since the European Patent Office is not part of the European Union, control over quality remains a technical and administrative issue. In the United States, the quality problem is tied to enhanced funding for the PTO, especially a struggle within Congress over diversion of patent fees to other purposes.

The widespread rejection of business method patents enabled the European Commission to present its proposed directive as a balanced validation of EPO practice, although the EPO appeared to have eroded the limits of patentable subject matter as much as the CAFC had done in the United States prior to the State Street decision.[24] However, the Commission's abbreviated and legalistic presentation of the issues in the documents culminating in the draft directive (February 2002) faced an array of political developments that led to the rejection of pure software patents by the European Parliament in September 2003. These included: intensive grass-roots lobbying by the open source software community[25]; a crescendo of patent litigation in the United States based on broad apparently overreaching claims, such Amazon's one-click patent and BT's claim to own the rights to hyperlinking; fear that software patents would subordinate European developers to the massive portfolios accumulated by large multinationals such as IBM; a series of extraneous political developments that had Europeans chafing at US unilateralism; wariness that US views might unduly reflect the interests of Microsoft and IBM as national champions; and concerted opposition by computer scientists, economists, and SMEs.[26]

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22. US Patent and Trademark Office, "Automated Financial or Management Data Processing Methods (Business Methods)": A USPTO White Paper, Ver. 1.43 (2000), available at: *www.uspto.gov/web/menu/busmethp/whitepaper.pdf*

23. Article 52(2) states:

    The following in particular shall not be regarded as inventions within the meaning of paragraph 1:

    …

    (c) schemes, rules and methods for performing mental acts, playing games or doing business, and programs for computers;

    Article 52(3) then adds the enigmatic qualification:

    The provisions of paragraph 2 shall exclude patentability of the subject-matter or activities referred to in that provision only to the extent to which a European patent application or European patent relates to such subject-matter or activities as such.

    [European Patent Convention Article 52, available at: *www.european-patent-office.org/legal/epc/e/ar52.html]*

24. Unlike the CAFC, the EPO does not oversee the adjudication of patents in dispute. It oversees an opposition process, but national courts have the final word on standards of patentability. The variation in standards among EU member countries was a principal rationale for proposing the directive.

25. Coordinated by the Eurolinux Alliance: *http://eurolinux.org/about/index.en.html*

26. See letter from André Arnold *et al*. to the European Parliament (18 September 2003), available at *http://swpat.ffii.org/papers/eubsa-swpat0202/komp0305/komp0305.en.pdf*; letter from Birgitte Andersen *et al*. to the European Parliament (25 August 2003), *www.researchineurope.org/policy/patentdirltr.htm*; Press Release, Confédération Européenne des Associations de Petites et Moyennes Entreprises, Statement to the Software-Patent Directive Threatens Small and Medium-Sized Software Enterprises (17 September 2003), *www.ceapme.org/html/content/press/68/Presse_EU-software_170903_en.pdf*

Does one size fit all?

Unlike copyright, which struggles regularly with the desirability of differentiating among technologies and formats, patent policy has become rigidly monolithic - often described as "one size fits all." This principle was inserted in TRIPs at the behest of the pharmaceutical industry, albeit with some ambiguity and flexibility. The opening paragraph (27.1) of the patent section reads:

> *"Subject to the provisions of paragraphs 2 and 3, patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application. Subject to paragraph 4 of Article 65, paragraph 8 of Article 70 and paragraph 3 of this Article, patents shall be available and patent rights enjoyable without discrimination as to the place of invention, the field of technology and whether products are imported or locally produced."*

Without delving into the ambiguities of interpretation,[27] note that the principle of "technological non-discrimination" is a matter of industrial policy slipped in between two principles of trade policy. This illustrates a classic problem of legitimacy with the negotiation of international agreements. Special interests can cloak narrow goals in generalist principles within all-or-nothing instruments that function as a de facto international constitution. This in turn effectively deprives legislators of control over national and regional policies, precluding targeted experimentation and any specific response to social values, economic concerns, or policy principles outside of the core mechanics of patent system.

The European Commission's original draft directive defined all "computer-implemented" inventions as technology, implicitly subjecting software to the one-size-fits-all principle. However, the study commissioned by the Parliament from the Institute for Information Law observed (Bakels and Hugenholtz, 2002):

> *"Proponents of software patenting have argued that Article 27(1) does not allow software from being excluded from patentability, since computer software is to be considered a "field of technology". The discussions preceding adoption of the TRIPs agreement, however, do not confirm such a reading. In the absence of a legal definition of "invention", the agreement arguably leaves it to the member states to determine what constitutes a patentable invention, and whether or not that includes computer software as such."*

In the plenary vote on the directive in September 2003, the European Parliament voted amendments to the Commission's draft that effectively eliminate patents on pure information processes. (However, the vote is only a stage in a co-decision procedure with the Council of the European Union.) The Parliament's amendments explicitly define pure software out from under the reach of TRIPs.[28] More specifically, they define "technical contribution" to require "a new teaching on cause-effect relations in the use of controllable forces of nature and… an industrial application in the strict sense of the expression, in terms of both method and result."[29] The standard is similar to the US

27. Superficial appearance to the contrary, the words "without discrimination" can logically only apply to "place of invention, the field of technology and whether products are imported or locally produced" rather than to "patents shall be available and patent rights enjoyable."

28. See amendments 31, 32, and 112, deleting Recital 6 and amending Recital 7 to clarify that the exceptions in EPC Article 52 do not belong to a field of technology.

Supreme Court's last word on the subject in Diamond v. Diehr (1981), which allowed for patents on computer programs within traditional physical processes, a decision which has been left far behind by intervening decisions of the Court of Appeals for the Federal Circuit.

In embracing new subject matter, the patent system has expanded but not adapted.[30] Affinity programs and reverse auctions are not treated differently from gene sequences and light-emitting diodes. Yet the one-size-fits-all principle seems hard to square with the extreme economic differences between, say, the development and distribution of pharmaceuticals and the development and distribution of open source software – or the kind of business methods that might be conjured up around a conference table. The principal tradition of empirical research on the use and value of patents in the United States, Japan, and Europe shows that different industries value and use patents differently – and that patents play a significant role in inducing innovation in only a few industries, notably pharmaceuticals and chemicals (Arundel, 2001).

The danger in uniform application of rules that work well in some industries is that they will work poorly in other industries. In fact, ideological uniformity in rules may well lead to disparate results in practice. To talk of "technology neutrality" or "nondiscrimination" focuses attention away from results and onto technology where any kind of policy-based discrimination would seem most arbitrary and intrusive. Yet this is not matter of technological convergence where the regime favors one choice or another among technologies that do the same thing. The relevant and important question is whether the patent regime favors certain business models over others – or discourages innovation in some sectors while favoring others.

A monolithic regime naturally tends to be optimized for those industries that benefit most, since their interest in the operation and evolution of the system will be the most organized and intense. Thus, the international patent system has been especially responsive to the needs of the pharmaceutical industry where patents are critical to protecting billion-dollar drugs and transaction costs are small compared to the amounts at stake. The principle of "technological neutrality" embeds the unique political and ethical issues of the pharmaceutical industry in the inertia of a system made constitutionally incapable of addressing industry-specific issues and conditions. It has nothing to do with protecting the pharmaceutical industry from incursions by the software industry, but it does insulate patent practice in pharmaceuticals (as well as other industries) from legislative oversight and control.

A monolithic system discourages and devalues input from industry leaders and experts in technology because their insights and perspectives are limited to discrete vertical segments. Change is only possible if insights aggregated from the entire business spectrum indicate that change is needed. Instead policy processes are controlled by the intermediaries and institutions that run the system, because only they have the credentials to analyze and critique the system as a whole - that is, not just

29. European Parliament Legislative Resolution on the Proposal for a Directive of the European Parliament and of the Council on the Patentability of Computer-Implemented Inventions, Eur. Parl. Doc. (P5_TA-PROV(2003)0402) (2003), Article 4 (3)(a) as amended, available at: *http://www3.europarl.eu.int/omk/omnsapir.so/calendar?APP=PDF&TYPE=PV2&FILE=p0030924EN.pdf&LANGUE=EN*.

30. There are in fact a few exceptions in the US patent statutes: prior user rights apply only to business method patents; there is a special non-obviousness standard for biotechnology; and surgical method patents cannot be enforced against nonprofit entities and individual doctors.

the black-letter law, but the judicial interpretation of the law and the strategic and tactical aspects of patent practice.[31]

Given the industry-based findings of the main empirical tradition to date, a monolithic patent regime is bound to be skeptical if not hostile towards empirical research. Patent policy remains the application of patent law, an interstitial product of judges facing two commercial adversaries in an increasingly complex and heterogeneous environment. As Judge Paul Michel of the Court of Appeals for Federal Circuit commented at the Berkeley conference on patent reform, March 2002:

> *"We just keep replicating the old results based on the old precedents, whether they have kept pace with changes in business, changes in technology, or changes of a different sort…. I cannot remember the last time when any meaningful economic or empirical, quantified data was cited in a brief."*

However, two prominent scholars, Mark Lemley and Dan Burk, have argued forcefully that the CAFC applies patent law so as to treat different technologies differently – without drawing attention to the fact (Burk and Lemley, 2002; 2003). They assert that such differential treatment derives from the different theories underlying patent law. They also claim that this technology-specific application is often incorrectly applied and is at odds with the economic characteristics of innovation in particular fields, including software and biotechnology.

From a policy perspective, this looks like a disturbing outcome. By denying differences among technologies or "activities" the law appears to be driving differential treatment underground, embedding it in case law, where it is opaque to nonlawyers and can only be uncovered and explained publicly by legal scholars. If Lemley and Burk are correct, it is also leading to suboptimal outcomes that may undermine innovation in particular fields.

The technology-neutrality principle is commonly justified on the grounds of administrative simplicity and political insulation. I.e., it is difficult and costly to tailor protection for different fields, and if this were done, it would lead different industries to lobby legislators for special treatment. Remarkably, there is virtually nothing in the legal literature that makes a strong argument for this principle despite its enshrinement in TRIPs.

The recent Federal Trade Commission hearings and report break new ground by concretely analyzing the relationship between patent practice and innovation in four different areas, including software and Internet commerce considered together. Although in some respects this sector is similar to computers and semiconductors, the distinguishing characteristics are more extreme and the dominant view of patents in these areas is negative.[32]

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31. In the same manner, the sustained development of policy positions within firms is limited to those who fully understand the system as a whole. The firm faces a classic agency problem since loyalty to the professional community and the integrity of the patent system may rival allegiance to the firm's long-term interests.

32. Although the FTC report reaches no firm conclusions on the desirability of patents in this area, it assesses the panelists views:

    Although some panelists stated that software and business method patents foster innovation, many disagreed, asserting that such patents are often questionable and are actually stifling innovation by increasing entry barriers and creating pervasive uncertainty. (Chapter 3, p. 44).

Differences in business practice and ecology

The FTC report and hearings also make an important contribution in explaining the cross-licensing practices that are characteristic of complex technologies and the ICT sector as a whole.

Cross-licensing is now accompanied by side payments (sometimes referred to as "offset" or "balancing" payments) from smaller to larger portfolios, much like settlements between network operators in telecommunications. These side payments could be described as a subsidy going from users to innovators, although these licenses are not public and there is no way to determine whether they are fair or consistent or influenced by the threat of superior litigating resources.

The case that those who are users of R&D should pay producers of R&D via patent cross-licenses with side payments is not unreasonable. But it has not been made in official documents, nor does it appear to have any support in scholarly literature.[33] Cross-licensing has been recognized as an efficient way of dealing with an overabundance of patents and the high costs of evaluating patents. However, while recognized as market response, the policy implications of cross-licensing with side payments have received little attention. Individual patents have little value if cross-licensing is required by the large number of licenses needed to participate. Traditional arguments that patents benefit small companies assume that a patent provides exclusivity, but if cross-licensing is required, there is no exclusivity. While it is widely agreed that patents facilitate niche entry by startups, the need for licenses from different sources to assemble and market a complex product may induce startups to sell out to large companies whose substantial portfolios allow them full freedom of action.

In effect, the side payments based on portfolio size enable large portfolio holders to "tax" companies with smaller portfolios. Assuming such private assessments are fair in principle, the next question is whether they are fair in application, and there is little public information on these licensing arrangements. Most are by their terms confidential and cannot be made public, although some major companies with licensing programs reportedly have fixed sales or volume-based royalty rates for licensing their entire portfolio. In an established homogeneous industry, a handful of leading manufacturers might well understand the value of each other's portfolios. But small software developers face thousands of patents, many of which are questionable and costly to evaluate, and meaningful negotiation may not be possible with a company that holds 1000 times as many patents.

In this regard, Microsoft recently announced that it too will be inaugurating a licensing program and has hired the architect of IBM's very successful program to direct it.[34] While initial publicity around this development has been phrased in terms of Microsoft opening up its technology, for developers familiar with IBM's sometimes aggressive practices it looks very threatening. Their fears have recently been reinforced by Microsoft's recent demands for fees for the use of its widely adopted FAT format.[35]

To the extent that they are able to establish patent thickets or are successful in seeking offset payments, portfolio holders may gain long-term advantages (based on twenty years of past investments) in keeping competition at a distance. From a policy perspective, this is harder to justify in software than in industries with naturally high barriers to entry.

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33. A short but articulate version of the argument is made by Dan McCurdy, CEO of Thinkfire, in FTC/DOJ hearing on 20 March 2002.

34. Sam Mamudi, "Phelps Spells out His Microsoft Vision", *Managing Intellectual Property*, November 2003.

35. Jim Wagner, "A FAT Licensing Uproar?", *Internetnews.com*, 24 December 2003.

Small firms with a few patents may find it more lucrative to focus on licensing patents, especially if they can find companies with products on the market have inadvertently infringed on the patents. From the perspective of these firms, sometimes referred to as "trolls", the highest and best use of patents may be for hold-up.

In general, with the multifaceted, multidimensional expansion of the patent system, there is greater space and opportunity for strategic behavior, and especially for manipulating the heavy burden of transaction costs. As shown in the 2003 report of the AIPLA economic survey, the costs of patent litigation are extremely high, especially when modest amounts are at stake:

Table 12.1. **Average legal costs/fees for single-patent litigation**

(In parentheses: through discovery only)

Amount in controversy	Costs per side	X 2 = total for both sides	Total costs as % of amount in controversy	Plus
< $1M	$0.5M ($0.3M)	$1M ($0.6M)	**> 100% (> 60%)**	Staff time, opportunity costs
$1M to $25M	$2M ($1M)	$4M ($2M)	…	
> $25 M	$4M ($2.5M)	$8M ($5M)	**< 32%**	

Source: AIPLA, Report of Economic Survey, 2003.

As parenthetical figures show, the total costs involved just getting through discovery average over 60% of the amount in controversy when the amount is less than USD 1 million. This burden favors large companies and specialists such as licensing firms or law firms that can manage these costs to their advantage.

Lowering the inventive step

The expansion in scope of the patent system has been accompanied by an increase in the intensity of patenting, associated with a long list of changes in the law, in practice, and institutions. The single most important trend is the lowering of the non-obviousness or inventive step standard. In the United States, this begins with the 1952 Act, which rejected the affirmative "flash of genius" standard. Instead the 1952 Act created a presumption in favor of the applicant unless the invention is shown to be obvious to a "person having ordinary skill in the art" (PHOSITA). Rather than an exceptional achievement within the realm of technology, patents have become a broad-based entitlement as reflected in the mission statement, "to help customers get patents," adopted by the USPTO during the Clinton Administration.

Statistically, the number of cases in which patents were found non-obvious on appeal plummeted after the creation of the CAFC, although this trend appears to have reversed somewhat in the past few years (Lunney, 2001). Several changes in the law related to the obviousness standard are the result of decisions by the CAFC: emphasis on a number of secondary considerations such as market success that work in favor of the patentee; a heightened presumption of patent validity so that patents can be invalidated only by "clear and convincing evidence", and an especially lenient standard for combinations of known art. The FTC report recommends reform of all three of these rules.

The rule on new combinations of known art has been especially problematic for software and business methods. The rule suggests that the first implementation of familiar processes on computers

or on the Internet will be patentable unless some specific suggestion or motivation to make the combination can be documented.[36] In other words, the standard appears to be little more than a novelty standard. Thus the Priceline patent for conducting reverse auctions on the Internet stands despite the fact that there is nothing new about either reverse auctions or the Internet. [37]

In theory, the granularity problem (the "software problem") could be addressed by adjusting the non-obviousness/inventive step standard upward. If patents were few and significant, developers and engineers would be more inclined to pay attention to them as a meaningful source of information and as property worthy of respect. But with low standards, poor quality, and the mismatch between slow patent cycles and fast product cycles, patents in this sector remain poorly defined – a source of economic friction, expense, and uncertainty.

The politicization of the patent system

By extending the US patent system in new directions for which it appears to be ill prepared, software and business method patents exacerbate fundamental structural problems centered on complex products and the longstanding but elusive problem of breadth. The constitutional demands of TRIPs inhibit the ability of governments to address these tensions in a straightforward manner, although the USPTO has achieved a de factor raising of standards by enhancing examination within a certain class of business method patents with dramatic results. The European Parliament has attempted to address tension by first removing pure software and business methods from the reach of TRIPs and from the patent system.

The rapid and radical expansion of patentable subject matter in the United States has, in effect, created a new dimension in the international policy economy of patents. Previously the political differences evidenced in TRIPs, WTO debate, and the bulk of scholarly research and policy have been almost exclusively north-south issues. Software and business method patents have given it a trans-Atlantic dimension, thereby politicizing the international patent system afresh - the very consequence that the "one-size-fits-all" provisions of TRIPs were designed to avoid.

Ironically, this might not have happened had the prominent excesses of US business method patents not created a consensus in Europe that a line needed to be drawn and maintained against non-technical patents. Once it was perceived that a line needed to be drawn, it became a matter of where and how. Given the judicial erosion of the subject matter limits in the United States and similar tendencies in EPO and European court decisions, the European Parliament was challenged to redraw the line more explicitly – and to address the TRIPs problem in the process. For if the Parliament failed to remove software from TRIPs, it might be permanently inhibited from further remedial action on an issue that by general agreement had become increasingly central to Europe's competitiveness and its vision of an information society.

In the case of pharmaceuticals, US and European interests had been closely aligned in the TRIPs negotiations and this led to the provisions on technology neutrality as a way of ensuring that pharmaceuticals were protected. In the case of software, Europe was confronted with an imbalance in which it faced US dominance at multiple levels: the scope of commercial software development, Microsoft's hegemony over the desktop, and the explosion of electronic commerce and new business models. Europe also faced a patent deficit in two senses. The USPTO had issued approximately three

36. *In re* Lee, 277 F.3d 1338 (Fed. Cir. 2002).

37. US Patent No. 5,794,207 (issued 11 August 1998). Expedia filed a declaratory action against Priceline, but the parties settled for undisclosed terms and the patent stands.

times as many software patents as the EPO, and a large number of the patents issued by the EPO belonged to non-European companies. The Commission presented this differential as a consequence of confusion caused by the qualified exclusion of computer programs from the European Patent Convention and lack of patent consciousness and legal sophistication among European SMEs:

> *"It would also appear that, owing to extensive ignorance of the current legal situation in Europe, about 75% of these patents are held by very large non-European companies."*[38]

Perhaps inadvertently, this set the tone for the political debate that followed four years later. By persistently treating the problem of software patents as primarily a legal issue and deferring to the US view of TRIPs,[39] the Commission allowed the debate to be recast in the Parliament in much larger terms.

Different values at the core

Just as pharmaceuticals raise ethical, social, and political issues beyond the stark novelty-based patent system, so do many kinds of software and services. This is especially apparent in Europe, where political bodies have taken a more socially defined approach to the potential of information technology and the Internet than the predominantly utilitarian perspective of the United States.[40] Yet even in the US, there is special concern for the values associated with free speech (Wagner, 1999).

The Parliament's opposition to patents for pure information processes echoes the recent development of the World Wide Web Consortium's patent policy. When a proposed policy for accepting of royalty-bearing standards elicited an outcry from the open source software community, the policy was intensively reworked. The final policy favors royalty-free standards for core Web functions with royalty bearing standards allowed only as a last resort.[41]

These endorsements of an open core for high-level software-based information infrastructure have both a social and economic logic. They promote inclusiveness through low-cost commodity access consistent with traditional universalism telecommunications policy – without the trappings of public ownership, public control, or subsidy. From an economic perspective, an open core follows from the demonstrated importance of nonproprietary Internet technology, open standards, open source software in driving complementary commercial activity and economic growth. An open core also helps contain the risk that patents may unduly lever strong externalities and networking characteristic of the digital environment.

The economic case for "openness" is perhaps strongest where the externalities and the opportunity and need for diversity of approach is greatest. As a widely cited OECD report notes (OECD, 1998):

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38. See "Promoting Innovation through Patents", Communication from the Commission to the Council, the European Parliament and the Economic and Social Committee, February 1999, pp. 12-13.

39. The view of the 1997 Green Paper was that TRIPs allowed computer programs to be patented, not that TRIPs required it. European Commission, "Promoting Innovation through Patents — Green Paper on the Community Patent and the Patent System in Europe", pp. 16-17, *www.europa.eu.int/comm/internal_market/en/indprop/patent/paten.pdf*

40. It is significant that the Commission has a Directorate General for the Information Society, a term that is seldom used, let alone institutionalized, in the United States.

41. *www.w3.org/Consortium/Patent-Policy-20030520.html*

"Openness is an underlying technical and philosophical tenet of the expansion of electronic commerce. The widespread adoption of the Internet as a platform for business is due to its non-proprietary standards and open nature as well as to the huge industry that has evolved to support it…. More importantly, openness has emerged as a strategy, with many of the most successful e-commerce ventures granting business partners and consumers unparalleled access to their inner workings, databases, and personnel."

The embrace of open source software by many large companies testifies to the business value of openness. In general, these companies are selling complementary products and services, an appropriability mechanism, which surveys show to be more effective than patents (Cohen *et al*., 1994).

Like other strategies and policies, openness is a matter of nuance and degree. Even a royalty-free standard is owned in the sense that it is evolved by identified people who will likely control the evolution of the software unless they abuse their authority. If there is a patent behind the standard, the patentee may allow free use of the patent solely to implement the specific standard. Yet the adoption of the standard may put the patentee in a good position to licensee other uses or aspects of the same patent.

Proprietary implementations may be open in some ways because the market demands it or because openness is a distinguishing feature. There is a complex business ecology around openness just as there is around ownership and control. As the OECD language suggests, much of it is shaped by need to develop relationships as assets, which requires sharing of control and knowledge under terms that are transparent to both sides.

Conclusion

Despite the centrality of the patent system to the knowledge-based economy, there is little consensus as to how to move forward. The effort for European software directive has opened up a debate that will be difficult to resolve. In the United States, the quality issue remains center stage but there has been little effort to address the problem scientifically.

Yet there is progress. The FTC study illuminates how the many different levels and aspects of the patent system operate and interact in different industry environments. The European Patent Office has embraced an explicit mission tied to economic results, "to support innovation, competitiveness and economic growth for the benefit of the citizens of Europe," a very different goal than helping customers get patents. The OECD's current project has much potential for advancing a shared interdisciplinary understanding of how the patent system is working in developed economies.

US law has moved patent practice toward every frontier of the knowledge economy – towards logic and cognitive processes, towards a vast set of unfamiliar disciplines, and towards basic science - areas where knowledge, innovation, and enterprise differ significantly from the industrial world in which the patent system took root. Much of this expansion has been reflexive. It is very rarely adaptive.[42]

42. TRIPs notwithstanding, Congress has occasionally legislated exceptions. One is the special provision allowing prior use rights in patented business methods (35 USC 273), although that was intended to remedy the inequities that might result from allowing patents on what was previously thought to be unpatentable. However, see also 35 USC 103(b), providing a special non-obviousness standard for biotechnology processes, and 35 USC 287(c), limiting remedies for patents on medical and surgical procedures.

Patents on software and business methods have extended the reach of the system into virtually every sector of the economy. With the strengthening of patents, the increase in patenting intensity, and the specialization and refinement of patent practice, this has greatly expanded the strategic landscape that businesses and policymakers must assimilate and navigate. The functioning of the system has become more complex and opaque than ever. But the case for deepening, and broadening, understanding of the system has never been greater.

However, patent law and institutions have little to report on the contextual value of patents – what alternatives and circumstances make patents stronger, weaker, superfluous, cheap, or costly. There is an absence of reported data beyond the patents themselves and the relatively few disputes that end up in litigation - most of which are settled on undisclosed terms. The Yale-Carnegie Mellon industry surveys do not address software, let alone business methods. Licenses, the expanding fabric of patent practice, are virtually inaccessible to researchers.

As the patent system ventures far from home, it fails to meet common policy standards of transparency, accountability, and participation. For software and other parts of the ICT sector, the system is fraught with risk, uncertainty, and too much information at the operational level. There is too little information and too little participation at the policy level. The action papers for global harmonization are blacked out on the USPTO website.[43] There is no standard for quality, and there are no benchmarks for success.

Much work needs to be done. If the system is to embrace the high ground to which it aspires, it must enter a new maturity. This requires a long, hard, and open look at the contexts in which it operates: business, economic, and political. Knowledge inside and outside the system must mesh and align with the controls that patents grant. Patents should be a reliable source of support for the creation and dissemination of knowledge – rather than a source of confusion and surprise.

The patent system struggles with paradox. By explicitly blinding itself to technological difference, it invites elusive differences in application and result that make it less transparent and accountable. Without looking outward, it risks drifting deeper into contradiction. It must not be seen as a system to promote innovation that is guided only by precedent and authority or a system for advancing knowledge that has no framework for self-evaluation. Or as a system that aspires to consensus in a globalized economy but makes policy in insular manner.

43. See items 11-14 at *www.uspto.gov/web/offices/com/strat21/action/actionpapers.htm*

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Chapter 13

INTELLECTUAL PROPERTY IN SERVICES: WHAT DO WE LEARN FROM INNOVATION SURVEYS?[1]

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In the first part of this paper we review what previous studies using innovation survey data on services have to say about the role of patents and other intellectual appropriation mechanisms. Only a few countries included services in their survey design for the first Community Innovation Survey (CIS1). Most countries did for CIS2. Statistics Canada also carried out its own innovation survey on services in 1996. In CIS 3 the coverage of the service sectors has been extensive, with new questions among others regarding intellectual appropriation mechanisms.

In the second part we examine more closely the results of the French CIS3 survey. We compare the use of patents and other intellectual appropriation mechanisms in manufacturing and services. Are services fundamentally different from manufacturing in their use of various mechanisms to protect inventions and innovations? Are alternatives to patents as appropriation mechanisms more important in services than in manufacturing? Is the heterogeneity in the use of these mechanisms between sectors more important within services than within manufacturing? Is there any apparent complementarity or substitutability between them?

In the third part we venture into some general conclusions regarding the nature of innovation and the use of patents and other intellectual protection mechanisms in services as compared to manufacturing, and in some service sectors as compared to others.

1. The authors wish to thank Bronwyn Hall for her comments.

Introduction

Innovation, one of the major factors – if not the major factor – of long-term economic growth, stems from the realization and first commercialization of a new idea. It can be a new mechanical device, a new chemical compound, a new measuring tool, but it can also be a new software, a new educational programme or a new hairstyle. When the idea is conceived, its originator is the only one, or one of the very few, to envision how it could be realized and lead to profits. Various institutional (legal) devices have been introduced and designed over time to prevent somebody else from exploiting an inventor's idea, and to protect it as an intellectual property: patents, trademarks, copyrights, industrial designs, and confidentiality agreements. These various forms of intellectual property rights derive their economic justification from the fact that the monopoly rents they confer to their holder is the price to pay to encourage innovation. This is the so-called static inefficiency versus dynamic efficiency argument. Many firms, however, do not sufficiently trust these institutional devices as appropriate ways to protect intellectual property and rely more on strategic devices: secrecy, being first on the market, complexity, frequent product renewals, customer lock-in strategies, innovations in marketing, use of contracts, use of complementary assets.

Are services in that respect any different from manufacturing? Or is there as much difference in that respect amongst service industries themselves (and manufacturing industries for that matter) as between manufacturing and services as a whole? What is the pattern of use of intellectual property appropriation mechanisms in services and how does it compare to manufacturing? In particular, are strategic means of protecting appropriability preferred over the institutional mechanisms of intellectual property rights (IPR)?

Whereas CIS1 (*i.e.* the first Community Innovation Survey conducted in 1993) was in many countries confined to manufacturing, the CIS2 (conducted in 1997) survey covered service sectors for over 12 European countries. No questions, however, were asked about mechanisms used to protect intellectual property. The CIS3 survey (conducted in 2001) provides qualitative data on the use of ways to protect intellectual property including in services. We shall draw on the evidence contained in the French CIS3 survey.[2]

Are services any different from manufacturing regarding the use of IPR?

The generally accepted view is that services are extremely different from manufacturing industries in many respects. For instance, services are often characterized by a greater product heterogeneity and tailoring to consumer preferences. A seat on a flight from Paris to New York can be offered in business or economy class, with advanced booking or on a stand-by basis, with or without cancellation restrictions, perhaps even in combination with a TGV transport to Brussels or a car rental in New York, and many other sources of product differentiation, all this to cater a particular type of customer. Services are characterized by a more intense and intrinsic user-producer interaction. A concert performance or an insurance contract are not material objects but immaterial things that not only require large physical investments, skilled workers and organizational capabilities on the part of the producer but that also require knowledgeable consumers. Services are mostly composed of intangible output. Many services fall into the

2. Previous surveys on the use of appropriation mechanisms were the so-called Yale1 survey (Levin *et al.*, 1987), the so called Yale2 or Carnegie Melon survey (Cohen *et al.*, 1996), the 1993 French *"Enquête appropriation technologique"*, Statistics Canada's 1993 Survey on Innovation and Advanced Manufacturing (Baldwin, 1997) and the 1996 Survey of Innovation in Services (Baldwin *et al.*, 1998).

category of non-rival goods that can be reproduced at minimal marginal cost: a tape recording, a software, an exhibition.

Are these differences sufficiently important to warrant a different approach to innovation surveys in services, for instance a different questionnaire? We shall concentrate on one aspect of the innovation surveys, namely the patterns of use of various intellectual property protection tools to appropriate the benefits from R&D and innovation? Do services differ from manufacturing in this regard?

In their comparison of innovation in services and manufacturing on the basis of CIS2, Tether *et al.* (2002) report that: *1)* service firms are slightly less innovative and less R&D-intensive than manufacturing firms of the same size; *2)* in services, product improvements are more important than cost reductions and hence product innovations are more frequent than process innovations; *3)* training, acquisition of machinery and equipment and other external technologies are relatively more important for innovation in services than in manufacturing.[3]

Since service firms innovate less and are less R&D-intensive than manufacturing firms of the same size we would expect less demand for IPR in services than in manufacturing. Indeed, one of the major reasons for seeking IPR protection is to recover by the acquisition of temporary monopoly rights the innovation costs incurred to invent and bring to market the new product, process, text, software, commercial secret, or trademark reputation for which legal protection is requested. This institutional appropriation mechanism allows firms to appropriate the benefits of their investments in innovation and thereby stimulates them to innovate. It is a stylised fact that processes are less often patent protected than products. It might have to do with the information disclosed in the patent application that would be more valuable for processes than for products or with the fact that products can be more easily reverse engineered than processes. In this regard, since product innovations are more frequent than process innovations in services, we would expect more patenting in services than in manufacturing. To the extent that in services knowledge is more often imported than internally produced, there is less intellectual property to protect.

However, besides these reported differences between service and manufacturing sectors, there is also a great heterogeneity between service sectors themselves. Tether *et al.* (2002) report that innovation increases with firm size and that there is a wide variation of innovation across service sectors, the most innovative sectors being technology producing sectors: telecommunication, computer services, and technical services. Those are precisely the sectors that were the object of the 1996 Canadian Survey of Innovation. From the results in this survey, Baldwin *et al.* (1998) report that, within these three sectors, firms that offer financial services are the largest, are most subject to tough competition, and rely most for their innovations on outside experts, that technologies change most rapidly in telecommunications, and that firms are the smallest, imitation the most frequent and R&D the most important in the technical services sector.

3. For CIS2, the target population included electricity, gas and water supply (NACE 40-41), wholesale (NACE 51), transport by land, water and air (NACE 60-62), telecommunications (NACE 64.2), financial intermediation including banks, credit agencies, insurance and pension funds (NACE 65-67), computer and related activities (NACE 72), and architectural and engineering services (NACE 74.2 part). Some countries included additional services. For instance, Germany included non-technical services (advertising, legal consulting, tax advising, accountancy services), renting, real estate, and sewage. CIS2 covered only 20% of economic activity in European market services.

Insofar as size is an important determinant for seeking protection of intellectual property, which is clearly the case for patents by industrial firms, as shown by Kabla (1994) on French data and by Arundel *et al.* (1995) on data from the PACE report, then variations of size within services will produce variations in the intensity and profile of use of various mechanisms for IP (intellectual property) protection. For the same reasons that there are sectoral differences in IP protection within manufacturing (see the Yale and Carnegie Mellon surveys), so there are likely to be differences amongst the services sectors because of differences in imitation, R&D-intensity, innovation from outside sources. We would expect sectors that rely more on outside sources for their innovation and that do little R&D themselves to have less of a need to protect their investments in research by seeking IP protection and the opposite for firms in sectors where imitation is easy, such as technical services. Now, the report by INSEE (2003) on CIS3 in services mentions a higher proportion of trademark protection and a lower one for copyright protection by firms in distribution as opposed to firms in technical services, that need to protect their softwares or databases. Finally, in the financial sector where innovations are mostly brought in through new IT equipment and IT service providers, we would also expect less IP protection.

The use of intellectual property protection tools in the service sectors: evidence from CIS3 in France

We compare the profiles of use of IP protection between services and manufacturing using the latest CIS3 French innovation survey, covering the period 1998-2000. Firms are assigned to industrial sectors on the basis of their principal activity. Starting with the APE114 industrial classification, we first aggregate sectors into three broad groups (N-3 aggregation): on the one hand, the high-tech manufacturing and the low-tech manufacturing sectors and on the other hand the service sectors.[4] We also work with a finer disaggregation into 47 sectors (N-47 aggregation). For a concordance of the three classifications, see Table 13.1. After cleaning up for a few outliers we end up with 1 605 high-tech manufacturing firms (HTM), 2 456 low-tech manufacturing firms (LTM) and 1 914 service firms (SERV). Among these three groups, there are respectively 1 185 (74%), 1 187 (48%) and 891 (47%) innovating firms in the sense of CIS3, *i.e.* firms that declare that they have introduced onto the market a new or significantly improved product, or implemented a new or significantly improved process, or declare ongoing or abandoned innovation activities.

In Figures 13.1 to 13.6 we represent the proportions of firms, within each of the three N-3 groups, for innovators and non-innovators respectively, which use each of the following seven types of intellectual property protection mechanisms considered in CIS3: patents, copyrights, registration of design patterns, trademarks, secrecy, complexity of design, and lead-time advantage on competitors.[5] Various observations can be made:

4. High-tech and low-tech manufacturing sectors are defined on the basis of R&D intensity.

5. In the harmonized questionnaire for CIS3, two questions regarding IPR were:

   "During the period 1998-2000, did your enterprise, or enterprise group,

   1) Apply for at least one patent

   2) Make use of any of these other methods (registration of design patterns, trademarks, secrecy, complexity of design, and lead-time advantage on competitors) to protect inventions or innovations developed by your enterprise?"

   All enterprises, innovators and non-innovators, had to respond to these questions.

- First, as can be expected, within each broad sector innovating firms use all types of protection mechanisms more intensively than non innovating firms. There may be a time-lag between innovating (in the sense given above) and applying for IPR, which would explain the use of IPRs even in the absence of innovation.

- Second, patenting is the favourite protection mechanism in the manufacturing sectors but not in the service sectors, where trademarks, complexity and lead-time are used more intensively. The first result may seem to be at odds with the conclusions of the Yale and Carnegie Mellon surveys that showed the predominance of secrecy over patents as effective protection mechanisms. Here the question, however, is not about the effectiveness of the various appropriation mechanisms but about their actual use over the sample period. Some IP strategies may be pursued even if they are not considered terribly effective. This is confirmed by the responses of the Canadian firms in technical services, which report a great use of copyrights, but where only one third thinks they are efficient (see Baldwin *et al.*, 1998).

- Third, innovating firms in the high-tech manufacturing sectors use all types of protection mechanisms, except design registrations, more intensively than innovating firms in the low-tech manufacturing sectors.

- Fourth, each of the various IP protection mechanisms is used by a lower proportion of innovating firms in the service sectors than in the high-tech manufacturing sectors, but not by a lower proportion than in the low-tech manufacturing sectors: lead-time, copyrights, complexity, and trademarks are used more intensively by the innovating service firms than by the innovating low-tech manufacturing firms.

- Fifth, non-innovating service firms tend to use the IP protection mechanisms (with the exception of patents) more than the non-innovating manufacturing firms.

Lelarge (2003) reports that in the sectors N21 ("computer services") and N25 ("architecture") the use of any IPR mechanism increases with the size of the firm and the size of its market. Patents and copyrights are substitutes. This can be easily explained by the fact that patents are legally granted only for technological advances, the transformation of an idea into a new product or process, whereas trademarks are appropriate for artistic or literary expressions, but not for their technological utilization (see Cowan and Harison, 2001). Trademarks seem to be complements to patents and to copyrights. However, patents and secrecy are not mutually exclusive, hence some ideas are patented and others not.

Baldwin *et al.* (1998) report on the basis of the 1996 Canadian Survey of Innovation in Services that the use of IPR varies across the service industries. In the three industries they consider, the communication services industry is the one that makes the least use of IPR, financial services use mostly trademarks, and the technical services industry uses all IP instruments more than the other two industries. The composition thus matters. This could explain why they find for the three Canadian industries a greater use of copyrights than secrecy and patents, which does not seem to be the case in France. They confirm the intensive use of trademarks and the preference of lead time over patents for innovators that also evident from the French statistics.

Is the service-manufacturing dichotomy useful for analysing IP protection?

The previous section showed that services were somewhat different from manufacturing in their profile of use of IP mechanisms, but much more different from high-tech than from low-tech manufacturing. It showed also that the split between innovating and non-innovating firms was much more striking than the split between services and manufacturing. To deepen our analysis, in the absence of any a priori theory that would explain differences in IP use in manufacturing and services, we proceed to two methods of data analysis: the correspondence analysis and the clustering analysis. We do this at the level of 94 sets of firms, which are the 47 sectors (of the N-47 aggregation of industries), split into the sets of innovating and non-innovating firms.

The correspondence analysis is a technique of dimensionality reduction and of graphical representation of the data (see Greenacre, 1993). The idea is to start from a contingency table and to explain by a few principal dimensions (fake variables constructed as particular linear combinations of the row or column variables of the contingency table) most of the variation in the cells of the table (the so-called inertia). In this case we want to understand the profile of use of various IP protection mechanisms and the profile of some of the characteristics of the N-94 sets of firms. We find that the first principal dimension explains 75.2% of the total inertia in the profiles, the second explains 8.2% and the third 7.3%. Table 13.2 gives the coordinates of the two principal dimensions of the profiles of use of IP mechanisms and of some characteristics of the 94 sets of firms, *i.e.* the projections of the profiles onto the space spanned by the first two principal dimensions. The figures in Tables 13.2 and 13.3 are used to construct Figures 13.7, 13.8 and 13.9. The plotting of the use of the various IP mechanisms along the first two principal dimensions (Figure 13.7), thus using the coordinates along the first two dimensions (the first two columns of Table 13.2) shows a clear (and expected) separation between users and non-users of all types of IP mechanisms along axis 1 and another separation between the use of patents, trademarks and registrations of design and all the other mechanisms along dimension 2.

More directly telling for our comparison of services and manufacturing are the two graphs where along the first two axes of principal dimensions, we represent in the first graph (Figure 13.8) the four binary indicators corresponding to the innovating/non-innovating firms dichotomy (YINNO and NYINNO) and to the belonging or not to the N-3 sectoral aggregation (HTM, LTM and SERV) dichotomy, and in the second graph (Figure 13.9) the six binary indicators corresponding to the interactions between the binary innovation and the N-3 sector aggregation indicators (HTM_I, HTM_NI, LTM_I, LTM_NI, SERV_I and SERV_NI). It is clear that the first dimension is highly and positively correlated to the innovation indicator and to the high-tech innovating (HTM_I) and non-innovating (HTM_NI) groups, and negatively to the low-tech non-innovating group (LTM_NI). The second dimension is correlated to low-tech industry group (LTM) and to the service industry group (SERV), in particular to the sets of innovating firms in those two groups (LTM_I and SERV_I). That is also what can be seen directly from the principal coordinates given in Table 13.3.

According to this first technique of data analysis then, distinguishing innovating from non-innovating firms seems much more important than distinguishing between services and manufacturing. Within the manufacturing/services split, the service sectors look actually closer to low-tech manufacturing sectors than the latter are to the high-tech manufacturing sectors.[6]

6. Services are closer to LTM according to the first factorial dimension, but according to the first, which explains 75% of the variation, services are closer to HTM.

Lebart (1994) recommends the complementary use of correspondence analysis and clustering analysis. We therefore proceed in a second step to a data clustering technique. Here the aim is not to find latent variables that explain most of the variation in the data, i.e. in the profiles of use of the various IP protection mechanisms or the profiles of firm characteristics, but to regroup in a number of different clusters the sets of firms that are closest in terms of these profiles. If we limit ourselves to three clusters, we can see in Table 13.4 (and Table 13.6), that the first cluster regroups principally all the sets of non-innovating firms at the N-47 industry level, the 18 in high-tech manufacturing, the 22 in low-tech manufacturing, the seven in services. The second cluster regroups essentially the sets (14 out of 18) of innovating firms of the high-tech manufacturing sectors (HTM_I), plus two sets of innovating firms of the low-tech manufacturing sectors (LTM_I) and one set of innovating firms of the services (SERV_I). Cluster 3 regroups mostly the innovating sets of firms in the low-tech manufacturing (17 out of 22) and service sectors (four out of seven).

If we distinguish six clusters (Tables 13.5 and 13.7), the clustering pattern becomes more complicated of course, but again we find a concentration of the sets of the non-innovating firms in cluster 4, be they are in services (all seven of them), high-tech manufacturing (15 out of 18) or low-tech manufacturing (all 22 of them). The sets of innovating firms in services appear in different clusters. They are not regrouped in one. Trade, computer services and telecommunications are clustered with pulp and paper in cluster 1; financial intermediaries and insurance services are clustered with the innovating firms in wood products and printing and the non-innovating firms in perfumes in cluster 3; research services are clustered with such high-tech sectors as automobiles, office machines and medical equipment in cluster 5; and architectural services are clustered with most sets of innovating firms in the low-tech manufacturing sectors in cluster 6 (and the non-innovating firms of organical chemistry).

Again, we can conclude from this second exercise in data analysis that services sectors and manufacturing sectors are very heterogeneous and services sectors are often much closer to manufacturing sectors than to the other services sectors. Some of the innovating sets of firms in services are close to the innovating sets of firms in the high-tech manufacturing sectors, others close to the innovating sets in the low-tech manufacturing sectors. The sets of non-innovating firms in services are overall much more alike to the sets of non-innovating firms in manufacturing than to the sets of innovating firms in services.

Overall, our data explorations strongly suggest that the crude distinction between services sectors on one hand and manufacturing sectors on the other hand is neither appropriate nor meaningful, at least as regards the analysis of IPR. The distinction may be more relevant for other issues, although one should always be cautious not to be a victim of "the fallacy of misplaced concreteness".[7]

7. In their introduction to a collection of studies on productivity issues in services at the micro level, the editors conclude: "After reading this wide-ranging set of articles, one is inclined to consider that services, after all, may not be that different from goods, and that productivity analyses raise similar difficulties for both. [...] A number of difficulties that are thought to be intrinsic to analysing productivity in service industries are brought about by a deceptive sense of familiarity arising from the many studies in agriculture and manufacturing industries, and they largely proceed from the general fallacy of misplaced concreteness." (Griliches-Mairesse, 1993).

If our results are robust, we should seriously rethink whether it is worth treating services separately from manufacturing in innovation surveys.[8] The mere fact that services are often intangible is not reason enough to have a different questionnaire for innovation in services and in manufacturing, as done in CIS2 or as proposed by some statisticians in France (see INSEE, 2002). The overall separation between high-tech and low-tech industries, if anything, would seem less crude. In order to go further in the precision and relevance of our analysis, we are rapidly impelled to take into account more detailed industry characteristics, which are not captured by the simplistic, and possibly misleading, usual separation in services and manufacturing. The same note of warning applies, of course, to any policy recommendation or directive on IPR and innovation issues, which will rely on the overall distinction between services and manufacturing, rather than on more specific industry characteristics. If it is thought that organizational innovations are important in services and should therefore to covered in more detail in the innovation survey questionnaires, the same could be argued for firms in the manufacturing industries.

8. For simplicity, our analysis at this point has been based on the "a priori" N-94 sectoral aggregation. We surmise that our basic conclusion will be confirmed, and even reinforced, when performing the comparable analysis at the firm level.

Table 13.1. **Sample of the French CIS3 innovation survey: N-3 and N-47 aggregations**

	N-47	N-3	Number of firms	Totals
Clothing	C11	LTM	261	
Footwear	C12	LTM	75	
Printing	C20	LTM	198	
Furniture	C41	LTM	126	
Jewellery, toys	C42-C43	LTM	75	
Metal	E21	LTM	84	
Smith shop	E22	LTM	91	
Other minerals	F12	LTM	51	
Glass	F13	LTM	52	
Construction materials	F14	LTM	128	
Spinning and weaving	F21	LTM	128	
Textiles	F22	LTM	94	
Fabric and stitch	F23	LTM	41	
Wood products	F31	LTM	106	
Pulp	F32	LTM	36	
Paper and cardboard	F33	LTM	111	
Rubber	F45	LTM	47	
Plastic products	F46	LTM	254	
Iron and steel non-ferrous metals	F51-F52	LTM	73	
Smelting	F53	LTM	64	
Primary metal	F54	LTM	190	
Fabricated metal	F55	LTM	171	2456
Pharmacy	C31	HTM	124	
Soap perfume	C32	HTM	97	
Home appliances, recorder, optical photo	C44-C46	HTM	60	
Automobile	D01	HTM	70	
Automobile equipment	D02	HTM	72	
Ship building, railroad rolling stock, aeronautics, bicycles, motorcycles	E11-E14	HTM	85	
Mechanical equipement	E23	HTM	96	
General machines	E24	HTM	153	
Agricultural machinery, industrial machines	E25-E26	HTM	67	
Specific machines, arms, ammunitions	E27-E28	HTM	124	
Office machinery	E31	HTM	20	
Motors	E32	HTM	41	
Emission machines	E33	HTM	45	
Medical equipment, precision equipment	E34-E35	HTM	151	
Mineral chemistry, organic chemistry	F41-F42	HTM	87	
Parachemical, artificial fibers	F43-F44	HTM	90	
Electrical equipment	F61	HTM	150	
Electronic components	F62	HTM	73	1605
Commerce	J20	SERV	793	
Financial intermediation	L01	SERV	191	
Insurance	L02	SERV	125	
Mail, courrier, telecommunications	N11-N12	SERV	42	
Computers	N21	SERV	247	
Architecture	N25	SERV	431	
Market and non-market research	N40	SERV	85	1914

Table 13.2.
Coordinates of the first two principal dimensions of intellectual property protection profiles

	Axis 1	Axis 2
Patent	0.8235	-0.0842
NPat	-0.2679	0.0274
Copyright	0.8944	0.6705
Ncopy	-0.0483	-0.0362
Complexity	0.9230	0.2509
Ncomp	-0.1141	-0.0310
Design	0.6852	-0.5489
Ndesi	-0.1131	0.0906
Secrecy	0.9290	0.1901
Nsecr	-0.1494	-0.0306
LeadTime	0.9019	0.0760
NTime	-0.1784	-0.0150
Trademark	0.5914	-0.0946
NTrad	-0.1938	0.0310

Table 13.3.
Coordinates of the first two principal dimensions of the profiles of some industry characteristics

	Axis 1	Axis 2
YINNO	0.9018	-0.0790
NYINNO	-0.9018	0.0790
HTM	0.2305	0.1701
LTM	-0.1458	-0.4185
SERV	-0.1346	0.8780
HTM_I	1.3257	0.2164
HTM_NI	-0.8648	0.1238
LTM_I	0.6478	-0.7945
LTM_NI	-0.9393	-0.0425
SERV_I	0.6099	1.4100
SERV_NI	-0.8790	0.3460

Table 13.4.
Clustering of 94 sets of firms (the sets of innovating firms and the sets of non-innovating firms in the 47 industries) in three clusters

	HTM-NI	HTM-I	LTM-NI	LTM-I	SERV-NI	SERV-I	TOTAL
CLUSTER1	18	0	22	3	7	2	52
CLUSTER2	0	14	0	2	0	1	17
CLUSTER3	0	4	0	17	0	4	25
TOTAL	18	18	22	22	7	7	94

Table 13.5.
Clustering of 94 sets of firms (the sets of innovating firms and the sets of non-innovating firms in the 47 industries) in six clusters

	HTM-I	HTM-NI	LTM-I	LTM-NI	SERV-I	SERV-NI	TOTAL
CLUSTER1			1		3		4
CLUSTER2	1		3				4
CLUSTER3		2	2		2		6
CLUSTER4		15		22		7	44
CLUSTER5	16		9		1		26
CLUSTER6	1	1	7		1		10
TOTAL	18	18	22	22	7	7	94

Table 13.6. **Clustering of 94 sets of firms (the sets of innovating firms and the sets of non-innovating firms in the 47 industries) in three clusters**

	N-47	N-3	CLUSTER1	CLUSTER2	CLUSTER3
Clothing	C11	LTM	NI		I
Footwear	C12	LTM	NI		I
Printing	C20	LTM	NI & I		
Pharmacy	C31	HTM	NI	I	
Soap and perfumes	C32	HTM	NI		I
Furniture	C41	LTM	NI		I
Jewellery, toys	C42-C43	LTM	NI		I
Home appliances, recorder, optical photo	C44-C46	HTM	NI	I	
Automobile	D01	HTM	NI		I
Automobile equipment	D02	HTM	NI	I	
Ship building, railroad rolling stock, aeronautics, bicycles, motorcycles	E11-E14	HTM	NI	I	
Metal	E21	LTM	NI		I
Smith shop	E22	LTM	NI		I
Mechanical equipment	E23	HTM	NI	I	
General machines	E24	HTM	NI		I
Agricultural machinery, industrial machines	E25-E26	HTM	NI	I	
Specific machines, arms, ammunitions	E27-E28	HTM	NI	I	
Office machinery	E31	HTM	NI	I	
Motors	E32	HTM	NI		I
Emission machines	E33	HTM	NI	I	
Medical equipment, precision equipment	E34-E35	HTM	NI	I	
Other minerals	F12	LTM	NI		I
Glass	F13	LTM	NI		I
Construction materials	F14	LTM	NI		I
Spinning and weaving	F21	LTM	NI		I
Textiles	F22	LTM	NI		I
Fabric and stitch	F23	LTM	NI		I
Wood products	F31	LTM	NI & I		
Pulp	F32	LTM	NI		I
Paper and cardboard	F33	LTM	NI		I
Mineral chemistry, organic chemistry	F41-F42	HTM	NI	I	
Parachemical, artificial fibres	F43-F44	HTM	NI	I	
Rubber	F45	LTM	NI	I	
Plastic products	F46	LTM	NI		I
Iron and steel non-ferrous metals	F51-F52	LTM	NI	I	
Smelting	F53	LTM	NI		I
Primary metal	F54	LTM	NI & I		
Fabricated metal	F55	LTM	NI		I
Electrical equipment	F61	HTM	NI	I	
Electric components	F62	HTM	NI	I	
Commerce	J20	SERV	NI		I
Financial intermediation	L01	SERV	NI & I		
Insurance	L02	SERV	NI & I		
Mail, courrier, telecommunications	N11-N12	SERV	NI		I
Computers	N21	SERV	NI		I
Architecture	N25	SERV	NI		I
Market and non-market research	N40	SERV	NI	I	

Table 13.7. **Clustering of 94 sets of firms (the sets of innovating firms and the sets of non-innovating firms in the 47 industries) in six clusters**

	N-47	N-3	CL1	CL2	CL3	CL4	CL5	CL6
Clothing	C11	LTM		I		NI		
Footwear	C12	LTM				NI		I
Printing	C20	LTM			I	NI		
Pharmacy	C31	HTM				NI	I	
Soap and perfumes	C32	HTM		I	NI			
Furniture	C41	LTM				NI		I
Jewellery, toys	C42-C43	LTM		I		NI		
Home appliances, recorder, optical photo	C44-C46	HTM				NI	I	
Automobile	D01	HTM				NI	I	
Automobile equipment	D02	HTM				NI	I	
Ship building, railroad rolling stock, aeronautics, bicycles, motorcycles	E11-E14	HTM				NI	I	
Metal	E21	LTM				NI		I
Smith shop	E22	LTM				NI	I	
Mechanical equipment	E23	HTM				NI	I	
General machines	E24	HTM				NI	I	
Agricultural machinery, industrial machines	E25-E26	HTM				NI	I	
Specific machines, arms, ammunitions	E27-E28	HTM				NI	I	
Office machinery	E31	HTM			NI		I	
Motors	E32	HTM				NI		I
Emission machines	E33	HTM				NI	I	
Medical equipment, precision equipment	E34-E35	HTM				NI	I	
Other minerals	F12	LTM				NI		I
Glass	F13	LTM				NI	I	
Construction materials	F14	LTM				NI	I	
Spinning and weaving	F21	LTM				NI		I
Textiles	F22	LTM				NI	I	
Fabric and stitch	F23	LTM		I		NI		
Wood products	F31	LTM			I	NI		
Pulp	F32	LTM	I			NI		
Paper and cardboard	F33	LTM				NI	I	
Mineral chemistry, organic chemistry	F41-F42	HTM					I	NI
Parachemical, artificial fibres	F43-F44	HTM				NI	I	
Rubber	F45	LTM				NI	I	
Plastic products	F46	LTM				NI	I	
Iron and steel non-ferrous metals	F51-F52	LTM				NI	I	
Smelting	F53	LTM				NI		I
Primary metal	F54	LTM				NI		I
Fabricated metal	F55	LTM				NI	I	
Electrical equipment	F61	HTM				NI	I	
Electric components	F62	HTM				NI	I	
Commerce	J20	SERV	I			NI		
Financial intermediation	L01	SERV			I	NI		
Insurance	L02	SERV			I	NI		
Mail, courrier, telecommunications	N11-N12	SERV	I			NI		
Computers	N21	SERV	I			NI		
Architecture	N25	SERV				NI		I
Market and non-market research	N40	SERV				NI	I	

Figure 13.1. **R&D-intensive manufacturing, innovating**

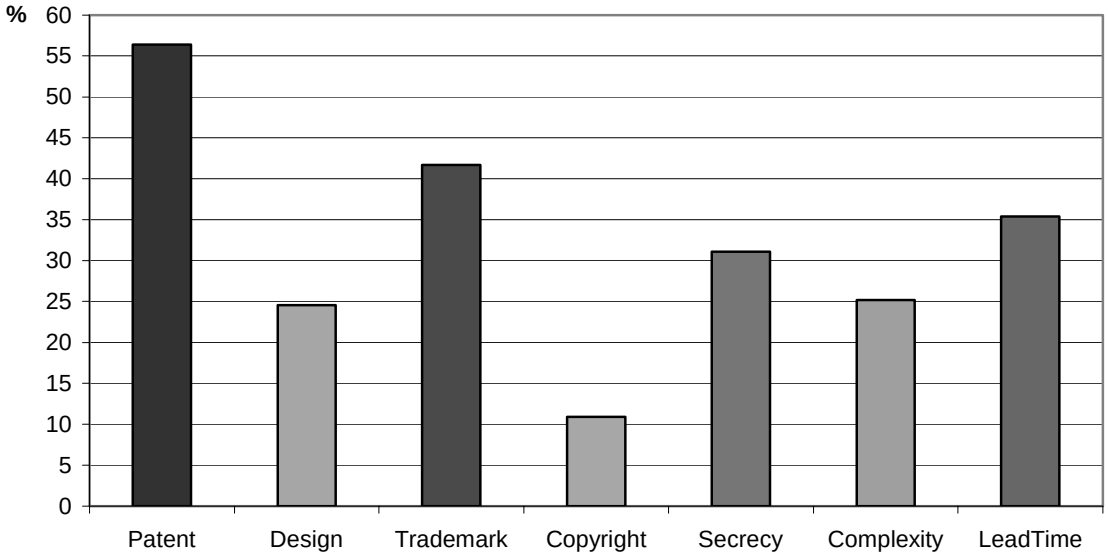


Figure 13.2. **Non-R&D-intensive manufacturing, innovating**

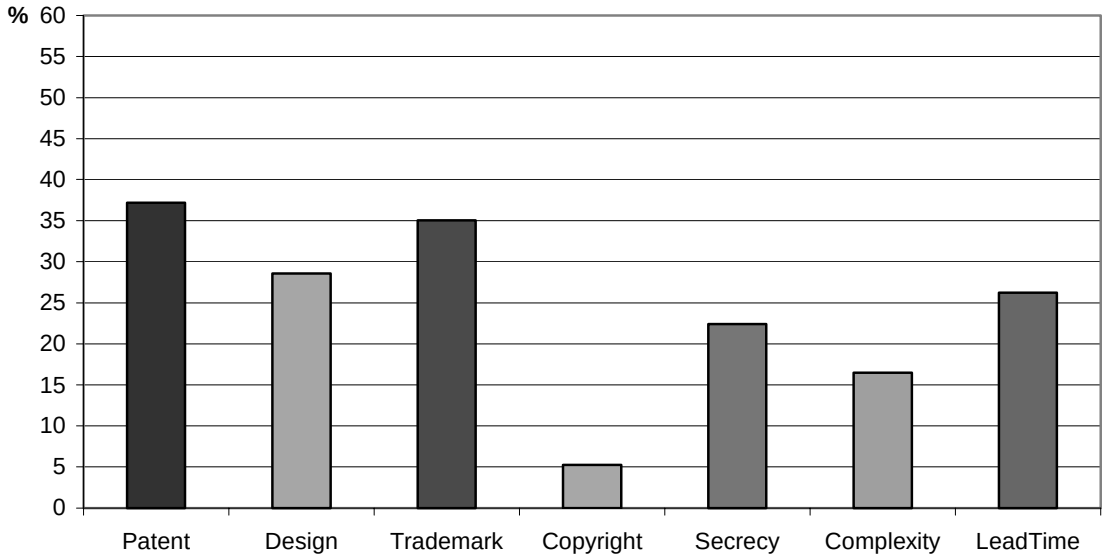


Figure 13.3. **Services, innovating**

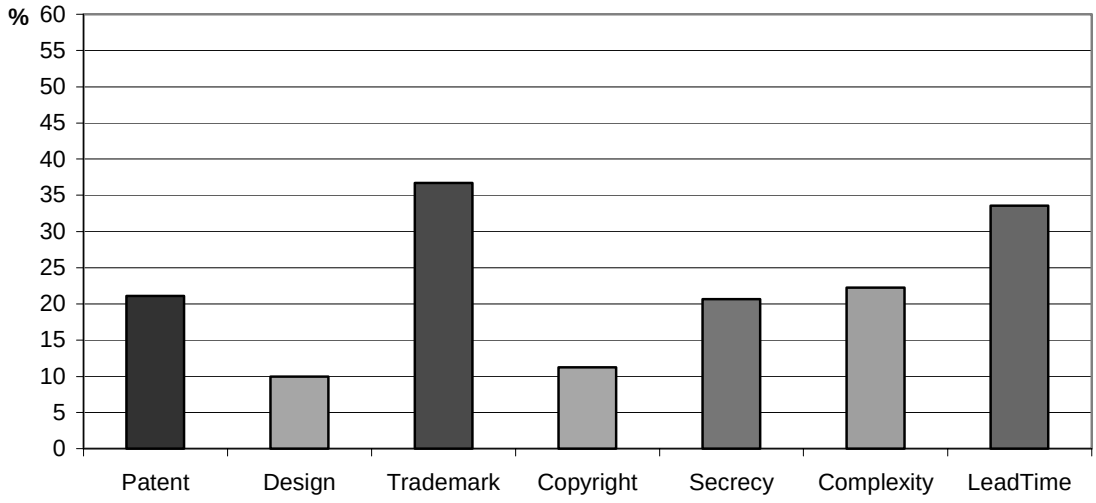


Figure 13.4. **R&D-intensive manufacturing, non-innovating**

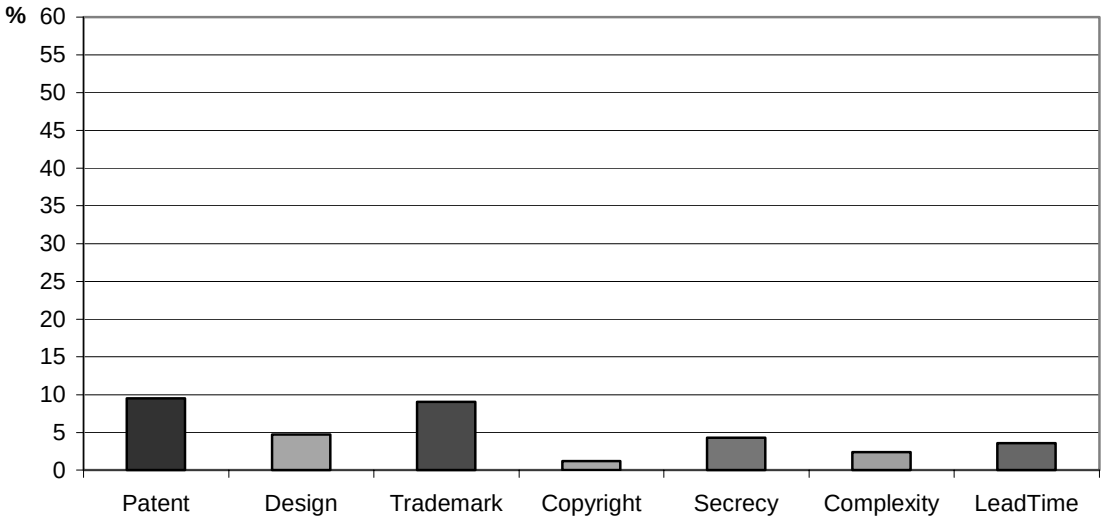


Figure 13.5. **Non-R&D-intensive manufacturing, non-innovating**

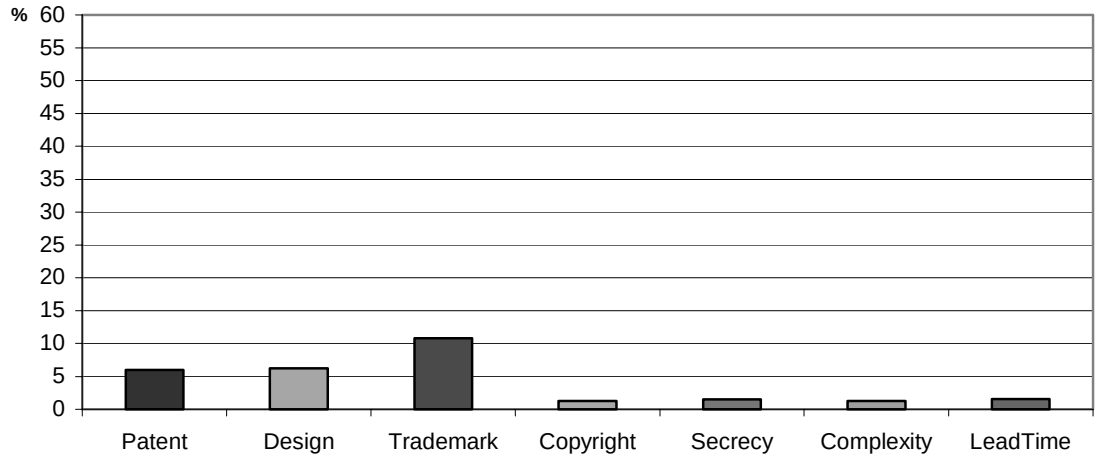


Figure 13.6. **Services, non-innovating**

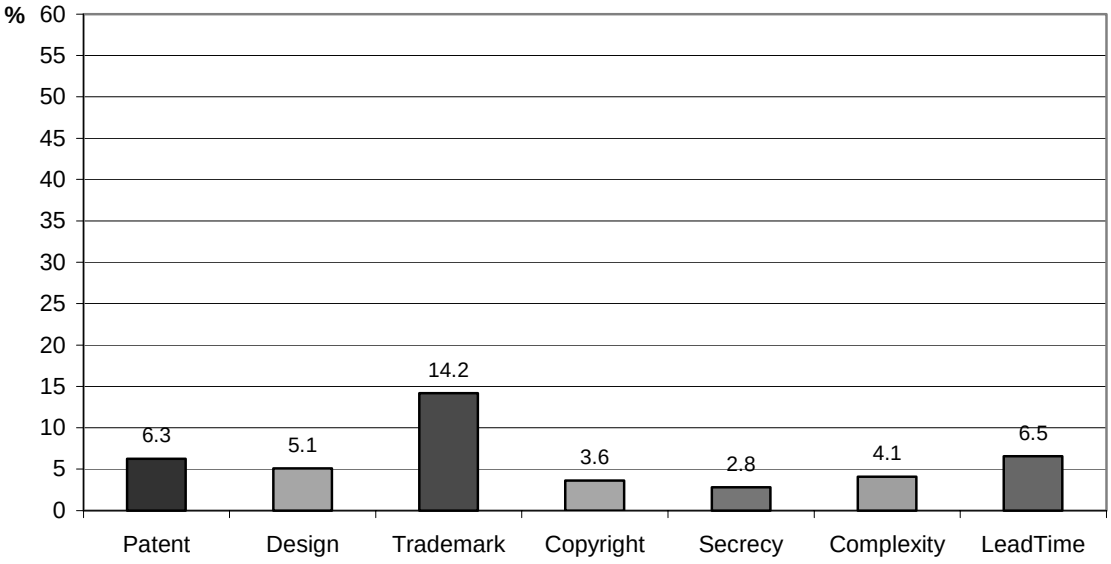


Figure 13.7. **Graph of coordinates of the 7 IP protection and non-protection strategies along the first two principal dimensions**

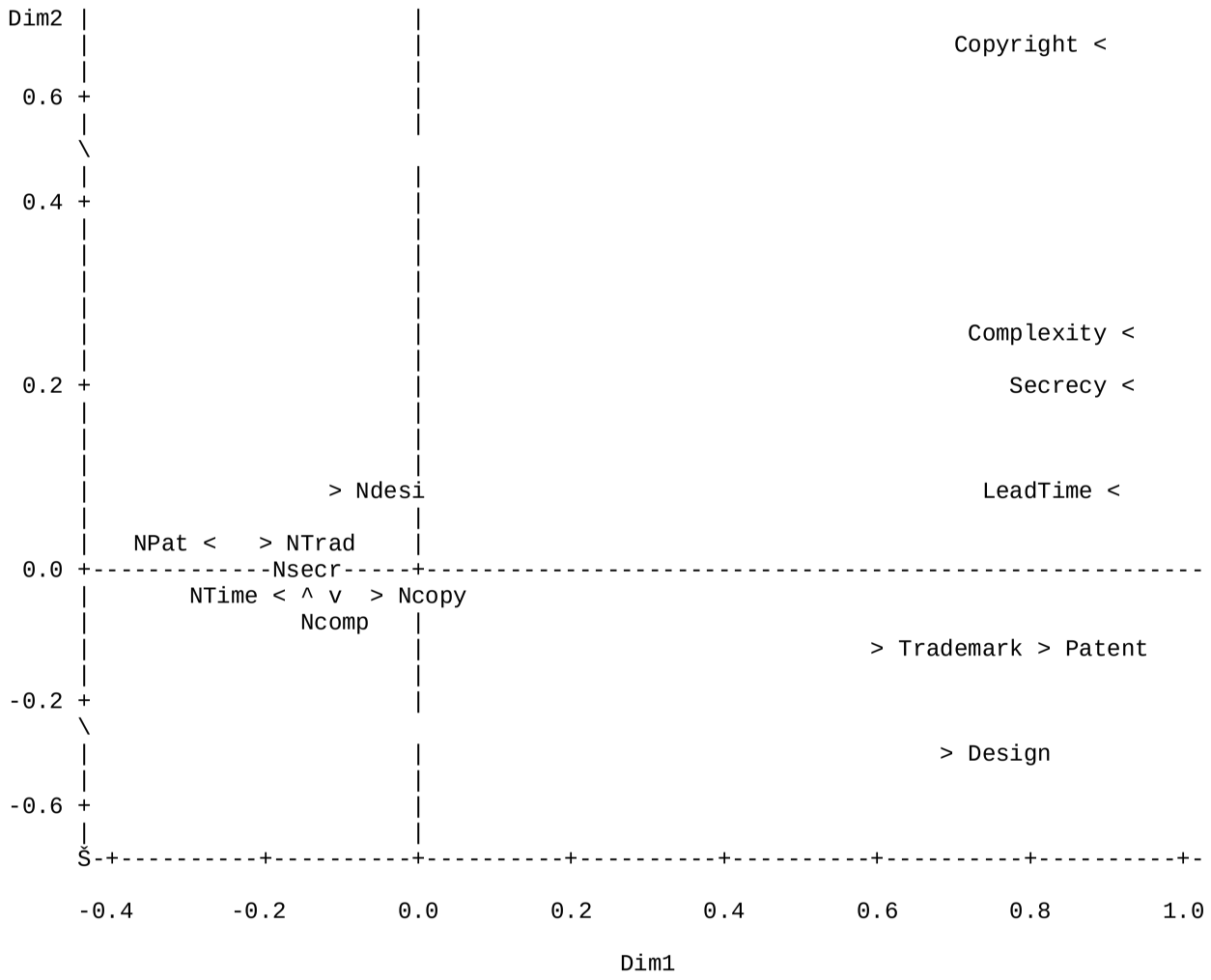


Figure 13.8. **Graph of coordinates of the innovation/non-innovation and industry affiliation along the first two principal dimensions**

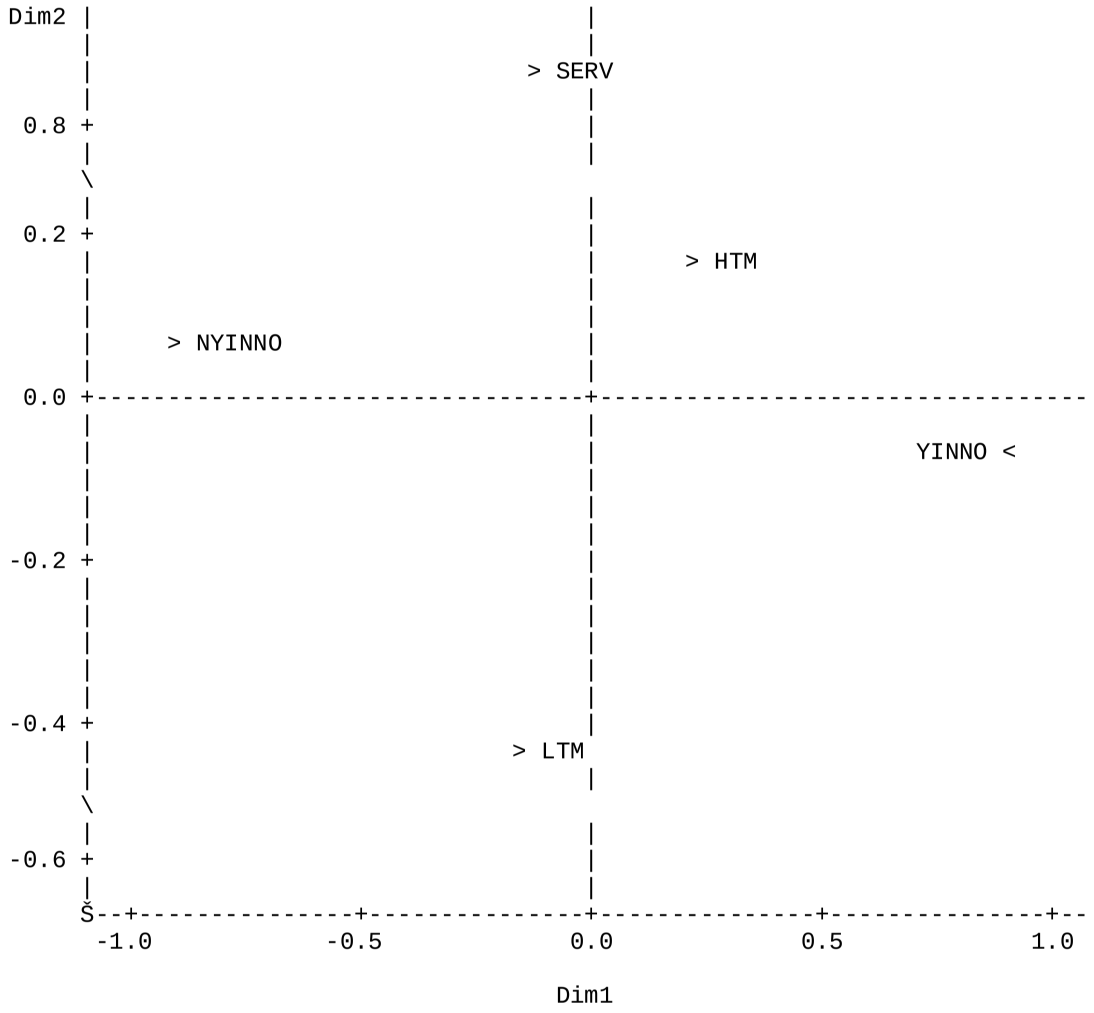
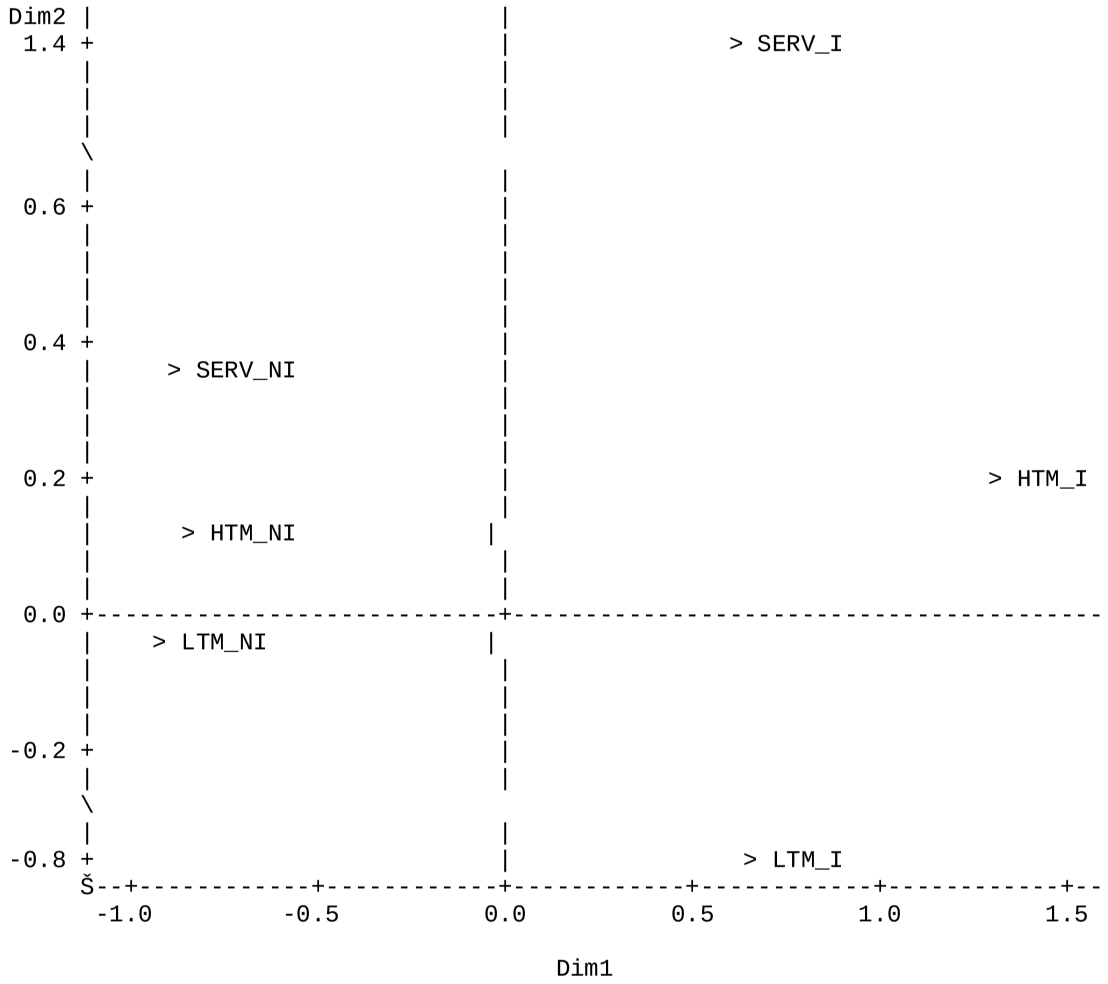


Figure 13.9. **Graph of coordinates of the innovation/non-innovation and industry affiliation interactions along the first two principal dimensions**



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Chapter 14

THE SOFTWARE PATENT EXPERIMENT[1]

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US legal changes have made it easier to obtain patents on inventions that use software. Software patents now comprise 15% of all patents, mostly acquired by manufacturing firms and large firms. Only 6% belong to software publishers. Our regression analysis finds that these patents differ from others: they are "cheap" patents. We explore whether these patents have increased R&D incentives. We find, instead, that software patents substitute for firm R&D; they are associated with substantially lower R&D intensity. Overall, the predominant use of software patents appears related to strategic "patent thicket" behavior.

1. Thanks to Peter Bessen of May8Software for providing a software agent to acquire our patent database and Annette Fratantaro for her work with the Compustat data set. Also thanks to John Allison, Tony Breitzman and CHI Research, Iain Cockburn, Dan Elfenbein, Bronwyn Hall, Joachim Henkel, Brian Kahin, Cecil Quillen, Leonard Nakamura, Eric von Hippel, Rosemarie Ziedonis and seminar participants at APPAM, Berkeley, EPIP Munich, Federal Reserve Banks of Philadelphia and San Francisco, the Federal Reserve System Applied Micro meetings, Harvard, IDEI, MIT, NBER, and OECD.

The views expressed here are those of the authors and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

Introduction

When it comes to patents, over the last two decades, the United States has undergone an almost accidental process of legal innovation. Standards were reduced — we now issue patents for inventions that, in the past, would not have qualified for protection. In addition, the scope of technologies that can be patented have been increased to include, among other things, gene sequences, computer programs, and methods of doing business.

This article investigates the effects of extending the patent system to a field of technology—computer software—known for rapid innovation well before software patents became commonplace. According to our estimates, the United States Patent and Trademark Office (USPTO) now grants at least 20 000 software patents a year and the numbers are growing rapidly. The European Commission is considering a proposal to formally recognize the patentability of computer programs in member countries. These changes have been controversial, but they are typically justified by the argument that making patents easier to obtain will increase the incentive to invest in R&D and therefore the rate of innovation.[2] In policy circles, it is fair to say this is the conventional wisdom.

There is sound empirical evidence that, for at least some industries, the availability of patents is an important factor that explains the willingness of firms to invest in R&D. For example, a number of surveys establish the important role that patents play in the US chemical and pharmaceutical industries.[3] But these surveys also show that in many other industries patents are not regarded as either very important or effective in protecting one's innovations. Other general reviews of the effects of the patent system reach ambiguous conclusions—patents help in many circumstances, but not in others, and in some instances the effects may be deleterious.[4]

The research described in this article suggests there is some reason for concern about the economic effects of software patents.[5] We find that software patents are not closely related to the creation of computer programs — the vast majority of software patents are obtained by firms outside of the software industry.[6] We also find that firms that focus on software patents, in the sense that a higher share of their new patents are software patents, have tended to focus less on research than other firms. Interpreting these facts is difficult, but they do suggest that the relationship between the increased availability of software patents and the incentive to invest in research and development (R&D) is more complicated than is often assumed in the policy debate. In short, we did not find much evidence in favor of the conventional wisdom.

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2. Many studies examine the relationship between growth in R&D and growth in productivity or economic output. See, for example, Guellec and van Pottelsberghe de la Potterie (2001) and Griliches (1994).

3. See Richard Levin *et al.* (1987) and Cohen et al (2000). Using data from the latter survey, Arora *et al.* (2003) find that firms who rate patents as both more important and more effective tend to do more R&D.

4. For recent reviews, see Federal Trade Commission (2003), National Research Council (2003), and Gallini (2002).

5. This article is based on our 2004 working paper.

6. We identify software firms as those companies included in Standard Industry Classification (SIC) 7372 (software publishers) as coded in Standard and Poor's *Compustat* database in 1999. For some purposes, we use a broader definition of software firms, i.e. those classified in SIC 737 (computer programming, data processing, and other computer related services).

Changes to our patent system

The American patent system has changed in a number of important ways over the last quarter century. In this article, we explore the potential effects of some of these changes: the relaxation of standards used to determine whether an invention qualifies for patent protection and the elimination of the so-called subject matter exception that precluded the patenting of computer programs.

What is a patent? For over 200 years, the US government has used patents to reward inventors for their discoveries. The reward is a grant of the legal right to exclude others from making, using, or selling the patented invention for a limited period of time.[7] If the patent is infringed, the patent owner may sue the infringer to recover lost profits. If the infringement was willful, additional damages may be awarded.

In certain ways, a patent is a custom design. The inventor's right to exclude is limited to those *claims* applied for and granted by the patent office. Those claims are based, at least in part, on the description of the invention contained in the application to patent office.

Not every invention can be patented. US patent law permits a patent to be granted only for inventions that are useful, new, and non-obvious. The first two requirements are fairly intuitive and sensible. One view of patents is that they are a bargain with inventors—the government grants a temporary monopoly on an invention, but only if it is both useful and represents an advance over our existing knowledge, which patent lawyers call the prior art. In exchange, the inventor must disclose the nature of the invention, which is described in the patent document itself. The third requirement, *non-obviousness*, is less clear. It rules out the patenting of an invention that would have been obvious to a practitioner in the relevant field at the time the invention was made. In other words, a patentable invention must be more than a trivial extension of the prior art.

Our patent law, and many judicial decisions, provides instructions on how the non-obviousness requirement is to be applied. During the 1980s, a number of judicial decisions revised these instructions in significant ways. In practice, the modified test for non-obviousness is easier to satisfy than the one applied prior to the early 1980s. As a result many more inventions now qualify for patent protection.[8] Other judicial decisions made it easier for a patent holder to obtain a preliminary injunction — a court order prohibiting a potentially infringing activity even before the question of infringement is decided by the court. Today, the threat of a preliminary injunction often carries significant weight in negotiations between patent holders and alleged infringers.

Subject matter exceptions. As a general principle, the American patent system is not designed to treat different kinds of inventions differently. For example, when Congress passed the 1952 Patent Act, the committee report endorsing the bill stated that the new law was meant to

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7. Today, a US patent expires 20 years after the date of application. In the past, the patent term ran for 17 years from the date of grant.

8. The changes in the 1980s were instituted by the Federal Circuit, a specialized appeals court for patent and certain other cases, created in 1982. For more information about these decisions, and their affect on subsequent litigation, see Hunt (1999) and Jaffe (2000). The economic effects of reduced patentability standards are examined in Hunt (forthcoming).

apply to "everything under the sun made by man."[9] These words are often mentioned in judicial decisions where a federal court is confronted with the problem of interpreting Congress' intent in drafting that law.

One exception to this rule was computer software. In the 1972 decision *Gottschalk v. Benson*, the Supreme Court ruled that the computer program in question was a mathematical algorithm and, as such, was unpatentable subject matter. But it did not take very long before new decisions began to blur this seemingly bright line distinction between computer programs and other inventions. For example, in the 1981 decision in *Diamond v. Diehr*, the Supreme Court ruled that an invention incorporating a computer program could be patented as long as the new and non-obvious aspects of the invention did not consist entirely in the software. Even this distinction was gradually eroded.[10]

Any real difference in the treatment of software and other inventions was essentially eliminated after a 1994 appeals court decision (*in re Alappat*) upheld the patentability of a computer program that smoothes digital data before displaying it as a waveform on a computer monitor. Shortly after that decision, the Patent and Trademark Office issued a comprehensive revision to examination guidelines for computer related inventions. Thereafter, the number of software patents granted increased dramatically (see *Software Patents Granted*).

Taking a closer look at software patents

Despite considerable interest in the effects of granting patents on computer programs, there is no official list of software patents. USPTO maintains a detailed system for classifying patented inventions by technology field — a sort of Dewey decimal system for patents. But there is no explicit classification for software inventions. Instead, researchers must devise their own ways of identifying software patents.[11] The data used in this article are based on a simple keyword search of USPTO's database of patents issued after 1975. We looked for patents that used the words "software" or "computer program" in the description of the invention.[12]

According to this definition, about 1 000 software patents a year were granted in the early 1980s, increasing to about 5 000 a year in 1990. The rate doubled again by the by 1996. Nearly 25 000 software patents were granted in 2002. This was a period of very rapid growth in patenting—the number of patents of any kind granted in 2001 was 1.7 times larger than in 1981—but the growth in software patents was much larger still. As a result, the share of all patents that are counted as software patents increased from about 2% in the early 1980s to nearly 15% by 2002 (See *Software Patent Share*).

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9. Senate Report No. 1979 82d Congress, 2nd Session (1952), p. 5.

10. For additional information on the changing treatment of software in patent law, see Hunt (2001).

11. For details on the different approaches see Allison and Lemley (2000), Allison and Tiller (2001), and Graham and Mowery (2003).

12. The exact search query is found in the Data Appendix. For a comparison of this definition, and the resulting patent counts, with others in the literature, see our working paper.

Software patents are an American phenomenon. We can learn something about the inventors and owners of patents by examining information contained on the patent document itself. From this information, we learn that software patents are a (relatively) home grown phenomenon. During the 1990s, 70% of software patents were obtained by inventors living in the United States; that is significantly higher than the 53% domestic share of inventors of all other patents. Similarly, 70% of all software patents owned by companies went to firms headquartered in the United States; 51% of all other patents owned by companies went to an American firm.

Established firms obtain most software patents. The typical owner of a software patent is a relatively large, well-established firm. During the 1990s companies obtained a larger share of software patents than other patents (88% vs. 80%).[13] To put it another way, individuals were relatively less likely to obtain their own software patent than a patent on another kind of invention.

We can also compare the financial characteristics of firms that obtain software patents and other kinds of patents.[14] To do this, we examine the median firm ranked in terms of the number of *1)* software patents obtained and *2)* the number of other patents obtained.[15] The median firm ranked in terms of software patents is much larger than the median firm ranked by other patents. If size is measured in terms of market value, the median software patentee is twice as large as the median patentee of other inventions (USD 24 million vs. USD 12 million). Measured in terms of sales, it is 50% larger (USD 13 million vs. USD 9 million). Measured in terms of spending on research and development, it is 68% larger (USD 956 million vs. USD 376 million).

Most software patents do not come from the software industry. We were surprised to find that the vast majority of software patents are not obtained by firms associated with computer software. In the second half of the 1990s, firms in the software industry received 1% of all patents granted to firms that are included in the Compustat file and at most 7% of all software patents (see Table 14.1, page 262).[16] Manufacturers accounted for three out of four software patents. The top five firms in terms of software patents obtained in 1995 included IBM, Motorola, Hitachi, AT&T, and Hewlett-Packard. Nine of the top ten firms ranked by software patents received in 1995 were on the list of the top 20 firms ranked by patents of any kind.

Firms in just three manufacturing industries (machinery, electronics, and instruments) alone accounted for two thirds of software patents granted to firms—a number that significantly exceeds their impressive 54% share of patents of any kind. These numbers are even more

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13. The USPTO data indicates the owner of a patent at the time it was issued. The owner may be the individual(s) who made the invention or an organization (assignee) such as firm or a government agency.

14. Much of our analysis is based on matching patents to companies in Standard and Poor's Compustat database. We rely extensively on data contained in the NBER Patent Citations Data File and data generously provided to us by Tony Breitzman of CHI Research. For details on the matching process see the Data Appendix.

15. The median identifies the firm where 50% of all firms have more patents than it does and 50% of all firms have fewer patents than it does.

16. These statistics are for successful patents applied for during 1994-97. For this calculation, the software industry is defined as firms included in the SIC 737, but excluding IBM which alone accounted for 6% of software patents granted.

remarkable when we examine the distribution of computer programmers across these industries.[17] These are presumably the workers responsible for creating most new computer programs. Manufacturers of machinery, electronics, and instruments employed only 6% of all computer programmers and yet they obtained two out of three software patents. Firms outside the manufacturing sector employed nine out of ten computer programmers; but together they accounted for only one out of four software patents. It would appear that the distribution of software patents across industries reflects something other than the creation of software.

In the next two sections we describe a number of findings from our statistical analyses. First, we explore differences in the software patenting behavior of firms across industries and over time. Then, we look for any relationships between a firm's software patenting behavior and its R&D investments.

Why are there so many software patents?

The most obvious answer to this question is that firms obtain software patents today, when they either could not or did not obtain them in the past. In addition, the software sector of the economy has grown over time. But this explanation tell us very little and it potentially exaggerates the effects of legal changes by ignoring economic and other factors that may have contributed to the explosion in software patenting. We will try to control for some of these factors and then examine the remaining variation in software patenting behavior across firms and over time.

Estimating patent propensity. Industries vary significantly in their *propensity to patent*—that is, the average number of patents obtained from a given amount of resources spent on developing new products and processes. For example, during the mid-1990s firms in the machinery, electronics, and instrument industries received between four and seven patents (of any kind) for every USD 10 million in R&D they spent (see *Distribution of Software Patents*). That compares to only about one patent per USD 10 million in R&D for firms in the software industry. Based on this simple calculation, all else equal, if we observed a USD 10 million increase in R&D in each of these industries, we would expect to see four to seven more patents by manufacturers of machinery, electronics, and instruments and 1 additional patent by software companies.

Our statistical analysis attempts to explain the number of software patents that firms obtain. Our technique is a more complicated version of the calculation described above. We control for a firm's investment in R&D and plant and equipment, its size, and other characteristics. We also control for employment of computer programmers and engineers in the firm's industry. We say that a firm, or an industry, has a higher software patent propensity if, it generates more software patents after controlling for R&D and these other factors. We also look for changes in software patent propensity over time, *i.e.* changes in the number of software patents obtained by firms that cannot be explained by changes in their R&D or other factors.[18] This residual change in patent propensity over time should capture, albeit imperfectly, the effect of changes in the legal treatment of software patents.

17. Our data on computer programmers comes from various editions of the *Occupational Employment Survey*, published by the Bureau of Labor Statistics. We thank Joseph Bush of BLS for his assistance.

18. For an excellent example of this methodology applied to the American semiconductor industry, see Hall and Ziedonis (2001).

What explains software patent propensity? We find that firms apply for more software patents when they are both more research and capital intensive and when the industry workforce consists of more programmers and engineers. We did not find a difference in the software patent propensity of old and young firms, except in the software industry. There, new firms have a significantly lower software patent propensity than older firms in the same industry.[19]

Manufacturers in general have a much higher software patent propensity than do firms in the software industry (see *Distribution of Software Patents*). After controlling for R&D and other factors, firms in the machinery, electronics, and instruments industries obtain software patents at a rate four to ten times higher than firms in the software sector. In addition, software patent propensity is significantly higher for firms in industries where their peers obtain more patents (of all kinds) per employee. These patterns suggest that a firm's acquisition of software patents is better explained by its industry's reliance on patents in general than by its investments in the development of software.

The rise in software patent propensity over time. The average annual increase in the number of successful applications for software patents over the years 1987 to 1996 was 16%. Our analysis shows that changes in firms R&D and capital investments, employment of programmers, and other factors explains about one-third of the rate of increase in software patents. The remaining two-thirds (about 11% a year) represent the increase in software patent propensity over time. Compared to the rate for 1987, and holding all other factors constant, firms were successfully applying for 50% more software patents in 1991, and more than 150% more by 1996.

It is likely that a good part of this increase in patent propensity is the result of changes in the legal treatment of software patents.[20] Such changes might work in two ways. The cost of obtaining software patents, relative to the cost of obtaining any other patent may have fallen. Alternatively, the economic benefit conferred by a typical software patent, again relative to the benefit conferred by any other kind of patent, may have increased. Or both of these may be true — in other words, our analysis suggests that the relative profitability conferred by obtaining software patents increased over time.

Do more software patents mean more R&D?

Ordinarily when a firm is able to obtain additional patents, the profits earned on its inventions should rise. This should encourage the firm to do more R&D. Similarly, when a firm performs more R&D, it should invent more, and that should make it easier to get additional patents. This is the traditional incentive theory of patents: By granting firms more and stronger property rights — that is, the right to capture more profits from their R&D investments — the government can stimulate innovation.

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19. A new firm in our analysis represents the first five years that a company is reported in Compustat.

20. We cannot attribute all of this residual increase to legal changes, because the pattern can also be explained by productivity growth, *i.e.* increases in the number of inventions per programmer. Our review of measures of productivity growth in the software sector suggests, very roughly, that an upper bound of productivity growth is unlikely to explain more than half of the residual increase in software patent propensity over time.

Complements or substitutes? When economists think about a problem like this, they often inquire whether the variables in question are *complements* or *substitutes*. In the standard textbook exposition, two goods are complements if a *fall* in the price of one good induces an *increase* in the consumption of the other. An example of two goods that might act as complements might be coffee and cream. On the other hand, two goods are substitutes when a *fall* in the price of one good causes a *decrease* in the consumption of another good. An example of two goods that might act as substitutes would be public transit and automobiles.

This intuition about complements and substitutes also applies to a firm's choice of inputs used by a firm. For example, if the cost of information technology (IT) declines, it is entirely possible that a firm will purchase more of the technology *and* hire more computer programmers who are skilled in using that technology. If that did happen, we would say that IT equipment and computer programmers are complementary inputs.[21] If on the other hand, we observed a decline in the number of computer programmers, we might conclude that IT equipment has substituted for computer programmers, who have become more expensive relative to cost of IT equipment.

To economists, then, the conjecture that making software patents easier to obtain will increase investments in R&D is a claim that these patents and R&D are complementary inputs in the production of profitable innovations. All else equal, the legal changes described earlier increased the return from obtaining software patents relative to other patents. We have already seen that one response was a very large increase in the number of such patents (the quantity demanded rose as the cost of software patents fell), even after controlling for other factors. But what has been the effect on demand for R&D?

The relationship between R&D and software patents has changed. To answer this question, we might examine the relationship between changes in a firm's research intensity (typically measured by the ratio of R&D to sales) and changes in the firm's *software patent focus* — their new software patents divided by all their new patents — over time. An increasing software patent focus should reflect a decline in the firm's cost of obtaining software patents relative to other patents. A positive correlation between changes in research intensity and changes in software patent focus would suggest that software patents and R&D are indeed complementary inputs.[22]

Our actual statistical analysis is a more complicated version of this exercise. We examine differences in firms' R&D intensity and software patent focus over five-year intervals. Of course many other factors might induce changes in R&D intensity, so we control for changes in input prices (including information technology), firm size, new vs. established firms, leverage, employment of computer programmers, and idiosyncratic factors specific to the firm or industry.[23]

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21. Note that the total value of IT equipment purchased might rise or fall depending on whether or not the firm's demand for IT is elastic. We say demand is elastic when a decline in price, in percentage terms, induces a larger increase, again in percentage terms, in the quantity demanded.

22. By positive correlation, we mean increases (decreases) in software patent focus are associated with increases (decreases) in R&D intensity in a way that cannot be explained by chance.

23. We used input prices data from the BLS Multifactor Productivity Series. Our regressions are based on cost shares or revenue shares (R&D/total costs and R&D/sales, respectively) to control for shifts in final demand. Examples of how economists use such techniques can be found in the Berndt (1991) and Greene (1993).

We find that, all else equal, during the late 1980s, firms that increased their focus on software patents tended to increase their R&D intensity, but the relationship was weak. In other words, more likely than not, software patents and R&D were complementary inputs during the 1980s.[24] For the 1990s we found a much stronger relationship, but it was negative — all else equal, increases in software patent share were associated with decreases in research intensity. This suggests that in the 1990s, software patents substituted for R&D. There is also evidence this negative correlation became even more negative by the late 1990s, but we cannot be 95% certain this is true.

The exact magnitude of the effect varies across firms distinguished by either their size or age, but not so much so that we can be sure the differences are not the result of chance. On the other hand, the effect is concentrated among firms in the machinery (including computers) and electronics (including semiconductors) industries and the software industry broadly defined[25] — in other words, among firms in those industries that account for about two thirds of all software patents. Outside of those industries there is no systematic relationship between an increase in software patent focus and changes in firms' R&D intensity.

Overall, the effect is economically significant. Taking the analysis literally, if the number of software patents grew only as rapidly as all other patents after 1991, the average R&D intensity of US firms would be about 7% higher than was actually recorded in 1997. This represents about USD 9 billion in additional private R&D spending for the entire US economy. It also represents about five years of the annual average increase in the research intensity of American firms since 1953.

But it is important to emphasize that the analysis does not identify the exact relationship that explains why an increases in software patent focus is associated with a decline in research intensity. In the language of statistics, this approach identifies a correlation but not causation. Still, we can compare the patterns identified in the data with a number of hypotheses about the effects of software patents.

Reconciling theories with the data

While we can't provide a full explanation of what happened, we can compare the facts identified so far with a variety of hypotheses or theoretical arguments that appear in the debate over changes to the US patent system.

The Incentive Theory. The first of these is the traditional incentive theory, which argues that by making available stronger property rights at lower cost, firms will have an increased incentive to engage in R&D. It is this conventional wisdom that is often cited in arguments in favor of extending patent protection to computer programs. Is our evidence consistent with this theory?

24. But we cannot say with 95% confidence that this is true.

25. Here we count all firms in SIC 73 (Business Services) as software and this includes IBM. If we exclude IBM from SIC 73, we do not find a systematic relationship between increases in software patent focus and changes in R&D intensity among the remaining firms in SIC 73.

The answer seems to be no. We observe that the vast majority of software patents are obtained by firms outside the software industry and with little investment in the inputs (computer programmers) required to develop software inventions. The distribution of software patents seems to follow more closely the general pattern of industry-wide patent propensities than anything peculiar to software in itself. Industries known for prodigious patenting in general account for the vast majority of software patents obtained. And firms located in such industries have a higher software patent propensity.

The increases in the total number of software patents and in software patent share are consistent with firms responding to a decline the relative cost of obtaining these patents, or alternatively an increase in their cost effectiveness. But the negative correlation between increases in a firms' software patent focus and their R&D intensity suggest that firms may be substituting for R&D with software patents. This negative relationship occurs in only certain industries (including computers and electronics), which just happen to be industries recognized for their prodigious patenting and the importance placed upon the strategic use of patents.[26]

A productivity shock. Another hypothesis is that the US economy has experienced a large productivity shock that favored inventions implemented via computer programs. Such a shock would be consistent with a large increase in software patenting and the long run trend towards higher research intensity among American firms. But it is inconsistent with the negative correlation between increases in software patent share and R&D intensity. What's more, the observed increase in software patent propensity seems too large to explain entirely by advances in the productivity of computer programming.

One variation on the productivity shock hypothesis points to the potential for outsourcing of software development as the market for prepackaged software expanded. In other words, firms might have chosen to purchase software rather than to develop it internally. Such outsourcing could explain a decline in research intensity, but firms outsourcing their software development firm would also likely reduce their focus on software patenting. Conversely, software developers that benefit from outsourcing might be expected to increase both their R&D investments and software patenting. Neither of these patterns is consistent with the data.

It has also been suggested that the use of software in the R&D process significantly reduce the cost of doing R&D and this might explain the observed negative correlation between software patent focus and R&D intensity. But previous studies have shown that firms respond elastically to changes in the cost of doing R&D.[27] In other words the quantity of R&D firms do increases by at least as much in percentage terms, as the decrease in its cost. Thus, even if software reduced the cost of research and development, R&D intensity should not fall and it might even increase.

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26. For evidence on the patenting behavior of such firms see Hall (2003). For a discussion of patent strategies in these industries see Levin *et al.* (1987) and Cohen *et al.* (2000).

27. See, for example, Berger (1993) and Hall and van Reenan (1999). In addition, our analysis takes into account changes in the cost of software and the share of computer programmers in the industry workforce.

Patent thickets? In contrast to the incentive theory already described, suppose instead that firms in an industry firms assemble large patent portfolios in order to extract royalties from competitors and to defend themselves from similar behavior by their rivals Economists have come to describe such an environment as a patent thicket.[28] In theory at least, extensive competition in patents, rather than inventions, may occur if firms rely on similar technologies and the cost of assembling large portfolios is not very high. In such an environment, firms may compete to tax each others' inventions and in the process reduce their competitors' incentive to engage in R&D.[29] The outcome of patent litigation and licensing agreements often depends on the size of the firm's patent portfolio. This creates an incentive to build larger patent portfolios, especially when the firm focuses on patents as a competitive strategy. In this account, firms choose to compete in court, rather than in the marketplace.

The changing legal treatment of software patents might explain a systematic change in the behavior of some firms. During the early 1980s, patents were relatively costly to obtain, and this might have discouraged substitution away from R&D and toward strategic patenting. By the mid 1990s, software patents became a relatively inexpensive way to expand patent portfolios. This may have increased the attractiveness of a strategy that emphasizes patent rights over a strategy based on R&D. Such a change in strategy would be particularly attractive to mature firms if their R&D labs are not as productive as they once were.

The patent thicket explanation is consistent with the observed rise in patent propensity and the negative relationship between changes in software patent share and research intensity in certain industries. It might also explain why software patents are more common in industries with high patent propensities (machinery, electronics, and instruments) rather than in industries that focus primarily on developing software. And it is consistent with the observation that software patent propensity is higher in industries where firms obtain more patents per employee.

Conclusion

Nearly 50 years ago, scholar Fritz Machlup presented the results of his study on the efficacy of the patent system to the US Congress. He concluded:

> *"If one does not know whether a system "as a whole" (in contrast to certain features of it) is good or bad, the safest "policy conclusion" is to "muddle through" .... If we did not have a patent system, it would be irresponsible... to recommend instituting one. But since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abolishing it."*

What would Machlup think about a significant expansion of the patent system, and a significant change in patentability standards, instituted in the absence of much evidence about the likely effects? Yet this is precisely what has happened in the United States over the last quarter century.

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28. For evidence of this phenomena in the electronics and semiconductor industries see Grindley and Teece (1997) and Hall and Ziedonis (2001).

29. For a theoretical model of this intuition see Bessen (2003).

These changes are often justified on the basis of the conventional wisdom—that granting more and stronger property rights will necessarily stimulate innovation. Our evidence suggests this assumption may be incorrect in the case of software patents in the United States during the 1990s. If, instead, the legal changes have encouraged strategic patenting, then the end result might be less innovation. Clearly, much more research should be done on this important policy question.

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DATA APPENDIX

Identifying software patents

We count as a software patent any utility patent (excluding reissues) granted after 1975 which satisfies the following conditions:

1. The terms *software* or *computer* and *program* appear in the specification;
2. The terms *antigen*, *antigenic*, and *chromatography*, do not appear in the specification; and
3. The terms *chip*, *semiconductor*, *bus*, or *circuit*, or *circuitry* do not appear in the title.

Using this algorithm, we identified 130,650 software patents granted in the years 1976 to 1999. For a comparison of this definition, and the resulting patent counts, with others used in the literature, see our working paper.

Matching patents to firms

Our statistical analysis relies on the matching of patents to companies in Standard and Poor's *Compustat* database. The majority of our matches are obtained from the NBER Patent Citations Data File. For details on that resource, see the working paper by Hall *et al.* (2001). We supplemented those matches using information graciously provided to us by CHI Research (for information about this data, see *www.chiresearch.com/information/customdata/patdata.php3*).

Both of these sources link a numeric assignee number issued by USPTO with an alpha-numeric CUSIP code that can be used to identify firms contained in Compustat. In addition we also matched the patents of the 25 largest publicly traded software firms and 100 other large R&D performers not already matched in the data provided by the other sources.

The resulting data set includes patents matched to 4 792 distinct subsidiaries and 2 043 parent firms. Over the 1980-99 period, our sample accounts for 68% of successful US patent applications by domestic non-government organizations (mostly corporations) and 73% of software patents granted to these organizations. The matched firms accounted for 91% of R&D spending reported by US firms in Compustat. These coverage ratios are quite stable over the two decades.

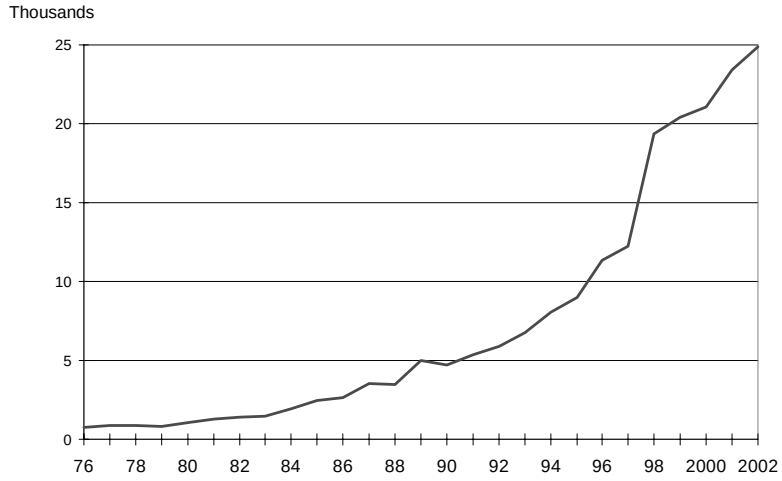
Still, only 37% of R&D performers in the Compustat data set were matched to their patents. This suggests the possibility of *selection bias* in some of our results, because firms successfully matched to their patents may somehow be systematically different from firms who are not matched. In particular, our coverage of the smallest and newest firms in Compustat is not likely to be as good as our coverage of larger and older firms. We conducted a number of statistical tests for selection bias and found this possibility had little or no effect on the results reported here. For details, see our working paper.

Table 14.1. **The distribution of software patents**

	(1)	(2)	(3)	(4)	(5)	(6)
	Share of all				All patents/ R&D	Software patent propensity
	Software patents	Programmers	Programmers & engineers	All patents		
Manufacturing	75%	11%	32%	88%	3.8	
Chemicals (SIC 28)	5%	1%	2%	15%	2.5	1.5
Machinery (SIC 35)	24%	3%	7%	17%	4.2	4.4
Electronics (SIC 36)	28%	2%	7%	27%	6.8	9.6
Instruments (SIC 38)	9%	1%	4%	11%	7.1	8.7
Other manufacturing	9%	5%	13%	18%	2.3	1.9
Non-manufacturing	25%	89%	68%	12%	3.0	
Software publishers (SIC 7372)	5%	33%	18%	1%	1.0	1.0 (all SIC 73)
Other software services (exc. IBM)	2%			1%	2.8	
Other non-manufacturing	4%	55%	49%	4%	3.4	3.8
Addendum: IBM	6%	--	--	2%	5.0	

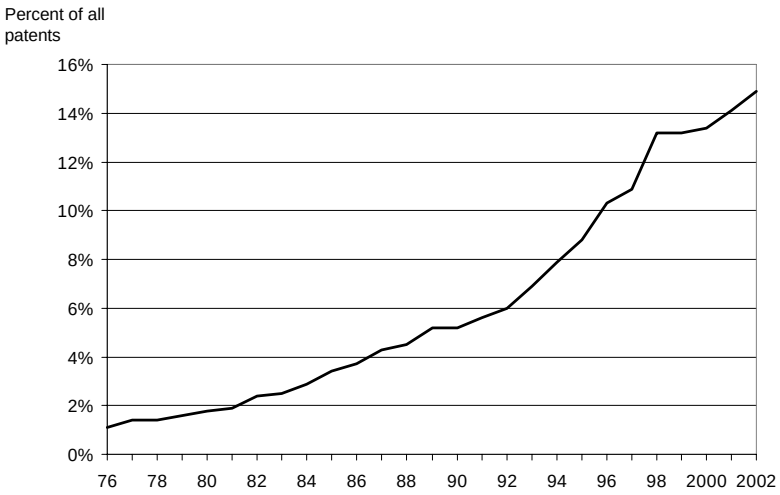
Notes: This table is based on successful patent applications made during years 1994-97 that are matched to a firm in the Compustat data set. Data on computer programmers is from the Bureau of Labor Statistics *Occupational Employment Survey* (various years) and the numbers include system analysts. Note that the tabulation of programmers and engineers for the software sector (SIC 737) includes employment by IBM. The fifth column reports patents granted per USD 10 million of R&D in 1996 dollars. The last column reports the relative patent propensity (for software patents) estimated in the statistical analysis contained in our working paper. The numbers are presented relative to the estimated patent of firms contained in the business services sector (SIC 73). For example, the estimated software patent propensity for the chemical industry is 1.5 times that for SIC 73.

Figure 14.1. **Software patents granted**



Note: The table plots software patents by grant date, not application date.

Figure 14.2. **Software patent share**



Note: The table plots software patents by grant date, not application date.

Chapter 15

THE USE OF PATENTS, COPYRIGHTS AND TRADEMARKS IN SOFTWARE: EVIDENCE FROM LITIGATION[1]

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The intellectual property (IP) regime for software has undergone significant changes in the United States during the 1980s and 1990s, with an increase in the legitimacy of patents and a concomitant restriction of copyright in some circumstances. This study examines litigation data on patents, copyrights, and trademarks, the three main forms of US federally protected IP rights, to understand the impact of these changes and the role of intellectual property protection in software. We find a surprisingly large and still growing reliance on copyright enforcement, and evidence that incumbent firms in the industry are relatively on the defensive in patent litigation. Moreover, when compared with other similar industries, defensive strategies in software patent litigation appear to be tilted towards declaratory judgment actions, rather than mutual hold-up through counter suing. This paper also studies the interrelationship between a firm's efforts to enforce different types of intellectual property rights. Prior research on patents and secrecy, as well as the policy debate in software, has tended to view different types of IP as substitutes rather than complements. We employ a fixed-effects seemingly-unrelated-regression (SUR) model to estimate (by GLS) the level of litigation in each type of IP, and find some evidence for complementarity between different types of IP use in software.

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Introduction

The role of legal intellectual property in enabling firms to appropriate returns from their knowledge assets has undergone significant changes over the last two decades. Since the creation of a single appellate jurisdiction for patents in the form of the Federal Circuit in October 1982, rates of patenting and patent litigation have grown rapidly in the United States. Simultaneously, the overall legal and political environment is also believed to have become much more "patent friendly" (Merges, 1996; Merges and Nelson, 1994; Scotchmer, 1996; Kortum and Lerner, 1999). One manifestation of this patent-friendly institutional environment is the effective extension of patent protection to new "subject matter" areas—notably, living organisms, computer programs, and business methods.

In the software industry, a mainstay of the knowledge-based economy, the extension of patent protection to computer programs has been controversial. In the early 1990s, spurred by court decisions and a Department of Commerce study, software patenting acquired sudden legitimacy and experienced a dramatic surge (Graham and Mowery, 2003). This watershed event generated substantial academic and policy debate about the merits and potential pitfalls of the new property right (Samuelson, Denber and Glushko, 1992; Samuelson, Davis, Kapor and Reichman, 1994). Recent extensions of software patenting's reach into the Internet economy in such areas as business methods and finance have only created new strategic opportunities for patentees and raised fresh policy concerns (Lerner, 2000). Opposition to software patents has also been voiced by the open source community, which perceives patents as a threat to the open source development model.

While much of the academic discussion has focused on the policy question concerning the type of intellectual property protection best suited to software, relatively little attention has been paid to the way in which software firms use different types of intellectual property in practice. Graham and Mowery (2003) is an exception to this general pattern, and found a declining trend in copyright registrations along with the rise in patenting in the 1990s. However, these findings have been subject to criticism arising out of the inherent limitations of copyright registration data. Our paper uses intellectual property litigation data to overcome these limitations, and finds that both patent and copyright litigation have grown at a very rapid pace in the 1990s. Because we use patent, copyright, and trademark litigation data together in our work, we are able to redress, to an extent, the oft-criticized and excessive focus on patents in intellectual property research.

This juxtaposition of patent, copyright, and trademark use in software suggests a potentially fruitful avenue for academic inquiry—examining the interrelations between different types of intellectual property in the appropriability strategies of firms. In particular, it would be valuable to understand when and how different forms of IP protection act as substitutes or complements to each other. The preponderance of the theoretical literature, which has typically been focused on the patent-secrecy tradeoff, has adopted the view of IP as substitutes.[2] Prior empirical research has also addressed this question to some extent through the analysis of survey data (Levin, Klevorick, Nelson and Winter, 1987; Cohen, Nelson and Walsh, 2000), but the evidence seems to be mixed.

This paper seeks to examine the complementarity-substitution dichotomy in more depth, and thus fill and important lacuna. The software industry affords a unique opportunity to examine the research question due to the relevance of patent, copyright, and trademark protection for the same products and technologies. Moreover, we can take advantage of the shift in the intellectual property regime in favor of patents for software as an exogenous shock that allows us to examine how changes in litigation are correlated between different types of intellectual property.

2. Recent work by Graham (2003), highlighting the use of secrecy during the patent application process, is a prominent exception.

While patenting has played an increasingly prominent role in the software industry during the 1990s, relatively little is known about precisely how patents are used. It is natural to assume that like other systems products industries, defensive patenting may be commonplace in software, leading to cross licensing of patent portfolios, and counter-suits in litigation (Grindley and Teece, 1996; Hall and Ziedonis, 2001; Somaya, 2003a). In this paper, we are able to evaluate for the first time the many roles that patents play in the software industry, and their relative importance when compared with other similar industries. We find that using declaratory judgment suits to proactively defend against patents is a disproportionately popular strategy in software.

The rest of this paper is organized as follows. The next presents a brief background discussion of the software industry and the use of intellectual property by software firms. The third section provides an in-depth look at the enforcement of patents, copyrights, and trademarks in software, and compares various descriptive data relating to software IP litigation with other industries. The fourth section examines the determinants of patent litigation in software technologies across a range of industries in which these technologies are used. The fifth section examines complementarity and substitution among patents, copyrights, and trademarks in software, using data on IP litigation for a defined set of packaged software firms. The final section discusses the significance and limitations of our findings, and concludes.

Background: software and intellectual property

While patent protection for software has generated controversy, its growth reflects an overall trend towards stronger and more widespread patent protection in the United States (Merges and Nelson, 1994; Scotchmer, 1996). Throughout the 1990s, patent filing in the US grew dramatically, and software patenting grew at an even faster pace (Kortum and Lerner, 1999; Graham and Mowery, 2003). At the same time, court decisions circumscribing the use of copyright, such as the Supreme Court's decision to limit so called "look and feel" protections in Lotus Development v. Borland International,[3] appear to have spurred a relative decline in the strength of copyright protection. Trademark protection remained limited in scope until the late 1990s, when trademark concerns expanded with the growth of the world-wide-web and the increasing commercial importance of domain names.

Software: A description

The software industry, which by 2001 had topped USD 185 billion in worldwide revenues,[4] had its genesis in the unbundling of software from hardware led by International Business Machine (IBM) in the late 1960s. Early mainframe computers did not have separable operating instructions, being instead hard-wired to complete required tasks. Unbundling had the effect of separating the instructions (software) from the machine (hardware). Subsequent to IBM's unbundling, an increasing number of independent software vendors (ISVs) began to enter the market, and this entry was further spurred by the introduction of the desktop computer in the late 1970s. This rapid entry of ISVs paralleled the introduction of more user-friendly input and output devices, the switches and tubes of early mainframes being replaced by keyboards, mouses, and screen displays with "graphical user interfaces" (GUI).

3. 49 F.3d 807 (1st Cir. 1995), aff'd 116 S.Ct. 804 (1996).

4. International Data Corp, *www.siia.net/divisions/research/growth.asp*. This estimate is for packaged software only, and thus underestimates global revenues, missing important elements such as embedded software. The packaged personal computer-based software market in the United States alone is estimated at nearly USD 30 billion.

Swift adoption of the desktop PC created a fast-growing market for operating and applications software during the 1980s. New entrants like Microsoft and Adobe Systems filled much of the growing demand for PC software, while incumbents, such as International Business Machine and Texas Instruments, played a more limited role. Through the 1990s, the increasing importance of network solutions, including ultimately the Internet, has provided further opportunities for new products and entry.

Software programs are generally separated into two types: Operating systems, and applications.[5] Operating systems manage the internal functions of the computer, serving as an interface between the hardware, application software, and the user. Applications process data for the user, accomplishing such tasks as word processing, bookkeeping, and gaming. In order to be of value, individual applications must be written to be compatible with the operating system that directs the hardware on which the application is expected to run.

The programming of both operating systems and applications is supported by two different types of code: object code and source code. Object code is the software that operates the computer, and as such is comprised of a series of binary "0" or "1" codes which operate the "on" and "off" circuits of the machine. This machine language is difficult if not impossible for human programmers to decipher and manipulate, and so software is written in source code. Source code is comprised of arithmetic and near-human-language statements, which can be both learned and read by humans. Because source code cannot be directly used by the hardware, a third type of code, assembly language, provides a mechanism for translating source code into machine-usable object code. In the marketplace, difficult-to-read object code finds its way into the hands of consumers, while the readable source code remains proprietary and in the hands of the programmer.

These language characteristics of software suggest potential challenges for, as well as provide a solution for, the public goods problem (Nordhaus, 1969) in innovation. In the case of software, the ease of copying in digital form—and the fact that quality does not markedly degrade with copying—exacerbates this problem, and increases the likelihood that the market will undersupply the good. Limiting customer access to only the object code (through source code secrecy) provides software firms with one mechanism to prevent copying of the product, and legal copyright protection over the written source code provides another. Patents and trademarks provide additional layers of exclusivity, for the technological ideas and brand name, respectively.

Network externalities and the economics of standardization introduce systematic distortions in software competition. The value to an adopter of software is enhanced by the number of other adopters, both due to the ability to communicate and exchange files, and the transferability of learned skills. Thus the likelihood that a single product may emerge as a standard is increased (Katz and Shapiro, 1985), suggesting substantial advantages from lead-time and early market entry. Intellectual property protection is particularly relevant in such markets, both in its ability to impede competition for a proprietary standard, and in the protection it extends to new entrants that challenge the standard.[6]

5. Firmware, software that directs certain functions of the hardware and substitutes for hardwiring, is often distinguished as a third type of software.

6. See R. Merges, P. Menell, M. Lemley and T. Jorde (1997). *Intellectual Property in the New Technological Age*, Aspen.

Intellectual property protections in software

Due to the economic characteristics of software, intellectual property protections have captured a central place in both firm strategy formulation and, by necessity, the policy process. The development of IP protections since the 1970s can be seen as an endogenous process in which the growth and increasing economic influence of the sector translated into an expansion of the quality and quantity of property rights. While secrecy and lead-time are no doubt important appropriability mechanisms in software (Liebeskind, 2000), we focus consciously on the affirmative legal property rights granted under the federal patent, copyright, and trademark laws.

Copyright

Significant policy uncertainty attended the development of the new technology of software in the 1970s, with the government first putting its imprimatur upon copyright as the most effective protection mechanism for software. Due in part to an early Supreme Court decision openly hostile to software patenting,[7] the commission charged by Congress (the Commission on New Technological Uses or CONTU) with recommending an appropriate mechanism chose copyright in 1979 (Samuelson, 1984). "Computer program" was subsequently explicitly adopted by Congress as copyrightable subject-matter in the Copyright Act amendments of 1980. As writings, computer programs are protected by copyright upon the moment of authorship, and registration with the federal Copyright Office is not technically necessary to enjoy protection.

Nonetheless, the quick and inexpensive registration procedure[8] does provide some advantages in copyright enforcement. Copyright infringement suits cannot be filed in the US courts until the copyright is registered, and plaintiffs are denied recovery of attorney fees and statutory damages (including the increased statutory damages for willful infringement) for any activities conducted by the infringer prior to the date of copyright registration.[9] Thus, the primary civil remedy available for copyright infringement in years prior to registration is the recovery of actual damages and any additional profits of the infringer.

Despite its legislative beginnings, the development of the software copy-"right" was, in reality, largely court-made. Litigation offered judges the opportunity to define the right granted by Congress after 1980, and thus the development of the software property right was attended with substantial uncertainty. Early cases demonstrated clearly that the literal copying of an incumbent's code was a violation of the Copyright Act,[10] but the copying of non-literal elements, such as the "look and feel" of the user interface, invited much more uncertainty about the scope of the copy-"right."

Appellate decisions in influential federal circuits appeared to support a reasonably broad protection of non-literal elements,[11] but in 1992 the Court of Appeals for the Second Circuit decided Computer Associates Int'l v. Altai,[12] a watershed decision that trimmed the broad protection of non-literal elements of program code. The logic and method announced in Altai has been widely adopted, and supported in

7. Gottschalk v. Benson, 409 US 63 (1972).

8. Registration requires a two-page application form and a filing fee of USD 30.

9. 17 USC.A. §411 (2000). 17 USC.A. §412, 504, 505 (2000). Statutory damages are capped at USD 100 000 even in the case of willful infringement.

10. Apple Computers v. Franklin Computer, 714 F.2d 1240 (3rd Cir. 1983).

11. Whelan Assoc. v. Jaslow Dental, 797 F.2d 1222 (3rd Cir. 1986).

12. 982 F.2d 693 (2nd Cir. 1992).

subsequent landmark cases such as Lotus Development v. Borland International[13] in which the firm Borland International was permitted to use elements of Lotus' 1-2-3 menu organization in its spreadsheet products.

Trademark

Trademark law has traditionally sought to protect the consumer and is not a property right for the owner per se, although this view of trademark has been undergoing a transformation that maps, in time, to the development of the software industry. Federal trademark protection extends to any word, name, symbol, or device used to identify goods or services in commerce, and thus does not literally apply to the written computer code covered by copyright. To the extent, however, that quickly identifiable logos and symbols may assist a software producer in developing a "bandwagon" effect leading to de facto standardization of an operating system or application, trademark protection may be quite valuable. Furthermore, a species of trademark protection — "trade dress" — protects the non-functional appearance of a product, and thus may offer the software producer protection over the non-literal "look and feel" elements of a computer program, thus overlapping the thorny issues with which judges hearing copyright suits have grappled during the last two decades.

Patent protection

Extending patent protection to software had been opposed both by the US Patent and Trademark Office (USPTO) and the US Supreme Court throughout the 1970s.[14] However, by the mid-1980s, software was legally considered patentable subject-matter, supported by both the administrative and judicial branches. Changes in the institutional structure of the courts — i.e. the founding of the Court of Appeals for the Federal Circuit (CAFC) in 1982 to hear all patent appeals—and changes in legal doctrine over time first permitted and then strengthened patent protection for software.

This increasingly permissive attitude as regards software patenting has been linked to an overall strengthening of the "patent right" since the mid-1980s, thus making the software patent right more valuable (Merges, 1996). After the Supreme Court allowed the patenting of software embedded in a machine in the 1981 cases of Diamond v. Diehr[15] and Diamond v. Bradley,[16] a steady stream of cases from the CAFC has supported the patentability of software. Even as software patent applications at the USPTO began to rise in the early 1990s, a study commissioned by the Department of Commerce[17] concluded that the patentability of software was long established in law, and should continue. While the policy debate has since softened in the United States, it has resurfaced internationally (particularly in Europe), in the open source community, and in the extension of software patenting to business methods and financial innovations.

The changing intellectual property environment for software described above has been reflected in the patenting and copyright registration data of software firms. Graham and Mowery (2003) report that patents issued per year to the top 15 packaged software firms (measured by 1997 revenues) grew rapidly through the 1990s, with over 200 patents issued to these firms in 1997 as compared to 0 in 1987. They

13. 49 F.3d 807 (1st Cir. 1995), aff'd 116 S.Ct. 804 (1996).

14. The US Supreme Court's *Gottschalk v. Benson* decision (409 US 63 (1972)) highlights the reluctance of both the Patent Office and the Court to extend patent rights to software.

15. 450 US 175 (1981).

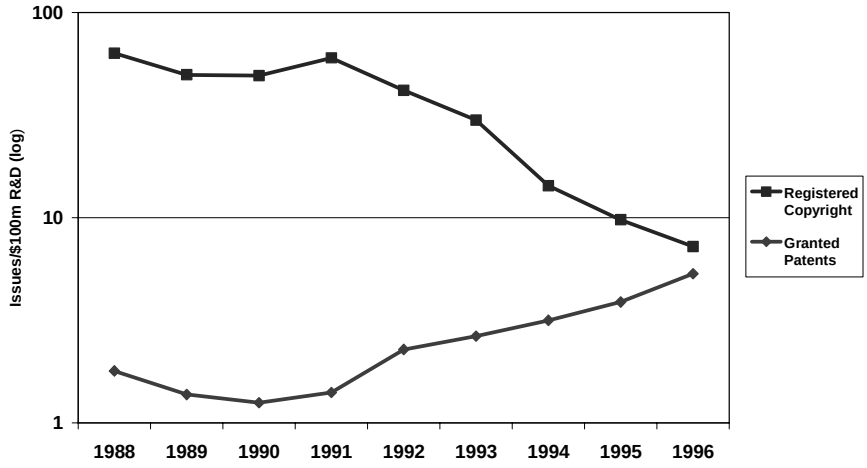
16. 450 US 381 (1981).

17. The Advisory Commission on Patent Law Reform, "A Report to the Secretary of Commerce", August 1992.

also found that copyright registrations of the top 15 packaged software firms initially flattened and then decreased after 1991, after a rapid cumulative increase of over 200% from 1987-88. Reflecting this broad trend, Graham and Mohery (2003) found that the software patenting propensity (patents obtained per R&D dollar spent) began to converge to the software copyright registration propensity (copyright registrations per R&D dollar spent) for this sample of large PC-only software firms (see Figure 15.1).

Figure 15.1. **Software firms' propensity to patent and copyright, 1987-97**

Three-year moving average, top 15 public PC packaged SW firms ('97 rev)



However, a comparison of patenting and copyright registration data is subject to some valid criticism. Primarily, this is because copyright registration data are less reliable measures of copyright use than are the patent filing data of patent use. Since the copy-"right" accrues to the inventor by the mere act of "fixation" (writing the code in the case of software), US federal copyright registration is mainly useful due to the advantages in litigation discussed earlier. Moreover, registration has very low direct costs (at most a few hundred dollars, as compared to about USD 10 000 for an issued patent), so that the exercise of this option is not as clearly a conscious choice by firms, especially since the property right itself is not forfeited by foregoing registration of the copyright.

Software intellectual property litigation

By contrast with patent filing and copyright registration, decisions to litigate over patents and copyrights reflect similar costs and incentives, thus making litigation data more comparable across the two domains. In addition, trademark litigation data provide an additional reference point with which to compare trends in copyright and patent litigation. In this paper, we use two different datasets of software intellectual property litigation, which are described below.

Data sources and construction

The first dataset of software intellectual property litigation used in this paper is based on the Softletter 100 list of (IBM) PC-based packaged software firms that have been compiled by a commercial firm (Softletter) for each year since 1985.[18] These lists were combined and cleaned by accounting for

18. Firms were only included in the list if over 50% of their sales came from packaged software.

name changes over time. Between 1985 and 1999, a total of 380 different firms were included in the Softletter 100 list, which form the core of our "industry dataset". While this sampling approach has some limitations, it has the advantage that it allows us to identify a set of firms that are clearly in "the software industry", which is otherwise difficult in a general-purpose technology like software (in our discussion of the "technology dataset" below, we highlight the broad mix of industries involved in software patent litigation). Softletter also provides us with data on annual firm revenues (which we deflate by the GDP deflator) and employment for both public and private firms on their lists.

The involvement of software firms in IP litigation is identified by searching for firm names from our industry dataset in the population of suits for all US federal district courts, obtained from the Federal Judicial Center (FJC).[19] The type of IP litigation—patent, copyright, or trademark—is identified by a code inserted by the Clerk of the Court in each suit record. Since the litigation data are obtained from the same source and identified using identical techniques, the possibility of biases stemming from idiosyncrasies of different data sources or sampling techniques is mitigated. Ad hoc corroboration with news reports was also used to verify the fidelity of the data. Further, mergers and acquisitions among the firms were tracked to ensure that ongoing litigation was assigned to the correct successor firms.

The construction of our industry dataset ensures that we capture virtually all the significant firms in the industry. For instance, even in 1999, the smallest firm in our dataset had revenues of approximately USD 4 million. Our construction did however raise one troublesome issue, specifically whether we ought to include a firm in our dataset for years in which the firm did not appear as one of the "top 100 firms" in the Softletter 100 listing. In the results reported here, we chose to include firms for all years irrespective of their presence on the Softletter 100 list firm for that year. However, we also conducted our analysis by including firms only for years when they were on the list, and found that there was no material difference in our results.

The second dataset we use in this paper, our "technology dataset," is focused on patent litigation in a specific set of software technology classes. These International Patent Classes are identified and discussed in Graham and Mowery (2003), and account for about 55% of patenting by packaged software firms.[20] Patent litigation data is obtained from the LitAlert® dataset that is based on patent litigation reported by US district courts to the US Patent and Trademark Office (USPTO). In turn, the USPTO data is matched to the FJC data described above using various common fields between the two samples.

As discussed in greater detail in prior research (Lanjouw and Schankerman, 2001; Somaya, 2003a,b), suits in the USPTO data are a subset of the FJC "population" of suits, averaging around 56% of the latter after 1983. Since patent numbers—and thus patent classes—are only available in the USPTO data, our industry dataset is based on suits reported to the USPTO. The FJC data matched to these USPTO suits are also used as appropriate. A total of 657 suits were thus identified between 1975 and 2002. This broader software technology sample provides a useful reference point for our industry sample,

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19. Federal Judicial Center. Federal Court Cases Integrated Database (various versions, 1970-2001), Ann Arbor, MI: Inter-university Consortium for Political and Social Research (distributor).

    The relevant cases were identifying by using firm-name search strings (based on the Softletter 100 lists), which were constructed to err on the side of inclusion. The resulting dataset was then manually checked to confirm that the match was accurate in each case, and over 85% of the cases were discarded in this manner. In cases of doubt, the case was painstakingly researched using secondary sources (news articles and company information) to either confirm or deny the accuracy of the match. In a small number of cases (less than 3% of the data set) where a match could not be confirmed or denied, the suit data were excluded.

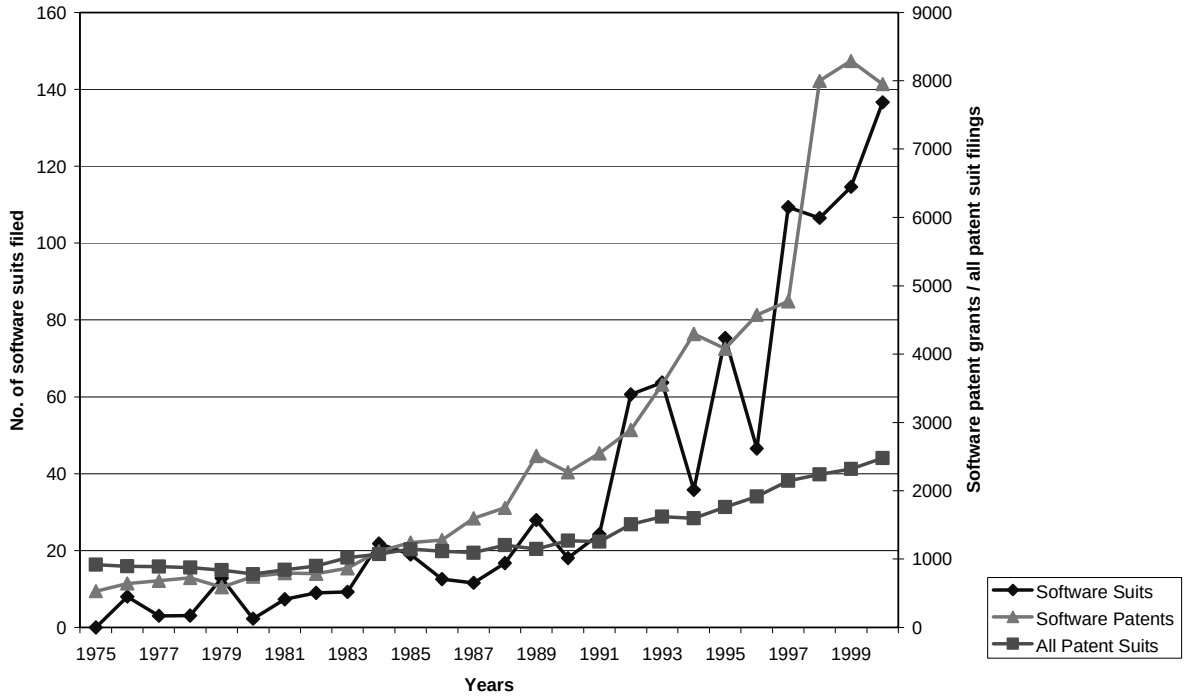
20. This is corroborated in our data - when patent litigation from the industry dataset is compared with the technology dataset, the overlap is about 57% of the former (for suits that could be coded).

and helps validate some of our results for software at large. However, it is not possible to identify copyright and trademark litigation using a technology approach, and those aspects of our analysis will per force be conducted using the industry dataset alone.

Key features of software IP litigation

Consistent with the increasing legitimacy of software patenting, Figure 15.2 illustrates a dramatic rise in both software patenting and patent litigation using the technology dataset (based on IPC classes).[21] The growth in patent litigation in the software technology classes easily outpaces the growth in patent litigation generally over this time period. A closer examination of software patent litigation reveals that software firms (both from our industry sample and outside it) are involved only in a small fraction of the suits. The majority of the suits in the technology sample involve various types of hardware firms, and firms from other industries (from genomics and finance to healthcare, food and construction) that employ software in their products or processes. The hardware firms are primarily semiconductor, telecommunications, or computer-related firms.[22]

Figure 15.2. **Estimated software patent litigation (Graham-Mowery IPC Classes), software patenting, and all patent litigation**

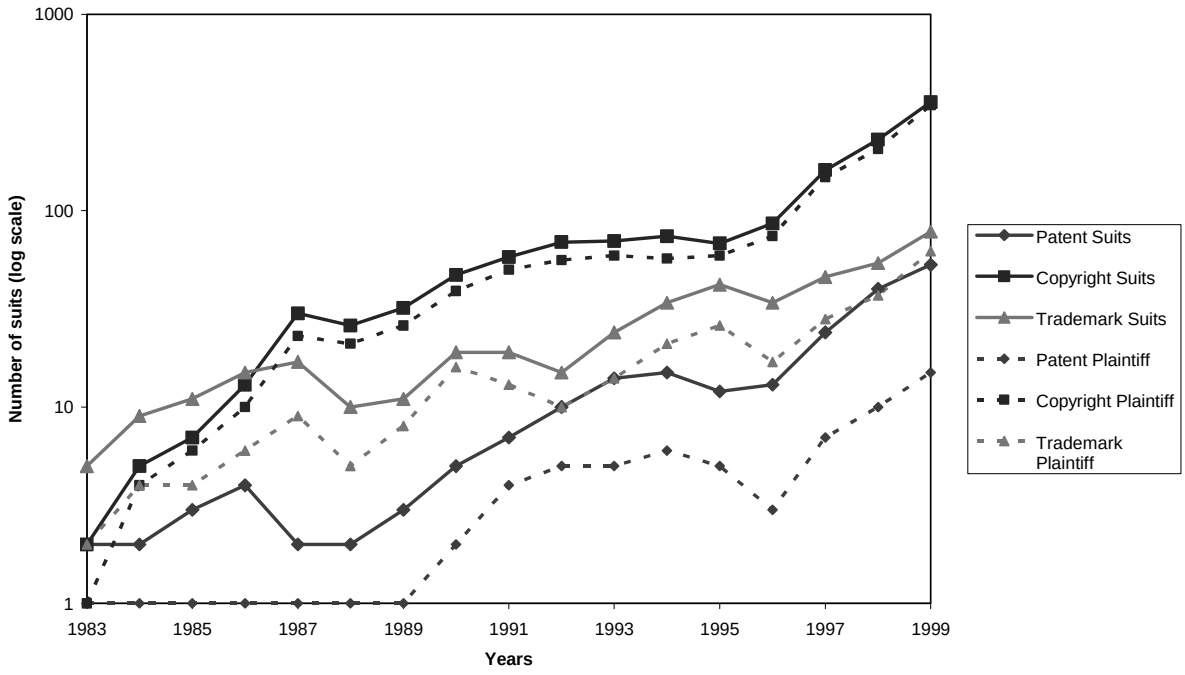


21. The data used in this graph were adjusted (by year) for the fact that the USPTO data contain only a sample of all patent litigation.

22. Among hardware firms, Intel was the most common party in software technology patent suits (18 suits as either plaintiff and defendant), but other firms like AMD, Digital, EMC, Hewlett-Packard, Hitachi, LG Electronics, Motorola, Sandisk, Storage Technologies, Texas Instruments, Xircom and Unisys also appeared five or more times.

Figure 15.3, which is based on the industry dataset, illustrates a similar rise in software patent litigation, and also a corresponding dramatic rise in copyright litigation. In numbers, patent litigation increased from a mere three active suits in 1989 to 53 suits in 1999.[23] Over the same time period, active copyright suits grew from 32 to 357 suits. While this dramatic growth in copyright litigation does not quite keep pace with compounded average growth rate of patent litigation, that is hardly surprising given the very low base from which patent litigation started. Moreover, as is evident from Figure 15.3, the growth rate of copyright litigation is easily keeping pace with patent litigation in the latter half of the decade.

Figure 15.3. **Patent, copyright, and trademark litigation of Softletter 100 firms (total and as plaintiffs)**



Given the observed declines in copyright registrations, copyright litigation growth is a somewhat surprising finding, and suggests that copyright may continue to play an important role in software despite its reported diminished value in the wake of the "look and feel" decisions. Indeed, our data demonstrate that even in 1999, the magnitude of copyright litigation as measured by the number of active suits is approximately seven times the magnitude of patent litigation. While trademark suits have also grown, their relative magnitude has declined since the mid-1980s.

Figure 15.3 is plotted on a log scale, so the increases in IP litigation in the late 1990s have actually been exponential. It is instructive to note that despite this exponential growth, the number of patent suits remains only a small fraction of all intellectual property suits filed by software firms, and particularly of copyright suits. This large difference must be qualified, since patent suits tend to be more expensive, and

23. These aggregate figures are not particularly affected by the specific measure of litigation used. Suit filings are a bit noisier and provide a somewhat lower relative estimate of patent litigation, since patent suits tend to last longer. When litigation is measured by suit days the trends track active suits very closely, but they are more difficult to read and interpret.

may have more at stake, than either copyright or trademark litigation. Nonetheless, comparing the raw numbers does provide some indication of its relative importance.

Moreover, as Figure 15.3 illustrates, patent suits are also somewhat unique in that a large fraction of these suits (on average about two-thirds) name the Softletter 100 firms as the defendant — *i.e.* the target of the patent suit. This finding suggests that the large established firms in the industry tend to be at the defensive end of patent suits, rather than using patent litigation to gain a proprietary advantage. In both copyright and trademark litigation, the opposite is true — Softletter 100 firms are bringing the suits, acting as the plaintiffs in a large fraction of the cases. The patent suits being brought against the industry incumbents (Softletter 100 firms) are mainly originated by small software firms and individuals. Hardware firms with software businesses (*e.g.* Sony and Apple Computer) comprise only a very small fraction (less than 10%) of these plaintiffs.

A closer look at the characteristics of patent litigation in software—in both our "industry" and "technology" datasets—illustrates interesting similarities and differences when compared with litigation in other areas of technology (Table 15.1). Because the time period over which these characteristics are measured has the possibility of impacting our results, we have segmented the datasets in several different ways, thus enabling comparisons between the segments we have generated, and with prior research on other industries.

Table 15.1. **Some comparative statistics on software patent litigation**

Industry sample	Software IPC-based	Software IPC-based	PC software: Softletter 100-based	Computers (Somaya, 2003a)	Research medicines (Somaya, 2003a)	All patents (Somaya, 2003a, 2003b)
Years:	1985-2001	1983-1993	1985-2000	1983-1993	1983-1993	1986-95
Number of Suits:	621	170	127			
Variables						
Fraction of decl. judgment suits	0.167	0.153	0.167	0.096	0.123	-
	(0.017)	(0.029)	(0.048)	(0.014)	(0.020)	
Fraction of multi-patent suits	0.248	0.076	-	0.076	0.023	0.040
	(0.017)	(0.020)		(0.012)	(0.009)	(0.003)
Ratio of suits to patents (per 100)**	1.336	1.270	-	2.474	0.661	1.873
	(0.492)	(0.487)		(0.891)	(0.201)	(0.212)
Fraction of individual-assigned patents	0.184	0.165	-	0.228	0.051	0.323
	(0.016)	(0.028)		(0.021)	(0.014)	(0.006)
Fraction of foreign-assigned patents	0.063	0.041	-	0.052	0.236	0.121
	(0.010)	(0.015)		(0.011)	(0.028)	(0.004)
Fraction of countersuits	-	-	0.071	0.143*	0.027*	-
			(0.023)	(0.017)	(0.010)	

Note: Standard errors appear in parentheses. * Unbiased estimates computed from the observed sample ratios.
** For software: average suits per 100 contemporaneous patents. Others: average suits over patent life per 100 patents issued in 1975-78.

Overall, Table 15.1 suggests that software patents are somewhat less likely to be litigated than the average patent (although the difference is not statistically significant). The lower incidence of foreign- and individual-owned patents in software litigation is similar to findings for computer patents, but significantly different from research medicine patents or the universe of all patents. As is the case for computer litigation, software patentees include multiple patents in the lawsuit more often than in other technologies, consistent with the perception that inventing-around and substitute technologies make appropriability difficult (with a single patent) in complex product technologies.

Perhaps the most interesting differences in Table 15.1 are in the defensive measures adopted in software patent litigation, especially when compared with computer patents. In software, there is a relatively lower incidence of "counter-suits", which are instances where a firm that is the target of a patent infringement suit opts to sue back with patents of its own. By comparison, software patent litigation is more likely to involve another generic defensive measure—the declaratory judgment suit. In declaratory judgment suits, non-patentees proactively take patentees to court seeking to either invalidate the patent or demonstrate that it is not being infringed. By choosing the timing, circumstances and venue of the suit, a non-patentee firm may improve its position with a declaratory judgment suit as compared to simply defending itself against a suit brought by the patentee.

The low incidence of counter-suits may be a consequence of software firms being relative newcomers to patenting, and especially to "portfolio patenting" with the objective of defending against hold-up by other patentees. However, this low incidence may also be a consequence of the relative ineffectiveness of defensive patents when used against small-firm and individual patentees. Defensive patenting works through mutual hold-up (Somaya, 2003a): When a firm faces a patent suit as a defendant, it can threaten to counter-sue its rival and thus hold-up the plaintiff's operations as well. This can force a settlement of the dispute when the cost to mutual hold-up is sufficiently high to deter both firms going forward with the suit.

However, small firms and individuals have no significant operations that can be held-up in this manner. In one extreme illustration, Goldtouch Technologies, Inc., a small entrant firm specializing in human-interface devices, sued Microsoft for over USD 1 billion in damages for an alleged infringement of Goldtouch's patents. Even though Microsoft counter-sued, the impact of the counter-suit on Goldtouch was likely quite small when compared with the potential payoff from winning its own infringement suit against Microsoft's "deep pockets." By comparison, using declaratory judgment suits to preempt potential litigation may be a more effective strategy, especially since software patents are generally believed to be of poorer quality (Merges, 1999).

The intensive use of declaratory judgment is best illustrated among the (admittedly small number of) patent suits in the industry dataset where Softletter 100 firms were plaintiffs. Of the 24 suits in this sample that we were able to code, approximately 20% were counter-suits, but we found that 37.5% were declaratory judgment cases. This not only illustrates the relative importance of a declaratory judgment in defensive litigation strategy, but also the relatively small fraction of infringement cases being filed by the large, incumbent firms. Thus, the relatively large fraction of patent suits in which Softletter 100 firms are defendants may actually understate the degree to which large firms are the targets of litigation if we take declaratory judgment cases into account.

Selection of software patents for litigation

We now turn our attention to a more in-depth investigation of the motivations for filing suit in the technology dataset. The analysis in this section follows from similar analyses conducted in past research for patents in general (Lanjouw and Schankerman, 2001) and patents in specific industries (Somaya, 2003a,b).

Data and methods

For this analysis, we focused on a sub-sample of the dataset from 1985 to 2001, when software patenting and litigation has been most active. Following prior studies, we focused on the primary patent being litigated in any given suit, and asked the question: What factors are correlated with the probability that a software patent will be the subject of a lawsuit? There were 621 suits remaining in our technology dataset after imposing the year cutoffs, with 396 distinct primary patents. For each of these "focal" patents, we identified a randomly-matched patent issued within one year of issue, and from the same 7-digit IPC class, as the focal patent. The matches were selected from the universe of all patents and the matched sample was created with replacement.

For each matched and litigated patent, a number of variables indicating potential value in litigation were coded. These include both backward and forward citations, the latter being adjusted for truncation in the citation series in the year that our citation data end (in 2001). Forward citations have been long established as a measure of patent value in the literature, but the significance of large numbers of backward citations is more circumspect. In addition to valuable patents, litigation may also be expected with patents that are of doubtful quality since the parties will likely debate the enforceability of such patents. We code the delay in issuance of a patent from the time of application as one indicator of the quality of the patent.

Another variable that may affect the probability of litigation is the size of the inventor team that made the patented innovation. Large teams are likely to indicate greater organizational resources behind the project and therefore more critical patented technologies. We also measure the number of countries involved in the invention (by location of inventors) to account for the "multi-nationality" of the patent. Dummy variables were also coded for whether the patent was assigned (at issue) to an individual, or foreign entity.

Table 15.2 reports the summary statistics for the variables described above. The table indicates that software patents in the pooled sample have a rather large percentage of foreign assignees (19%), but a smaller fraction of individual assignees (11%). The number of inventors for any given patent ranges from one to nineteen, and in rare cases (2%) they are from two countries. As is typical with patents, forward and backward citations (as well as delays in issuance) varied over a wide range. Since the forward and backward citation variables were also highly skewed, they were transformed by logs for the model estimation. The probability of a patent being litigated (*i.e.* being in the technology dataset sample, rather than the matched one) was estimated by a simple probit model. The results of the estimation are reported in Table 15.3.

Table 15.2. **Summary statistics of IPC-based software matched patent data**

Variable	Obs.	Mean	Std. dev.	Min.	Max.
Litigated patent	792	0.5	0.50	0	1
Foreign assignee	791	0.19	0.39	0	1
Individual assignee	790	0.11	0.31	0	1
Backward citations	792	14.7	22.3	3	345
Forward citations (est.)	792	70.7	93.6	2.13	1061
Delay in issuance	776	2.51	1.08	0.56	13.0
Number of inventors	760	2.34	1.85	1	19
Inventor countries (no. of)	755	1.02	0.14	1	2

Correlation matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	Litigated patent	1							
(2)	Foreign assignee	-0.36	1						
(3)	Individual assignee	0.21	-0.05	1					
(4)	Backward citations	0.14	-0.11	-0.03	1				
(5)	Forward citations (est.)	0.25	-0.17	-0.08	0.16	1			
(6)	Delay in issuance	0.03	0.08	0.08	0.06	0.01	1		
(7)	Number of inventors	0.06	-0.08	-0.18	0.16	0.20	0.00	1	
(8)	Inventor countries (no. of)	-0.09	0.07	0.03	-0.03	-0.03	-0.01	0.09	1

Table 15.3. **Probit estimates for litigated software patents**

Dependent variable = litigated patent	Model (1)		Model (2)		Model (3)		Model (4)	
Constant	0.128	**	-1.537	***	-1.290	***	-0.496	
(std. err.)	(0.053)		(0.234)		(0.302)		(0.494)	
Foreign assignee	-1.349	***	-1.192	***	-1.242	***	-1.275	***
(std. err.)	(0.142)		(0.150)		(0.157)		(0.164)	
Individual assignee	0.910	***	1.093	***	1.064	***	1.111	***
(std. err.)	(0.166)		(0.174)		(0.176)		(0.181)	
Log of forward citations			0.866	***	0.881	***	0.867	***
(std. err.)			(0.111)		(0.112)		(0.114)	
Log of backward citations			0.225		0.222		0.223	
(std. err.)			(0.169)		(0.172)		(0.182)	
Delay in patent issuance					-0.190		-0.184	
(std. err.)					(0.131)		(0.136)	
Square of delay in issuance					0.030		0.031	
(std. err.)					(0.018)		(0.019)	
Number of inventors							0.023	
(std. err.)							(0.030)	
Inventor countries (no. of)							-0.836	**
(std. err.)							(0.386)	
No. of obs.	790		790		776		754	
Log likelihood ratio	-475.66		-438.29		-427.56		-410.86	
Pseudo R-squared	0.1313		0.1996		0.2051		0.2139	

, * indicate statistical significance at the 5% and 1% level, respectively.

Results and discussion

The probit estimates for the probability of litigation are similar in many respects to those in other industries. As expected, forward citations of software patents are significantly correlated with litigation, indicating that more valuable patents tend to get litigated. Consistent with prior work, backward citations are not significantly correlated with litigation, and foreign-owned patents are also significantly less likely to be litigated. By contrast, individual-owned patents are significantly more likely to be litigated, a pattern that is similar to patents in research medicines, but not other industries.

The contrast between individual and foreign-owned software patents is also evident when comparing the proportions of these patents in the litigated and matched samples (from Tables 15.1 and 15.2, respectively). While individual-owned patents comprise a larger fraction of litigated patents than foreign-owned patents, this pattern is reversed when comparing the matched patents (or the universe of software patents). This difference may suggest that individuals are more litigious in software, or simply that individuals tend to patent more selectively than firms. By contrast, in the case of foreign patentees a general preference for litigation avoidance appears to be the only reasonable explanation. Given their higher costs for patenting, it is unlikely that foreign firms are being less selective than US patentees in obtaining patents.

Our results show little support for the hypothesis that patents with larger teams of inventors may be more valuable, and thus more likely to be litigated. We find that the "team-size" variable is significant at the 10% level if forward citations are not included in the analysis, indicating that the information about value contained in team-size is adequately captured by the forward citations variable. Interestingly, patents that entail a multinational team (Table 15.2 suggests that these are merely two-nation teams) are significantly less likely to be litigated even after accounting for foreign ownership. We have no reasonable explanation for this finding.

Complementarity in software firms' use of intellectual property

In this section we explore the relationships between the use of different types of intellectual property by software firms. While secrecy is no doubt an important appropriability mechanism in software, it is inherently difficult to observe and study empirically. Thus, given our data constraints, we focus on patents, copyrights, and trademarks, the other three primary forms of intellectual property used in software.

Complementarity and substitution between types of intellectual property

In prior literature, different types of intellectual property have tended to be characterized as substitutes to each other. This characterization is in part a reflection of the law, in which different types of IP protections are deemed suitable for the protection of different types of innovations. Thus, in its Kewanee Oil versus Bicron Corporation (1974)[24] decision, the US Supreme Court declared that trade secret protection was employed for "lesser or different inventions" than those the patent laws protected. This legal view of intellectual property as alternatives to each other was bolstered by a focus on the "innovation" as the unit of analysis, even if the same technology or product was comprised of different types of innovation.

24. 416 US 470.

A second pillar of the IP-as-substitutes view was the widespread focus on patent and trade secret protections in the early decades of the 20th Century, and their central role in protecting innovation in industries such as chemicals and manufacturing. Since patent law explicitly requires that inventors disclose their invention, it was natural to assume that obtaining a patent required the compromise of a trade secret. Moreover, the idea that patent rights can substitute for trade secret protection when the latter fails, or vice versa, has been widely supported in theoretical studies of appropriability (Horstmann, MacDonald, and Slivinski, 1985; Teece, 1986; Friedman, Landes, and Posner, 1991; Arora, 1997). Moreover, empirical evidence based on a survey of R&D managers in a wide number of industries also suggested that the means of appropriation across industries could be grouped into one of two groups, consisting of either patent or non-patent mechanisms (Levin, Klevorick, Nelson, and Winter, 1987).

In recent years, an alternative and more nuanced view of firms' use of IP has developed. Building upon Levin et al. study, Cohen, Nelson, and Walsh (1994) analyzed the findings of a later appropriability survey, and found that different appropriability mechanisms—specifically patenting and secrecy—are often used together to protect innovations in the same firm. While the authors' quantitative analyses support the suggestion in Levin et. al. that employing patenting is distinct from using other capabilities (e.g. lead time, sales, manufacturing), they also find that secrecy does not necessarily comprise a distinct strategy, but may instead be a complement to patenting. Graham (2003) uses secondary data on patent continuations to demonstrate empirically that firms pursue secrecy strategies in concert with their patent prosecutions—actively hiding patent applications from competitors when secrecy is valuable.

IP substitution and complementarity in software

While recent research has moved away from the notion that different forms of legal IP protection are inherently substitutes, the types of IP evaluated are for the most part still limited to patents and (trade) secrets. Moreover, with the exception of Graham (2003), empirical studies comparing the use of different types of IP within firms have generally been limited to survey data. The variety of intellectual property protections used in the software industry offers a unique opportunity to study the use of different types of IP by software firms without relying on self-reported survey data alone.

Moreover, questions concerning the most effective types of IP to protect software innovations have often sparked vigorous debate in legal research. Menell (1987) suggested that copyright was an inappropriate protection for software because it would fail to encourage innovation and hinder the functioning of markets, and recommended patent protection instead. Samuelson (1984) also faulted copyright as being ill-suited to software, but suggested a sui generis form of intellectual property as an alternative. More recently, scholars have examined the role of the IP regime in facilitating the formation of software component markets, and argued again in favor of patent protection (Lemley and O'Brien, 1997). Open source groups on the other hand have argued vociferously against patent protection, and maintain that copyright law, which most open source licenses use to police their communities, is best suited to software.

Fundamentally, these legal debates suggest that different forms of IP, particularly patent and copyright, are alternative tools to protect technology in software. The observed decrease in copyright registrations at the same time that the legitimacy and use of software patenting increased (Graham and Mowery, 2003) appears to be consistent with this view of IP as substitutes. The rationale for this conclusion would be that copyright has failed to provide adequate protection for the functional innovations involved in the "look-and-feel" lawsuits, and that patents have therefore been substituted to protect the valuable elements that copyright has failed to protect. However, as noted earlier in this paper, there does not appear to be a corresponding trend in the litigation data. An interview-based study of patenting (Liebeskind, 2000) also suggests that since software patents are sometimes weak and generally difficult to enforce, a combination of other types of IP may be used as substitutes instead.

The hypothesis that different types of IP may be complementary in use can be motivated through arguments about "common inputs" and "complementary effects." A critical common input for the effective use of any form of IP protection is an IP-aware management and its legal support staff. Having acquired a certain IP-related level of managerial capability, firms may find it cost-effective (in both the pecuniary sense, as well as the costs of attention and awareness) to pursue all forms of legal IP aggressively. While some IP-related tasks such as patent prosecution and litigation can no doubt be subcontracted to law firms, the capability-building tasks of formulating, monitoring, and implementing an IP strategy are likely to be conducted in-house on account of a variety of agency and contracting costs. Similarly, firms may also develop a reputation for aggressiveness in IP litigation in one area, and then leverage this strategic asset as a common input for litigation on all IP fronts, which would also suggest similar complementary effects.

Alternatively, different forms of IP may work more effectively in conjunction with each other, and thus serve as complements. For example, patent protection may prevent the sale of close substitutes to a software product, thus making the product more valuable. Such a lucrative product, in turn, is likely to attract copyright (and trademark) infringement, which the owner may be motivated to curb through enforcement. In recent research, Lybecker (2003) has used a similar motivation to argue that stronger patent rights for pharmaceuticals are more likely to elicit counterfeiting, and therefore require stronger anti-counterfeiting enforcement as well.

Data and methods

We examine the existence of IP substitution or complementarity in software by focusing on the industry data set of Softletter-chosen firms described earlier. Briefly, the firms included in this dataset were among the top 100 firms (by sales) in the PC-standard software industry for at least one year between 1985 and 1999 (published in the following year's Softletter list). Thus, the sample includes virtually all the sizeable firms within this narrowly defined, but distinct, sub-segment of the software industry. Over this time period (1985-1999), these firms engaged in 124 patent suits, 270 trademark suits, and 851 copyright suits. In addition to IP litigation data, data on sales, employment, age, location, and ownership changes were collected on these packaged-software firms (including private firms). Thus, an unbalanced firm-year panel was created that straddles the early 1990s, the era when the intellectual property regime changed in the US in support of software patents, as a result of actions by both the USPTO and the courts.

An interesting research challenge in this context is how the enforcement of IP through litigation should be measured. Merely focusing on the suits filed in any given year mis-specifies the measure in two ways: First, it weights all IP suits equally, irrespective of the size or importance of the suit and, second, it places all the weight of litigation on the year the suit was filed rather than distributing it over the life of the suit. While using the number of active suits in a given year addresses the latter issue, it fails to fully address the former. Thus, using that measure would equally weight a suit that is active for only fifteen days with one that is active for the entire year. Our analysis seeks to address this issue by using the number of suit-days in a year for each firm as the litigation dependent variable. The use of this weighted variable is supported by prior research (Somaya, 2003c) showing that the duration of patent suits is correlated with other measures of patent value, and can be viewed as a strategic variable in relation to litigation.

Our interest is in examining the extent to which firm decisions to pursue litigation in different types of IP "move" together. To accomplish this, we must first account for alternative explanations for different levels of IP litigation by firms, and then examine the correlation between the unexplained parts of their litigation in different types of intellectual property. This is best accomplished in a seemingly unrelated

regression structure of regression equations, where the error terms for each regression are correlated with each other. Our specification is as follows:

$$P_P = X_{PP}\beta_{PP} + \varepsilon_{PP}$$
$$P_D = X_{PD}\beta_{PD} + \varepsilon_{PD}$$
$$C_P = X_{CP}\beta_{CP} + \varepsilon_{CP}$$
$$C_D = X_{CD}\beta_{CD} + \varepsilon_{CD}$$
$$T_P = X_{TP}\beta_{TP} + \varepsilon_{TP}$$
$$T_D = X_{TD}\beta_{TD} + \varepsilon_{TD}$$

where the left hand variables P, C, and T denote suit-days in patent, copyright, and trademark suits respectively, and the subscripts P and D denote whether the focal firm is a plaintiff or defendant in the suit. The right hand independent variables X, coefficients β, and error terms ε are indexed with the IP-type (patent, copyright, trademark) and plaintiff/ defendant respectively. Further, the error terms ε are correlated between each these equations.

We account for alternate drivers of IP litigation by including revenue, and revenue per employee (a measure of employee strength orthogonalized from revenue) among the independent variables. In addition, we introduce firm and year fixed effects to account for idiosyncratic differences between firms and years. While it would probably be an improvement to use R&D expenditures in place of (or in addition to) revenues, we are unable to obtain R&D data for the private firms in our sample, since these data are not reported. In spite of this omission, our approach is validated by the well-established finding of strong correlation between R&D and revenues in past research, especially when fixed effects are controlled for.

After controlling for these independent variables, correlation between the residual errors can then be interpreted as evidence for inter-relatedness between the firms' use of intellectual property. Thus, after controlling for the various independent variables, if the incidence of any one type of IP litigation increases along with the incidence of another type of IP litigation—that is if the residuals are positively correlated — we can surmise that there is some form of complementarity between these two types. Likewise, if the residuals are negatively correlated, this would suggest that the two types of IP act as substitutes.

Results and discussion

The empirical model described in the previous section is estimated with generalized least squares (GLS), and the estimates are reported in Table 15.4. We were unable to estimate the model with all firms included due to the proliferation of parameters, and we therefore restrict the sample to firms with litigation in at least two areas of IP. This restricts our sample to 51 firms, and 391 firm-year observations for each of the dependent variables.

Table 15.4. **Parameter estimates and correlation matrix of residuals for seemingly unrelated regression using GLS**

Dep. var. = no. of suit days	Copyright plaintiff	Copyright defendant	Patent plaintiff	Patent defendant	Trademark plaintiff	Trademark defendant
Revenue	1.359 (0.193)*	0.875 (0.171)*	0.458 (0.123)*	1.027 (0.137)*	0.714 (0.186)*	0.409 (0.163)*
Revenue per employee	-2.317 (1.434)	-4.123 (1.268)*	0.698 (0.913)*	-2.035 (1.014)*	2.983 (1.383)*	3.205 (1.208)*
RMSE	1.675	1.481	1.067	1.184	1.615	1.411
"R-square"	0.780	0.589	0.426	0.724	0.555	0.497
Correlation matrix of residuals						
Copyright plaintiff	1					
Copyright defendant	0.115	1				
Patent plaintiff	0.097	0.072	1			
Patent defendant	0.153	0.108	0.214	1		
Trademark plaintiff	0.144	0.016	0.076	0.144	1	
Trademark defendant	-0.026	0.084	0.098	0.117	0.185	1

Notes: Breusch-Pagan test of independence: chi2 (15) = 86.564, Pr = 0.0000.
Standard errors in parentheses.
* Indicates a parameter significant at the 95% confidence interval.

It is important to note that the estimates reported in Table 15.4 all stem from a single six-equation model. Thus, each column in the table contains the estimates for one of these six equations, with the correlations reported in the bottom half of the table being related to the model as a whole. In all cases, the incidence of IP litigation is positively and significantly correlated with revenues, as one would expect. Interestingly, revenue per employee is generally positively correlated with higher IP litigation, except in the cases where the firms are patent- or copyright-defendants. It appears therefore that firms that are at the higher end of the market (higher value added per employee) or more "successful"[25] tend to attract patent and copyright enforcement against them.

25. Since most costs in software production are fixed and employee-related, higher revenues per employee may indicate greater success in the market.

The correlations between the residual errors are highly significant as a group, thus allowing us to meaningfully reject the hypothesis that the use of different types of IP is unrelated. A closer examination of the correlations reveals two broad patterns. First, the magnitude of correlation is quite high between the plaintiff and defendant roles for each type of IP. This result may be due in part to the filing of declaratory judgment suits or other forms of retaliation (such as counter-suits) against a filed infringement suit. Second, the magnitude of correlation is high between the use of copyright and trademark in a plaintiff role and the "use" of patent litigation in a defendant role.

Furthermore, the coefficients in each of these cases are positive, suggesting that different types of IP enforcement are being used in concert, rather than independently or in lieu of each other. While it is interesting that this correlation is strong with the defendant role in patent enforcement, this relationship should nevertheless not surprise the reader. We noted earlier that Softletter 100 firms are more likely to be defendants in patent suits, and are often responding to patent enforcement by others even in their plaintiff role (through declaratory judgment actions and counter suits). Thus it appears that these firms' efforts in patent litigation are weighted disproportionately to defensive strategies, and it is these defensive actions that are correlated with their copyright and trademark enforcement.

While it appears that we may have some *prima facie* evidence for complementarity in IP use, our results also pose a challenge in understanding the source of this complementarity in view of the correlations with the defensive-patent role. Two interpretations are possible. First, it is conceivable that software firms which are targeted for patent enforcement by others develop an IP capability that the firm then puts to a broader use in other areas of firm strategy. This argument is essentially one about common inputs. Second, it is possible that certain unobserved characteristics of firms induce them to use trademark and copyright enforcement at the same time as they are targeted by patent enforcement. Since the model incorporates fixed effects, such characteristics will have to be time varying, such as the emergence of a successful product or success in an area of business. In either case, our suggestions are speculative, and further analysis of the precise drivers of the IP complementarity in software awaits future research.

Conclusions

In this paper, we conducted a wide-ranging investigation into intellectual property litigation in software, including an exploratory study of complementarity or substitution between different types of IP use in software firms. Our research uncovered a number of interesting facts about software IP litigation that has not been previously remarked upon in academic research. First, despite the increasing use of patents by software firms, the vast majority of intellectual property suits undertaken by software firms actually involves copyright law, and the growth rate of copyright litigation is continuing to keep pace with patent litigation, even in percentage terms.

Patent litigation in software is also peculiar in that the majority of litigation is initiated by smaller firms, individuals, and industry outsiders against the large incumbent firms in the PC software industry. Moreover, even suits brought by the incumbent firms are often in response to enforcement by others, either in the form of declaratory judgment suits or counter-suits. There also appears to be a much stronger reliance on the part of firms upon the declaratory judgment suit as a defensive mechanism, especially when compared with the use of mutual hold-up strategies through counter-suits.

This paper also finds two interesting patterns that require further investigation, which we leave for future research. First, prior research has reported that the extension of patent protection to software stimulated increased patenting by software firms, and a relative decline in copyright registrations (Graham and Mowery, 2003). But our current research finds that copyright litigation has continued to grow despite the changes in the institutional environment. At a fundamental level, one would expect copyright registration and enforcement trends to be correlated, and it is unclear if the differences we

observe are artifacts of the data, the low barriers and weak incentives for registering copyrights, or some other secular trend.

Second, even though we uncover some evidence for complementarity in IP use among software firms, it is unclear what mechanism underlies this inter-relationship. Moreover, the nature of our results force us to define "use" of the patent system somewhat broadly, so that even firms that are defending against patent suits can be said to be "users" of the system, albeit in a subtle manner. While there is some justification for this approach here, since the large Softletter 100 firms are mostly defendants in patent suits, more work is needed to understand this phenomenon.

Finally, our research has some inherent limitations. First, it is limited to the three main types of intellectual property governed by federal law. This design does provide some advantages since it avoids the criticism leveled at prior work because it enables us to use broadly comparable litigation data. However, this approach does not allow us to study other types of intellectual property (e.g. trade secret) and other appropriability mechanisms (e.g. complementary capabilities and lead-time). Moreover, software technology exhibits several unique characteristics, including the relatively high importance of both copyrights and patents for appropriability in the same products. While software is no doubt an important, pervasive, and fast-growing sector of the economy, some of our findings are inherently sector-specific and cannot be perfectly extended to other technologies and sectors.

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Chapter 16

WHY ARE SOFTWARE PATENTS SO TRIVIAL?

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This paper presents the views of the representative of the Foundation for a Free Information Structure and Eurolinux Alliance. In his opinion, most software patents are trivial and broad and the reasons are to be found in the patent system itself rather than in the insufficiencies of the examination process. The extension of patentability to software comes at the expense of several of the necessary filters needed to raise the proportion of 'good patents' among those granted. One of those filters is the non-obviousness requirement.

Most software patents are trivial and broad

Most software patents are trivial and broad. The reasons are to be found in the patent system itself rather than in the insufficiencies of the examination process. On the one hand, the requirement of non-obviousness is not and cannot be as performing as many proponents of a patent reform seem to wish. It can work only as one (weak) filter among several, which when combined serve to raise the overall score rate of the patent system, *i.e.* the proportion of "good patents" among those granted. The extension of patentability to software comes at the expense of several of these necessary filters. The system has thereby been so badly compromised, that, no matter how the non-obviousness screw is turned, it is unlikely that its score rate can be raised back to a level that could justify its continued existence.

A problem of law, not of patent examination

By browsing through the *European Software Patent Database*[1], gathered and maintained by the Foundation for a Free Information Infrastructure (FFII), one can easily compile a "horror gallery" of trivial and broad patents. It will be much more difficult to find even a single claim object that a programmer would find admirable and possibly worthy of a special exclusion right. Some people say that this is because the patent offices do not do their job well. If the criteria of novelty and non-obviousness, also known as inventive step, were applied 100% correctly, these people say software patents would not do much harm. Some have been prophesying for a decade that is only a matter of time until this problem will be solved. However, the solution seems further away than ever.

A dialogue between a Spanish information scientist and the deputy director of the British Patent Office, conducted in December 2000 on a publicly archived mailing list[2], goes right to the heart of the problem: the non-obviousness criterion is not what the naive engineer or programmer thinks it is. Criteria such as novelty, non-obviousness, technicality and industrial applicability may seem intuitively reasonable, and the naive patent professional may believe that they are the very yardsticks of reason. The naiveté of both the engineer and the patent professional consists in forgetting that "the law is an ass", as the proverb goes. The primary function of the non-obviousness criterion is not to assure what an engineer or programmer thinks is a reasonable inventive height, but to provide a filter that can be applied by patent examiners in a predictable way. Applicability and reasonability are two entirely different requirements, which need not match.

It is enough if the non-obviousness filter helps, in combination with other filters, to yield a reasonable amount of "good patents" in the end. Patents will be deemed "good" if the scope of exclusion is felt to be:

1. Sufficiently broad to allow the patent owner to at least recoup the patenting costs (*e.g.* costs of patent acquisition and enforcement, disadvantage incurred by disclosure)

2. Sufficiently narrow to avoid imposing unjustified costs on competitors (*e.g.* to make inadvertent infringement unlikely).

1. *http://swpat.ffii.org/patents*

2. *http://aful.org/wws/arc/patents/2000-12/msg00111.html*

The non-obviousness filter is a means of raising the percentage of "good patents" in the patent system. We have proposed means of estimating this score rate for various fields.[3] It seems to be well below 50% in most fields and below 1% when it comes to software and business methods.

Why not just raise the inventive step standard?

The criterion of inventive step as it stands is not designed to sort out trivial patents by itself, but to help raise the score rate of the patent system, in combination with other filters. It is very difficult to prove that even the most trivial new idea does not contain an inventive step. The 2001 EPO Examination Guidelines even admonish examiners to be very critical of such proofs, apparently for good reasons:

> *"It should be remembered that an invention which at first sight appears obvious might in fact involve an inventive step. Once a new idea has been formulated it can often be shown theoretically how it might be arrived at, starting from something known, by a series of apparently easy steps. The examiner should be wary of ex post facto analysis of this kind."* [4]

The EPO basically treats inventive step as an extension of novelty. In order to prove lack of novelty, an opponent must point to one single prior art document whose teaching falls into the scope of the claim. If no single document is found, the opponent will try to show that the person skilled in the art would have arrived at the teaching by combining two documents. In this case the claimed invention is said to be un-patentable due to lack of inventive step.

In the case of software patents, the person skilled in the arts rarely even consults documents. New programming problems occur all the time and inventing a solution on the fly is the normal way to go. Most such solutions are not even published in any information science journal that an examiner might consult for testing their novelty. Rather, the program will usually also function as its own publication - a form of publication which can pose a severe challenge for the novelty concept of the patent system.

Yet not every innovation in the field of computing is produced on the fly, and some major advances are discussed in some highly-respected journals. So, should not we try to raise the inventivity standard, so that those really respectable achievements can be singled out for rewarding by a patent (or a patent-like exclusion right)? Even if lawmakers wanted to seriously tinker with the existing patent system and raise the inventivity standard, something which has become a mantra in some patent reform proposals, they would encounter enormous practical difficulties:

- *Fuzziness of invention height:* How would they define inventive height or *erfindundhöhe*, as it is still sometimes called in old-fashioned German patent jargon? At least 20 inches above the state of the art? At least 20 twists of the brain beyond the state of the art"?[5]

3. *http://swpat.ffii.org/analysis/testsuite*

4. *http://www.european-patent-office.org/legal/gui_lines/e/c_iv_9.htm*

5. It has been suggested that a social game could help here: let the patent applicant first publish only his problem and provide incentives for the public to submit solutions until a certain deadline. All these solutions are then considered to be prior art. This could really work, but it is a very radical reform proposal for a patent system which is governed by strong forces of inertia, who will always find forceful legal arguments against any even very moderate reform proposal that has a true potential of diminishing the number of patents granted.

- *Triviality by sequentiality:* Abstract-logical constructions are usually composed of many small innovation steps that neatly build on each other to form a perfect whole. Each patent will usually focus on one of these logical steps, thus making this patent trivial and broad, even if the innovation itself was truly ingenuous. This has happened for example in the case of the MP3 patents.[6] In case the scope of the MP3 patents could have been narrowed by applying strong non-obviousness requirements claims would have probably ended up being too narrow, not allowing rightholders to recoup patenting costs., *i.e.* claims that do not allow the rightholder to recoup patenting costs.
- *Incommensurate blocking effect due to non-triviality:* In the (very rare) case of fundamental breakthroughs in abstraction (*e.g.* Karmarkar inner-point optimisation method[7]) it may be impossible to define a claim scope that is both rewarding to the applicant and not too burdensome on follow-on innovation at the same time. This is the main reason why mathematics and discoveries have been excluded from patentability.

The broken models: technical or industrial character of inventions

Traditionally there has been another criterion helping if not to sort out trivial ideas then at least to significantly lower the ratio of trivial patents: the requirement of inventions to be technical or industrial in character. This requirement, more precisely defined as the requirement that forces of nature be part of the problem solution which is rewarded by the patent, limits the patent system to applied natural science and matter-producing industries. In most countries it has been part of the patent law tradition at least until recently. The European Parliament reaffirmed this requirement in September 2003 by voting for a strict definition of the concepts invention, technical and industrial along these lines[8].

This criterion excludes those post-industrial innovations that are based only on abstract calculus and do not require experimentation. Finding a new causal relation between natural forces and a physical effect is usually much more costly than finding a new mathematical relation. While mathematical relations are composed of tiny functional elements that combine to a perfect whole, the physical world is causal rather than functional, and the whole is not the sum of the parts. Material phenomena may be described by mathematics, but such description is at best an approximation. Even a system of lego bricks will usually not work out the way you may have built it in your mind. The more the system becomes complex, the more deviations can accumulate into unforeseeable effects. Undisturbed clean-rooms exist only in the world of ideas.

When the patent system is no longer limited to industrially applied natural science, its score rate plummets. Software is an art of abstraction and software patents come as a result of an opening of the patent system toward the abstract and functional characterized by the proliferation of function claims in patents, which consist of unspecified means to achieve some so-called technical effects, so that problems and not solutions are claimed. In these cases, since no new causal chain between material means and material results is involved, it becomes difficult for the patent applicant to claim his invention. It will usually be neither permissible nor economically rewarding to claim the specific mental steps by which a computing problem is solved. Rather, the patentee will try to claim the input and output (*i.e.* the technical effects) of the operation. However, unlike in chemical patents, there are no surprising effects to be claimed. Everybody knows that a computer can produce calculation results

6. *http://swpat.ffii.org/patents/effects/mpeg*
7. *http://swpat.ffii.org/papers/konno95*
8. *http://swpat.ffii.org/papers/europarl0309*

and show them on the screen. The only difficulty lies in knowing *how to tell the computer to do it*, and that is routinely left to the thousands of creative programmers, who, if allowed to do so, could independently devise hundreds of different creative solutions, all of which produce the claimed technical effect, but none or few of which are disclosed in the patent description.

These and similar problems have been analysed in detail by some of the patent examiners who are struggling with them.[9] There is moreover a literature of mathematicians and epistemologists who explain in detail why the models are broken when the requirement of technical character (concreteness and physical substance) is given up.[10] The German Federal Court of Justice already warned of this in the concluding remarks of its Disposition Program decision of 1976, which laid the foundations for the non-patentability of software in Germany:

> *"…from a purely objective point of view the concept of technical character seems to be the only usable criterion for delimiting inventions against other human mental achievements, for which patent protection is neither intended nor appropriate. If we gave up this delimitation, there would for example no longer be a secure possibility of distinguishing patentable achievements from achievements, for which the legislator has provided other means of protection, especially copyright protection. The system of German industrial property and copyright protection is however founded upon the basic assumption that for specific kinds of mental achievements different specially adapted protection regulations are in force, and that overlappings between these different protection rights need to be excluded as far as possible. The patent system is also not conceived as a reception basin, in which all otherwise not legally privileged mental achievements should find protection. It was on the contrary conceived as a special law for the protection of a delimited sphere of mental achievements, namely the technical ones, and it has always been understood and applied in this way.*
>
> *"Any attempt to attain the protection of mental achievements by means of extending the limits of the technical invention – and thereby in fact giving up this concept – leads onto a forbidden path. We must therefore insist that a pure rule of organization and calculation, whose sole relation to the realm of technology consists in its usability for the normal operation of a known computer, does not deserve patent protection. Whether it can be awarded protection under some other regime, e.g. copyright or competition law, is outside the scope of our discussion."*[11]

As foreseen by the Federal Court in 1976, the introduction of software patents has opened a can of worms. It has not only removed the only viable criteria for limiting the scope of patentable subject matter, but also broken the models of the patent system on which requirements such as novelty, non-obviousness and enabling disclosure are built. It has overturned the balance of the patent system, leaving it behind in a state of inconsistency and dysfunctionality.

9. See Kiesewetter-Köbinger (2000), *"Über die Patentprüfung von Programmen für Datenverarbeitungs-anlagen, Softwarepatente ohne Grenzen"* and Kiesewetter-Köbinger, *"Stellungnahme zur Patentierbarkeit von Softwarekonzepten*".

10. See Tamai (1998): "Abstraction-orientated Property of Software and Its Relation to Patentability".

11. *http://swpat.ffii.org/papers/bgh-dispo76*

The European Parliament vote has given the patent community a chance to repair the system. By reintroducing the requirement of concreteness and physical substance (technical character), the score rate of the system can perhaps be brought back to acceptable levels. However, due to the unwieldiness of the system, there may not be many other chances like this. If this chance is missed, people in a large majority of disciplines may soon be voicing doubts about the legitimacy of the whole system and pressing for radical reform in unforeseeable directions. Judging from the cyclical movements of the patent system during the last two centuries, it would not be surprising if a failure by the patent institutions to seize their chance could open the way to the strongest anti-patent wave that history has seen so far.

Chapter 17

THE ROLE OF IPR FOR THE SOFTWARE INDUSTRY: A CHANGING LANDSCAPE?

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This chapter presents the views of a Microsoft representative on the role of IPR for the software industry. Over the past few decades, the software industry has emerged as one of the most innovative sectors of the economy. Performance gains in computer hardware, advances in software functionality, and the growth of the Internet into an established communications and commercial medium have fueled the integration of software into nearly every aspect of modern life. Microsoft believes that IPRs have contributed to the software industry's success. Without the possibility to address free-riding through IPRs, developers would not have been able to capture some of their software's value in the market place, and further investment in software development would have been limited. IPRs are thus an important engine of growth and development for the software industry. Intellectual property covers various rights, among them trade secret, copyright and patent. It may well be that the role and importance of each of those rights is changing as the software industry itself evolves.

A brief overview of the evolution of the software industry and of the role of intellectual property rights

The history of the software industry can be divided into at least two phases, each characterized by distinct technologies and market structures, which in turn have influenced the relevance and significance of available IP regimes.

During the first phase, software's tight integration with hardware and the IT industry's vertical structure meant that most commercial software was developed by a handful of large firms that sold programs directly to customers in "big iron" combinations of hardware, software and services. Software developers during this period relied primarily on trade secret protection and contract law to guard their innovations against appropriation by others.

Trade secret law was not the only legal remedy available to software developers during the first phase of the industry. Already in 1964, the US Register of Copyrights announced that the Copyright Office would accept claims to register software. Yet the conditions imposed on such registration—including proof that the program contained sufficient "original authorship" to qualify for protection and had been "published" prior to registration—lessened the appeal of copyright for many software developers. Given these hurdles, relatively few software developers took advantage of copyright protection for their programs. Between 1964 and 1 January 1977, only 1 205 software programs were registered for protection under the Copyright Act, and over 80% of these were registered by two companies, IBM and Burroughs.

In the second phase, which emerged in the early 1980s and continues in many respects to this day, software's separation from hardware and the industry's new horizontal structure resulted in a diverse, heterogeneous IT environment based in large part on mass-market business models, and in which a much larger number of users obtained software through a significantly broader range of distribution channels. While this transformation helped make the software industry one of the fastest-growing segments of the economy, it also raised a series of technological and legal challenges for software developers. Principal among these challenges was unauthorized copying. As hardware became more powerful and less expensive, people found it increasingly profitable to copy software, either as a means to avoid purchasing authorized copies, or to sell such unauthorized copies to third parties. At the same time, the emergence of mass-market distribution models for packaged software led some to question whether trade secret law remained a viable mechanism for combating such third-party copying. Although the scope of various IP protections varied during this phase, most developers started to rely more heavily on copyright than in the past to protect their innovations in the marketplace. Copyright was used to combat a form of copying, commonly referred to as "counter-feiting" or "piracy". Today, copyright remains probably the best legal tool to confront this particular type of free-riding.

Recent developments in IP law, together with technological innovations and broader changes in the IT industry, suggest that the software industry may now be entering a third phase. These changes have brought to the fore copyright's limited ability to shield developers against other forms of copying. Indeed, copyright is of limited help in protecting against the imitation, or "cloning," of specific innovations embodied in a software program, when the free-rider is not necessarily engaging in the kind of wholesale literal copying that characterizes counterfeiting or piracy. Both activities however diminish incentives for innovation because both make it more difficult for the original developer to realize a competitive return on its development costs.

An emerging role for patent in the changing landscape of the software industry?

Why can we expect patents to play a more important role in the future?

For our industry 10 to 15 years ago, patent protection really was not that important. The reason was simple: everybody kept their source code secret and, in effect, relied on trade secret law, supplemented by contractual restrictions on customers. If no one could see your source code, then it was not very easy for others to get at your inventions and copy them in a way that would put you at risk. This reliance on trade secret law was consistent with the hardware-plus-software business model pursued by most leading IT firms at the time. And although a community of independent software developers was emerging, even these developers generally earned most of their revenue developing customized programs for individual customers, rather than creating multipurpose applications for a broad customer base.

But things have changed. People have concluded that the more computers become part of critical infrastructure and society, the more interest there is by government, by universities, by many others, in seeing what's in a computer programs source code. That's one reason Microsoft has taken to heart much of that principle and developed a number of new programs to make our source code accessible. But the problem is, once you make your source code accessible, it is no longer secret, and the ability to rely on trade secret protection starts to be eviscerated. So the fundamental challenge is this: how can we continue to encourage companies like ours and others to make those source code details available, and at the same time ensure that there is continued incentive to invest in R&D and innovation? That, in fact, is the role that the patent system has played in many countries around the world for centuries.

Due to the greater "openness" achieved on the software market in part because of the tremendous success of open source software, but also because of an increased reliance on industry-wide technical standards, patent law seems to be more adapted than other means of protection. First, because patent law requires inventors to disclose their inventions, patents provide a more effective mechanism than either copyright or trade secret law to promote the goal of product transparency. Also, whereas copyrights protect only the expression of an idea and not the idea itself, patents protect the actual invention, not just one specific implementation of an invention. Thus, unlike copyright, patent protection enables software developers to share the inner workings of their programs with partners, customers, and others (even competitors) without significantly diminishing the developer's ability to prevent others from cloning those aspects of a software program that are truly novel and innovative. Thus, in contrast to trade secrets, patents allow software developers to maintain the integrity and value of their IP assets in a way that does not conflict with the pursuit of greater IT interoperability and product transparency.

Second, the patent prosecution process is designed to ensure that legal protection will extend only to technologies that are truly novel, useful, and non-obvious. Thus, patents should provide an even greater incentive than copyright for software developers to focus their efforts on achieving innovative rather than incremental advances in technology.

The need to improve the functioning of the patent system

Therefore it is essential that the patent system works well and that true innovation is protected. We need to take the system we have in place today, which has been proven for more than two centuries, and continue to make it even better. We need to enable patent examiners around the world to move quickly to produce patent applications. We need to ensure that they have access to prior arts so they can grant patent applications when they are deserved and deny them when they are not. And, perhaps more than any single thing, we need to continue to take steps to harmonize the world's patent

system so that the patent system is accessible to everyone in every country. We see the European Draft Directive on the patentability of computer-implemented inventions as an important step towards the harmonization of this field of law in Europe.

The European debate on computer-implemented inventions: is there something new under the sun?

As you know, the release in 2002 of the Draft Directive on the patentability of CII has sparked an intense debate around the benefits of patents in the field of software. This debate is particularly interesting. I do not want to discuss into details the merits of the Commission's draft and of the amendments that were adopted by the Legal Affairs Committee of the European Parliament last June. Let me just say that as a true European, I support the view of the Rapporteur at the Legal Affairs Committee, Ms. Arlene McCarthy, who recently wrote: *"From medical inventions to household appliances, mobile phones and machine tools, inventions involving software are increasingly a fact of life. With many of our traditional industries migrating to the Far East leaving behind job losses, we Europeans are having to rely on licensing out inventiveness to generate income and create jobs. […] We must legislate to ensure our inventors are not put at a disadvantage in the global market place."* (Guardian Unlimited, 12 June 2003).

Since the Commission's draft was put on the table in February 2002, some representatives of the European software developers voiced their concern. It is instructive to remember that the US software industry voiced similar concerns when software patents became a reality at the end of the 1980s: a common critique was that *"patents would kill the goose that had laid the golden egg of software creativity (…) A particular concern was that software patents would give an advantage to large firms (…) There was fear over the clash of a "patent culture" - with its attendant high overhead costs - and the freewheeling and productive culture of programmers who were said to write code not strictly for profit but for technical sophistication"* (R. Merges, The Uninvited Guest: Patents on Wall Street, Conference draft, June 2003).

Well, that reminds me of some arguments and complaints that we hear in Brussels. So, what happened in the United States? Well, the demise of the software industry never happened. On the contrary, programmers creating start-ups found that venture capitalists placed a premium on companies with a robust patent portfolio and patents were not just "for the big guys". It seems clear that the industry continues to move ahead despite the advent of patent protection, according to its detractors, or precisely because of the use of patent protection. *"Perhaps patents overall simply do not affect the "big variables" of economic life - industry structure, the basic pace of innovation, etc. - in such an industry to any great extent"* (R. Merges, *op. cit.*). That might be an interesting learning for the actual debate on the draft Directive.

If, in light of the US experience, the enhanced use of patents will not affect substantially the structure and the dynamics of the software market, it will definitely impact the strategy and the behavior of the firms on the market.

The increased reliance of developers on patent will probably characterize the future software industry as it fits well with other trends of the market towards open and interoperable systems.

PART 5

CURRENT AND FUTURE POLICY CHALLENGES

Chapter 18

INTELLECTUAL PROPERTY STRATEGY IN JAPAN: TOWARDS AN "IP-BASED NATION"

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This chapter presents the views of the Deputy Counsellor of the Intellectual Property Strategy Headquarters at the Cabinet Secretariat of Japan. It aims to briefly sketch the recent development of IP policies in Japan. In the last few years, the government of Japan has been quite active in making intellectual property policies and has even adopted the slogan of "intellectual property-based nation".

Introduction

In the last few years, the Japanese government has been quite active in making intellectual property policies. The government adopted the motto of *chizai rikkoku* ("intellectual property-based nation") and has tried to mobilize a wide range of policy measures to revitalize the economy and society by utilizing intellectual property. Not only policymakers but also industry and the media are paying a lot of attention to IP, and articles on the subject can be found in major newspapers almost every day. There may be almost too much enthusiasm. Nonetheless, there is little dispute that IP plays an important role in the knowledge-based society, and Japan is no exception. This paper aims to briefly sketch the recent development of IP policies in Japan.

Why is intellectual property important?

Why is IP drawing so much attention in Japan? There are two reasons: the recession and competition from China. As the term "lost '90's" illustrates, the Japanese economy has not yet recovered from the recession of the 1990s. The recession may be attributable to various factors. The problems with bad loans and deflation are notorious. However, there is also the impact of emerging Asian economies. For instance, China has been catching up to Japan in terms of technological capabilities, while having the advantage of cheap labor. Japanese firms can no longer compete with Chinese firms so long as they use labor and capital in a conventional manner. They have to be innovative in order to be competitive on the global market. However, innovation does not simply occur. It is the product of human ingenuity and endeavor. Thus, when policymakers began to think that they needed to do something to foster innovation, IP was chosen as a tool to encourage it.

Intellectual property is another way of saying knowledge, with the implication that it can be protected by law. Whether you use the term intangible assets, intellectual property, or knowledge, it is fair to say that the role of intangible assets has been increasing in the age of intellectual capitalism.

When you say that IP is important, you can easily imagine a so-called "pro-patent" policy that advocates strong legal protection. However, this is just one part of picture. IP protection furthers not only the interests of inventors or creators; society at large can enjoy the benefits of new inventions or works that would not have been developed without it. It would be a "win-win" game to successfully develop a system where the protected IP are fully exploited and returns are re-invested for generating new IP. This may be applicable in the North-South context. An IPR system in developing nations would not only facilitate technology transfer from developed nations in the short run, but also provide incentives for endogenous innovation in the long run, which could be also a win-win game for both developed and developing nations.

Recent chronology

It was Prime Minister Koizumi's statement on 4 February 2002 that started the recent development of IP policies. In his general policy speech, which is equivalent to the US President's State of the Union address, Prime Minister Koizumi expressed his determination to establish an IP strategy. He was the first prime minister in Japan who declared that IP should be utilized strategically.

The Strategic Council on Intellectual Property was established in March 2002.[1] The Strategic Council introduced the notion of an "IP-based nation" to describe the policy goal, and released the Intellectual Property Policy Outline[2],. It also recommended new legislation with a focus on IP. The Basic Law of Intellectual Property was enacted in November 2002, laying out the basic policies and principles.[3] Furthermore, it established IP Strategy Headquarters and urged for the development of the IP Strategic Program, as discussed below.

The Intellectual Property Strategy Headquarters were established on 1 March 2003.[4] The Headquarters, headed by the Prime Minister, consist of all Cabinet Ministers and 10 experts from the private sector. The 10 experts include four university professors, three CEOs of private firms, an attorney, a patent agent and a scientist. It is quite unprecedented that all Cabinet Ministers participated in the discussion on IP policies, which clearly illustrates how important IP is today.

After several months of discussions, the Headquarters completed drafting of the Intellectual Property Strategic Program on 8 July 2003.[5] This program includes five chapters and contains about 270 action points altogether. The five chapters cover creation, protection, exploitation, media content and human resource development. The following sections touch upon highlights of the Program.

New role of universities

In a knowledge-based economy, the role of universities is not limited to the two conventional functions of education and research. Rather, universities are expected to generate useful technologies and to effectively transfer them to the private sector - which is willing to commercialise them. There is little dispute that the United States was the pioneer in this field. It has taken various measures, including the famous "Bayh-Dole" Act, since the 1980s. On the other hand, it was in the late 1990s that Japan began to recognise the role of universities in technology transfer. Legislation was then enacted in 1998 to encourage universities to establish technology licensing organisations[6]. As a result, more than 30 TLOs have been established in Japan as of today.[7] However, establishing organisations such as TLOs is just a first step. The next step is to make the system work, and in this regard there is much room for improvement. Japanese universities should improve their ability to manage IP, including evaluation of inventions, technology marketing, etc. There should also be clear rules and regulations enabling universities to own the IP generated by their researchers. In addition, funding must be secured for filing patent applications and prosecuting them. The government has chosen 34 universities and provided them with subsidies to encourage IP activities[8].

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1. *www.kantei.go.jp/foreign/policy/titeki/index_e.html*
2. *www.kantei.go.jp/foreign/policy/titeki/kettei/020703taikou_e.html*
3. *www.kantei.go.jp/foreign/policy/titeki/hourei/021204kihon_e.html*
4. *www.kantei.go.jp/jp/singi/titeki2/index.html* (in Japanese only)
5. *www.kantei.go.jp/foreign/policy/titeki/kettei/030708f_e.html*
6. *Daigakuto ni okeru gijutsu ni kansuru kenkyuseika no minkanjigyousha heno iten no sokushin ni kansuru houritsu* (The Law to Encourage Transfer of Technological Research Output from Universities to the Private Sector) available at *www.meti.go.jp/policy/innovation_corp/top-page.htm* (in Japanese only)
7. As of October, 2003, 36 TLOs are approved according to Ministry of Education, Culture, Sports, Science and Technology. *www.mext.go.jp/a_menu/shinkou/sangaku/index.htm* (in Japanese only)
8. Press Release by Ministry of Education, Culture, Sports, Science and Technology, 15 July 2003, available at *www.mext.go.jp/a_menu/shinkou/houdou/index.htm* (in Japanese only)

Strengthening enforcement

Intangible assets such as IP have the characteristics of public goods: non-excludability and non-rivalry in use. No incentive would be provided for creating IP without legal protection, which is why effective legal protection is critical in an "IP-based nation". It does not, however, mean that the stronger the legal protection, the better off society will be. Rather, too much legal protection may hinder innovation. It is therefore critical to strike a balance. Japan already protects IP in accordance with the WTO/TRIPS agreement that sets forth minimum standards of protection. In general, Japanese laws afford IP no less legal protection than those of the United States and European nations. The remaining issue is the effective enforcement of IP laws, which the IP Strategic Program is focusing on strengthening.

Patent examination

Prompt and proper examination might be a goal for all patent offices. However, the backlog of patent applications has been increasing worldwide. USPTO and EPO are familiar with workload issues, but the situation is even worse at JPO. Some 800 000 applications are pending examination, whereas JPO examines 200 000 applications a year on average.[9] Multiple factors may contribute to the backlog. The JPO has scarce human resources, with only one-third the number of patent examiners of USPTO or EPO.[10] About half of all applications tend to be rejected, which implies that Japanese applicants may file without searching for prior art in advance. The IP Strategic Program has enumerated various measures to deal with these problems. In order to increase JPO's staff, hundreds of patent examiners with fixed-term contracts may be employed. Also, to encourage applicants to research prior art in advance, patent prosecution fees may be discounted when applicants submit search reports issued by certified entities together with patent applications.

Another reason for the backlog is the increasing number of international applications[11]. In other words, the same inventions are filed in different regions, which reflects the fact that the world economy has become increasingly globalised and borderless. It also suggests the importance of co-operation between JPO, USPTO and EPO in the examination of applications. Multilateral harmonisation efforts such as the Substantive Patent Law Treaty (SPLT) should be further encouraged as well.

Several years ago, Mr. Arai, former Commissioner of JPO and currently Secretary-General of the IP Strategy Headquarters Secretariat, proposed a "global patent system" whereby one patent would be granted and valid for all nations. This may be too idealistic because it is taken for granted that a patent in one nation is independent of a patent in another nation, as provided for under the Paris Convention. However, given the expanding global activities in business and science, it is no wonder that a global patent could be envisaged as a long-term goal. Given that national borders still exist in legal contexts, a practical approach would be, for the time being, to proceed incrementally. For instance, USPTO and JPO are currently co-operating for mutual exploitation of examination results. It is worth considering moving one step further towards mutual recognition.

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9. Figures and data in this section are based on a paper presented by JPO at the Experts Group Meeting concerning enforcement of IP laws under IP Strategy Headquarters held on 28 November 2003, available at *www.kantei.go.jp/jp/singi/titeki2/tyousakai/kenrihogo/dai3/3siryou7.pdf* (in Japanese only)

10. JPO has about 1 100 patent examiners, whereas USPTO has about 3 200 examiners and EPO has about 2 900. Sources are the same as above.

11. Whereas domestic applications remain to be stable, international applications have risen dramatically since the mid-1990s. See Japan Patent Office, "Trends in Industrial Property Applications and Registrations" (2003), *www.jpo.go.jp/cgi/linke.cgi?url=/shiryou_e/toukei_e/trends_of_ipr.htm*

IP High Court

Dispute settlement is critical in the coming "IP-based nation". Since IP is intangible, disputes over the extent of patent protection are inevitable to some degree. The judicial system should therefore be able to resolve conflicts properly and quickly as they arise. However, IP lawsuits are not so easy for the court to deal with. First, since IP lawsuits involve advanced technologies, expertise in technologies is required. Second, businesses, which are facing fierce global competition, strongly desire a high degree of legal certainty and swift court decisions. These requirements seem to reasonably justify the establishment of a court that specializes in IP.

The United States established the Court of Appeals for the Federal Circuit (CAFC) in 1982, and although strictly speaking, it does not specialize in patents, it can be perceived as a patent court in a practical sense.[12] It is also true that the CAFC was created to deal with so-called "forum shopping", which was a problem unique to the United States. Moreover, little empirical evidence shows that the CAFC did contribute to the success of US high-tech industries such as IT and biotechnology,[13] which does not necessarily mean, however, that it harmed sound development of these industries. In reality, the CAFC has a very powerful voice not only in the United States but also in other nations, including Japan. It is often said that when Japanese firms are contemplating lawsuits, it is in the United States and not in Japan that they bring the case to court.[14] This suggests that "forum shopping" may exist in the international context. Coincidentally, European countries have been discussing the establishment of a Community Patent Court by 2010.[15] Given the powerful voice of the CAFC in the United States and the potential creation of Community Patent Court in Europe, Japan may well consider establishing an court specialized in IP. However, Japan has not had specialized courts of any kind so far. There are therefore opinions calling for careful consideration regarding the creation of specialized courts. Despite these concerns, the Headquarters, recognizing the existence of patent courts worldwide, determined that the Japanese government would aim to submit the necessary legislation to the Parliament in 2004 to establish an IP high court.

Measures against counterfeiting and piracy

Counterfeiting and piracy are no longer negligible problems. For instance, it is reported that about 100 Japanese firms have lost more than JPY 100 million (USD 1 million).[16] Traditionally, most of the losses came from trademark infringement. Today, as the technological capabilities of infringing parties improve, goods infringing patents are prevailing.

The IP Strategic Program takes dual approaches to address these issues internationally and domestically. In an international context, Japan should become more active in calling for effective protection of IPR. Japan will not only urge other countries to abide by international agreements such as TRIPS but also may consider utilizing the Free Trade Agreement (FTA) as a tool to protect IPR in a

12. The speech by Honorable Richard Linn, Circuit Judge, US Court of Appeals for the Federal Circuit, at Nekkei Intellectual Property Forum on 8 September 2003.

13. For example, see Samuel Kortum and Josh Lerner, "What is Behind the Recent Surge in Patenting?" *Research Policy* 28:1 (1999).

14. Marushima Giichi, *"Canon tokkyo butai"* (Canon Patent Team) (Kobunsha, 2002).

15. *http://register.consilium.eu.int/pdf/en/03/st07/st07159en03.pdf*

16. Moreover, 25 out of 100 firms reportedly suffer more than JPY 1 billion (USD 10 million). Japan Institute of Invention and Innovation, *"2002 nendo moho higai chosa hokokusho"* (FY 2002 report of survey on damage caused by imitation) (2003).

partner country. Japan will also continue to strongly support other countries' efforts to reduce counterfeiting and piracy. Official Development Assistance (ODA) may be utilized for this purpose.

Domestically, Japan will tighten its control over counterfeiting and piracy. Japanese customs' function should be enhanced to prevent counterfeiting and importing of pirated goods. Amendments to relevant laws in order to allow customs' officials disclose information concerning those who import or ship the goods that infringe IPR are currently under examination. Furthermore, the ability to discern the counterfeited goods should be improved to deal with high technologies embodied in manufacturing them. The Japanese government will therefore study more effective border measures and consider options including the establishment of a new administrative body such as the International Trade Commission in the United States and the introduction of special court procedures to rule on cases expeditiously.

Counterfeiting and piracy hurt not only Japanese firms but also all other firms in developed economies. Indogenous innovation is hampered countries where counterfeiting and piracy are prevailing because free-riding is cheaper than inventing based on new ideas. Consequently, counterfeiting and piracy may hinder the sound development of the world economy; they raise problems for all nations but there also are many areas for international co-operation.

Patentability of medical treatments

As discussed above, the IP Strategic Program puts a focus on strengthening enforcement of IP laws. One exception is patentability of inventions related to medical treatment. Traditionally, no one has cared about such an issue because medical doctors' activities have nothing to do with patents. However, recent developments in biotechnology have inevitably raised the question of whether new medical methods should be patentable or not. Proponents argue that since advancement of medical technologies depends on biotechnology, patent protection is necessary to provide incentives and encourage investment. However, opponents argue that medical doctors are not motivated by patents and, therefore, development of medical technologies should be left in the public domain.

The JPO Committee on IP Policy initiated discussions on this issue in 2002 and released a report one year later in June 2003.[17] It concluded that some inventions relating to regenerative medicine such as skin-cultivation or bone-cultivation methods are patentable, but that medical treatment in general should remain non-patentable. Internationally, laws on this issue are divided. On the one hand, the United States allows patent eligibility of medical methods, with certain exceptions, for medical practitioners. On the other hand, the European Patent Convention excludes them from patentable subject matter. From October 2003, Japan resumed discussions, aiming to reach a consensus on the patentability of medical treatments in general. It is hard to foretell what conclusions will emerge at time of this writing.

17. Patent System Subcommittee, Intellectual Property Policy Committee, Industrial Structure Council, "Application of Methods related to Medical Activity to the Patent Law" (2003) available at: *www.jpo.go.jp/shiryou_e/index.htm.*

Media content business

IP is not limited to science and technologies. Works such as films, animation and game software are also valuable IP. As IT infrastructure such as broadband has been developed, demand for "content" has been increasing. Moreover, recent Japanese films and animations are gaining popularity worldwide. One example is "Pokemon". Another example is the animation film "Spirited Away" by Hayao Miyazaki which won an Academy Award in 2003. Moreover, Japanese game software is highly competitive worldwide.

However, policymakers have traditionally paid little attention to this growing sector. Therefore, the Japanese government has decided to discuss a package of policies to help the media content business grow further. It is supposed to issue policy recommendations within one year.

Human resource development

Regardless of the type of legal system, it is the people that make the system work. In particular, IP professionals such as IP lawyers and patent agents are very important players in the "IP-based nation". IP expertise requires not only legal skill but also understanding of advanced technologies. Unfortunately, law studies in Japan have not succeeded in producing lawyers with technological backgrounds. This is because law degrees in universities are undergraduate degrees and most applicants for the bar exam have no chance to learn science and technologies. However, the entire judicial system in Japan is now in a process of reform. For example, Japan decided to introduce graduate-level law schools which are similar to US law schools. About 70 universities are currently preparing to open US-type law schools as of April 2004. Since Japanese universities continue to have undergraduate departments of law, a fairly large number of students may be graduates of these programs. Nonetheless, there will now be greater chances for students with technical backgrounds to enter law school. It is expected that these law schools will produce many multidisciplinary IP lawyers.

Furthermore, interdisciplinary and comprehensive research of IP itself should be encouraged as it would lay the foundation of an "IP-based nation." IP is a fairly new field and many research questions remain unanswered. IP research would not only contribute to IP education, but also provide many ideas and thoughts to policymakers. In particular, since IP is considered to be one subject of legal studies, few empirical studies exist. Scholars with non-legal backgrounds should be invited to conduct research related to IP.

Continuing discussion

The IP Strategic Program left some delicate issues unresolved and left them for further discussion. Patentability of medical methods is one example. Also, the IP Strategic Program only outlined some issues and left the details for further discussion, *e.g.* strengthening enforcement of IP laws and media content business. For these issues, IP Strategy Headquarters created three expert groups as a forum for further discussion. Each expert group consists of intellectuals from the private sector and no Minister is involved. All expert groups started discussions in the autumn of 2003 and are supposed to complete their reports within one or two years.

Conclusion

This paper has attempted to illustrate recent IP policy initiatives in Japan. As far as individual policies are concerned, this paper has only touched upon a few of the 270 items in the IP Strategic Program. Those who are interested in the remaining items can consult the full text of the Program.

The Program will be reviewed annually and may be revised, if necessary. Therefore, any comments, opinions and suggestions are welcome.

Japan has just begun its steps to becoming an “IP-based nation”. Things may go too far or move too slowly. No one knows whether these attempts will be successful. However, no one can say that it is an error to aim for a society where intangible assets such as IP are highly valued.

Chapter 19

THE PATENT SYSTEM: CURRENT AND FUTURE POLICY CHALLENGES

A VIEW FROM THE EUROPEAN PATENT OFFICE

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This chapter presents the views of the Vice President of Legal and International Affairs at the European Patent Office on current and future policy challenges related to patents, innovation and economic performance. In his opinion, the patent system has become a key institution of the knowledge-driven economy, but is still in a state of turmoil. New technologies and new issues are emerging fast. Reforms are discussed, and strategic decisions are called for. The link between patent policies and economic performance needs to become clearer, as the decisions to be taken are relevant to public prosperity.

Introduction

The patent system has by nature a major impact on the economic system. With the emergence of the knowledge-driven economy, the globalization of the market economy, and the establishment of worldwide IP standards, the importance of patents has grown considerably.

The rate of patent filings in the last decade has clearly outpaced economic growth in all countries, and this is neither a statistical aberration, nor the plain consequence of an expansive business cycle: it is the signal of a structural, deep-seated, and still developing shift in the economic landscape. The developments we are seeing in technology, society, economics, and politics are fast-moving and far-reaching, and let intellectual property emerge as a key issue. They pose new challenges to the patent system itself, and patents have become a critical topic for policy makers, business companies, and interest groups. The field of patents has never been so much in the public eye. During the 1990s it became increasingly obvious that the significance of knowledge for economic activities had fundamentally changed, as in one industry after another, knowledge had become more important than ever before as a factor of production.

While in the traditional industries competitive advantage is achieved by restructuring around knowledge and information, reducing the quantity of labor, natural resources, or capital per unit of product, the high-tech industries that have recently emerged produce and distribute goods with higher and higher content of knowledge, or even knowledge and information themselves. The most distinctive feature of the knowledge-driven economy is that it uses knowledge pervasively as both an input and an output throughout the economy. Production assets increasingly take the form of intangibles, of ideas, rather than material things. As tangible goods have more and more knowledge embedded in them, the economy becomes “weightless” or “dematerialized”. Dematerialization, with the shift from tangibles to intangibles, is the defining feature of the knowledge-driven economy. Information and knowledge generate wealth, and patenting is one of the instruments to capture and secure it, especially at a time of free trade among nations and high exposure to competition, as at the present time.

A strategic direction

The European Patent Office is well aware of these developments. In Spring 2001, amongst all upheavals, the EPO gave itself a strategic direction, formulated through its mission statement: *to support innovation, competitiveness, and economic growth.* Alongside all changes in the environment, this clarifies the main intentions of the EPO and the reasons why it exists. It allows the consistency of strategic decisions with one single overriding goal to be checked. We are persuaded that the EPO will remain successful in serving its mission only if it keeps on acting swiftly with respect to all changes in the technical, economic, social, and political sphere. Strategic pillars are and will remain mastering the workload, quality, and the systemic synergies.

In view of implementing changes, there is a clear need to recognize the complexity of the world we live in, to adopt a systemic framework of analysis, and to understand the profound shift that is taking place. In particular, there are many questions about the relationship between the patent system and the economics of technological change, answers to which would greatly help in designing the patent system and the patent policies of the future.

There is currently a need to explicitly understand the relationships between the patent system and the changing economic landscape. There is a need to provide good answers to complex questions. In order to retain a systemic view, there is a need to supplement the narrow perspective of many independent compartmental analyses and solutions with a single multidimensional approach. This is

essential to ensure that the current policy debate concerning the future of the knowledge-driven economy, and of the role of the patent system in it, is conducted in an informed manner.

Living in a knowledge society

Today, knowledge and skills stand out as a major competitive advantage, together with the management of technological innovation. If a nation can boost productivity through improving skills and technology, matching them to market needs and wants, its prosperity will rise. On the other hand, if there are impediments that stand in the way of relentlessly improving productivity, a nation will stagnate.

Today's world is not divided by ideology, but by technology. It is a world of innovation and adoption, but also of exclusions and divides. In this world sharing information, knowledge diffusion, and learning-intensive synergies are as important for economic performance as the creation of new knowledge. The possession of information and knowledge alone does not confer power: sharing information and knowledge does. It is a world where it is critical to remain joined with others, in networks, and to be connected to the heartland of the global economy. With this in mind, we note that there is a strong, direct relationship between development, innovation, and intellectual property.

The market economy, which increases the efficiency in resource allocation and encourages the adoption of best practice technologies, has proved to be the most favorable environment for entrepreneurship and technical innovation. All institutions and incentives devised in absence of a market economy and of sound property rights have failed because neither the institutions nor the incentives were good enough to encourage either endogenous innovation or import of new technologies.

Against this background, although the liberal and free trade camp is against the restrictive aspects of the patent system, patent protection appears more than ever to industrial firms and investors as an essential instrument in managing the risks of pouring increasing amounts of money into research and development, of bringing technological innovations to domestic and foreign markets, and of trading technology. Whether with exports, licensing, joint ventures or foreign direct investments, the activities of innovators and adopters concur to the establishment of partnerships and the division of economic tasks. This creates a higher value for all parties involved.

In this process, markets enable efficient allocation of scarce resources. However, in order to function, they need to be supported by suitable networks. In this context, the patent system offers an infrastructure contributing to the generation and the diffusion of knowledge, enables a market of ideas, and is a key institution of the knowledge society.

The patent system as a manager of risk

Innovation is primarily achieved by investment in intangibles: education, training, collaborations, alliances, relationships, research, and development. Interacting with tangible and financial assets, intangible assets create corporate value and generate economic growth. The management of innovation is about appropriating the benefits of one's own innovation and exploiting the innovation of others. As the value of innovation related intangibles is characterized by the triplet idea-market-control, such a value can be protected and leveraged by IP rights. Clearly, investing in intangibles entails inherent risks: a few initiatives will succeed, while many others will fail. However, under proper management, the high risk of intangibles can be leveraged into considerable value, as the rate of return on intangibles is higher than that on tangibles and financials.

Economic growth in developed countries relies increasingly on advances in science and technology, with many countries spending heavily to foster R&D. But quality of spending and effective management of innovation is as important as R&D investments themselves, and the patent system contributes to manage the risks related to these investments.

Patenting decisions do influence business risks. While the traditional business risk managed by the patenting system was simply having one's idea stolen and copied, nowadays we recognize a broader variety of risks, all related to seeing one's investment vanish. These are risks for the entire economy, as the stakeholders are not only the applicants or the investors, but also the competitors, the partnerships, the licensees, the consumers, and in some cases standard bodies, or consumers, or even nations states.

The influence of patenting decisions is felt not only in a variety of business areas, such as finance, strategy and taxation, but also in many policy fields, such as trade, competition, health, ethics, environment, development, consumer protection and the Internet. One immediate conclusion from all current developments is that, long considered a technical issue, patent policy has now entered the political arena, is held up to public scrutiny, and is obliged to justify its own existence and its own choices. We do need to consider the patent system in the context of the entire economic system, and risk management offers a unifying perspective.

The patent system as an infrastructure for the economy

We do believe that patenting only makes a positive economic contribution if it successfully manages risk and knowledge. We believe that the economy that encourages and supports an efficient market in ideas will prosper and succeed. We also believe that the EPO mission statement is decisive. In view of the EPO mission statement and of the foregoing considerations, three questions emerge: How to create more economic value? How can a market of ideas be strengthened? How to guarantee the balance among different economic actors?The European Patent Office is growing, with a doubling of the number of the EPC Member States, a doubling of the number of applications, a doubling of the budget, and a doubling of the staff. Simultaneously, the European Patent System is moving into the future, with the London Protocol on translations, the PCT reform, the Community Patent, the Protocol on Litigation, and is heading towards a reconfiguration.

The Office has signaled its desire to launch a debate about improving synergies within the European Patent System in a constructive fashion, by making a number of concrete proposals and suggestions as to how the EPO and National Patent Offices of Europe could co-produce economic value for the benefit of the citizens of Europe. On this basis, we do perceive that the many constituents of the European Patent System more and more share the goal stated in the EPO mission statement.

Conclusions

The patent system has become a key institution of the knowledge-driven economy, but is still in a state of turmoil. New technologies and new issues are emerging fast. Reforms are discussed, and strategic decisions are called for.

The patent system as we know it today consists of a complex structure of national laws and customs, international private agreements and practices, international conventions and arrangements. In spite of this legal complexity, however, the patent system as it currently stands has to a considerable extent "just grown", without much reference to fundamental economic principles or explicitly articulated goals. It is now time to revisit the system and its objectives.

The patent system will remain effective in its purpose only if it will keep on adjusting to change in the technical, economic, social, and political sphere. Today adjusting to change means adjusting to the globalization and to the knowledge-driven economy, and fitting in the new and ever changing environment that is taking shape.

The patent system, which is an institution devised for encouraging technological innovation, is an integral and important part of the environment in which technological progress flourishes. However, neither technological progress, nor the patent system is a neutral device, and it is only natural that policy issues are controversial. The emergence of the knowledge-driven economy pushes the patent system on the foreground of the political debate.

From the point of view of public policy makers, it is relevant and urgent to give a fresh look to the economic rationale of the patent system, in order to prepare and evaluate future policies and to adjust the institutional framework to the new situation in political, legal, and social terms. From the point of view of the stakeholders of the patent system, and that is citizens, industries, and governments, it is relevant to prepare a framework of discussion and to confer one another on these themes.

When it comes to make reforms, the decision-making bodies are called to retain a systemic view. Since it is just not possible to reform everything at once, reforms take place step by step, an issue after another. In this way, however, policy makers may draw in fragmented data and scattered analysis, and the risk of a lack of a systemic view is very high.

The link between patent policies and economic performance needs to become clearer: the decisions to be taken are relevant to public prosperity.

Chapter 20

THE PATENT SYSTEM: CURRENT AND FUTURE POLICY CHALLENGES

A VIEW FROM THE UNITED STATES PATENT AND TRADEMARK OFFICE

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This paper provides information on current and future challenges to the patent system from the perspective of USPTO, which is based on the view that strong patents benefit both developed and developing countries insofar as they facilitate technology transfer and foreign direct investment and encourage research and development. A number of recent changes have increased the workload at patent offices, calling for more uniform patent laws and for diminishing the duplication of efforts among patent offices, however, before those objectives are achieved, a number of challenges have to be addressed at multilateral and bilateral negotiations.

Protecting intellectual property internationally

A number of recent changes have increased the need for more uniform patent laws and reduced duplication of effort among patent offices. The introduction and expansion of new communications technologies, such as the Internet, have accelerated processes of industrial globalisation and the worldwide sharing of information. Geographic borders are crossed more easily than ever, meaning that patent holders seek to protect their inventions in more countries. Currently about 75% of USPTO examinations are duplicated by another patent office, either before or after USPTO. In addition, the increasing importance of intellectual property protection as a means of protecting competitive advantage and the emergence of new types of patentable inventions, such as biotechnology and software, have resulted in more patent filings, increasing the workload at patent offices.

The US government believes that strong patent systems benefit both developed and developing countries. Strong patent systems facilitate technology transfer and foreign direct investment. They encourage research and development and are catalysts for new technologies and industries, including small and medium-sized enterprises — a view reflected in the Conventions establishing the World Intellectual Property Organisation (WIPO). As a consequence, the objectives of the US government as regards international intellectual property right (IPR) policy are as follows:

- Strengthen and expand intellectual property rights globally, moving forward from the level achieved so far, which is already quite satisfactory.
- Expand bilateral, regional and multilateral discussions on patent law reform.
- Reduce duplication of effort among intellectual property offices.
- Facilitate work-sharing among patent offices.
- Adopt uniform electronic filing and processing solutions.
- Address current challenges, such as the IPR regimes in developing countries and the slow-down of progress in patent reform discussions.

There are many misperceptions about the role of developing countries when it comes to IP protection. Developing countries are often portrayed as victims of the IPR policies of developed countries, rather than as users of the patent system. Some of these views are led by a patronising view of the developing world's role in innovation. However, the challenges facing developing countries are related more to a lack of economic freedom and opportunity than to the IPR policies of developed countries, and these challenges are linked to a shortage of economic and legal infrastructures, including infrastructure for the grant and enforcement of intellectual property rights. The US government feels very strongly that large innovation reservoirs existing in developing countries such as China and Brazil need strong IPR regimes in order to better tap into innovation networks. Although there are many models of success all around us, many developing countries are not able to cash in on their capabilities. There is a need to provide developing countries with technical assistance on IPR grant and enforcement.

International treaties

International discussions about patent reform have been fruitful in the past few years. Since 1970 the Patent Cooperation Treaty (PCT) has facilitated the filing of applications internationally and provided non-binding search and examination results. Some years later, in 1995, the agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs) established minimum standards for patents and other IPRs and set out detailed rules for enforcement, including civil, criminal and

provisional (injunctive) provisions. It also extended the principles of national treatment and most-favoured nation to IPRs and made TRIPs subject to WTO dispute settlement procedures. The Uruguay Round Agreements Act (URAA) of 1994 implemented, among other provisions, the TRIPs agreement in the United States. The latest international IPR agreement signed is the Patent Law Treaty (PLT) of 2000, which sets forth maximum formal requirements that contracting parties may impose and provides easier access and reduced costs for multinational protection. However, PLT needs ten signatory countries in order to enter into force, and only seven states have ratified it to date. The ratification and implementation package is currently in the clearance process in the United States.

International discussions of intellectual property issues continue, although they seem to be slowing down. The government of the United States takes part in international discussions on the reform of the PCT and belongs to the Standing Committee on the Law of Patents (SCP). Issues of particular importance are highlighted below.

Simplifying international filing procedures at WIPO

The use of the PCT has exceeded expectations since its inception, with about 115 000 PCT applications in 2002 and relatively high growth in developing countries. In the United States, PCT filings represented almost 40% of all filings in 2002. This success called for simplification of procedures and a reform, which is now under discussion among signatory countries. The proposal presented by the US government for PCT reform in August 2000 focused on the need to streamline the cumbersome procedures for international filing set out in the treaty and to avoid duplicative processing. Following negotiations and other proposals, some steps have been achieved.

The 2001 PCT Assembly Meeting unanimously adopted the modifications of the time limits fixed in Article 22(1) of the PCT, extending from 20 months to 30 months the time for countries to perform the acts necessary to enter the national phase and transitional arrangements. The move to a 30-month priority period has been beneficial to this kind of effort as it provides more time for the applicant to evaluate the need for foreign filings and might thus reduce the workloads for offices and facilitate work-sharing.

In July 2002, the Reform Committee made several recommendations, which were adopted by the 2002 PCT Assembly Meeting. Some went into effect 1 January 2003, and most 1 January 2004. The first stage of these reforms has now been largely achieved:

- Include international search opinion with the international search report.
- Automatic designation and election of contracting parties.
- Allow for exclusion of specific member states.
- Simplification of fee system with a “flat” international filing fee.
- Implementation of a “communication on request” system.
- Require that only one applicant needs to sign the PCT request form.
- Reduce formal requirements for power of attorney.
- Conform certain priority provisions of PCT to PLT.

As regards convergence of national and international practices, the objective is to have the ability to prepare a relatively simplified application in a single format, preferably in electronic form, that would be accepted by all patent offices as a national/international application. In addition, in light of the changes adopted so far, PCT search and examination guidelines are being overhauled. USPTO has taken the lead in revision, cooperating with the Trilateral Offices and WIPO. These revised guidelines may have an independent harmonising effect, which should be consistent with ongoing discussions on the Substantive Patent Law Treaty (SPLT) at the Standing Committee on the Law of Patents (SCP).

Harmonising substantive patent law at WIPO

The objective of discussions on substantive matters at the SCP started with the objective to reach "deep harmonisation" on a limited set of issues, for both law and underlying practice, reflecting a new approach to international negotiations.

The goal of ongoing work on harmonisation on substantive patent law is to create a system based on mutual recognition, mutual exploitation and work-sharing, so that applicants would only need to draft and use a single application and would obtain consistent examination results around the world.

However, despite early progress on some issues such as establishment of an international grace period, the prospect of success became clouded in the May 2003 meeting, calling into questions the purpose of the discussions. The main areas of controversy over the latest meetings include questions about the appropriateness of harmonisation, patent-eligible subject matter, references to Article 27 in TRIPs, and proposed exceptions to patentability for in areas related to public health, the environment, protection of genetic resources, traditional knowledge, and social development. Developed and developing countries raised different sets of issues.

Developing country issues include those concerning genetic resources and traditional knowledge and the question about the appropriateness of harmonisation. It is worth noting, however, the importance given to harmonisation in Article 4(i) of the Convention Establishing WIPO: *"…the Organisation…shall promote the development of measures designed to facilitate the efficient protection of intellectual property throughout the world and to harmonise national legislation in this field."*

In contrast, the issues raised by developed countries, which include some long-standing contentious matters between the United States and Europe, can be summarised as follows:

- First-to-invent versus first-to-file.
- Priority art effect for applications filed abroad (first to invent and In *re Hilmer*[1]).
- Best implementation mode requirement.
- International grace period.
- "Technical" and "industry" requirements.

1. In *re Hilmer*, 359 F. 2d 859 (CCPA 1966). "The Hilmer doctrine bifurcates the date that an application obtains priority from the date that the patent granted on the application obtains prior art effect for applications filed outside the United States. The Hilmer doctrine excludes from admissible evidence, certain 'secret' evidence of one inventor's acts of invention occurring outside of the United States, in determinations of patentability or validity of another inventor's claimed invention." *(www.oblon.com/Pub/display.php?hilmerdoctrine.html)*

- Eligible subject matter ("pure" business methods).
- Prior art effect of prior filed, later published applications and patents (novelty only or novelty and non-obviousness).
- Double patenting.
- Deposit requirements (In *re Lundak*[2]).
- Loss of right provisions.
- Problem-solution approach.
- Uniform treatment of all claims.
- Unity of invention.

In view of the large amount of issues on the table, the US position at the moment is to limit the number of issues for discussion to those essential to achieve the initially articulated goals. The objective is to resolve developing country issues and to resolve or accommodate developed country issues. For instance, differences as regards the definition of subject matter between the United States and the rest of countries should not block resolution of other issues. To avoid that situation, discussions on "technical matter" might have to take place primarily between Europe and the United States.

Efforts beyond and outside WIPO

Efforts beyond WIPO are mainly focused on work-sharing, consistent with objectives of USPTO *21st Century Strategic Plan* to reduce duplication of effort among offices. They are driven by the goal of mutual recognition and exploitation and seen as a way around the slow pace of discussions on international harmonisation. The advantage of such initiatives is that they tend to be more practical than treaties, and countries obtain immediate gains. They put a "real world" component to otherwise philosophical or abstract "law" issues. They also help to establish trust in the work of other offices such as search results. These efforts will help reenergise SCP directly or by way of increased bilateral and multilateral agreements among work-sharing countries and offices.

Conclusions

Protecting intellectual property rights internationally is essential in a global, knowledge-based economy. Recent increases in filings have led to workloads that are difficult to manage for patent offices. The *status quo* is unacceptable because of its attendant costs and redundant work process. The goal of increasing work-sharing among patent offices must be pursued, but a number of challenges will need to be addressed first.

2. In *re Lundak*, 773 F.2d 1216, 227 USPQ 90 (Fed. Cir. 1985).

Chapter 21

PATENTS AND THE TRANSFER OF TECHNOLOGY TO DEVELOPING COUNTRIES

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This paper explores the implications of patents for the transfer of technology to developing countries, with a focus on developing countries that have significant scientific and technological capability. The contribution of this paper lies in the separation of different forms of technology transfer and analysis of the roles of patents in these different forms of transfer. It, in turn, reviews the impact of patents on the transfer of technology through foreign direct investment, on the transfer to indigenous firms, both through licensing and through independent innovation, and finally on the transfer of technology through public-sector research.

Introduction

This paper explores the implications of patents for the transfer of technology to developing countries. The area has been extensively explored in previous papers. The contribution of this paper lies in the separation of different forms of technology transfer and analysis of the roles of patents in these different forms of transfer. It, in turn, reviews the impact of patents on the transfer of technology through foreign direct investment (FDI), on the transfer to indigenous firms, both through licensing and through independent innovation, and finally on the transfer of technology through public-sector research. The paper reviews the most important of the previous studies and considers a number of case examples in order to provide conclusions that are as balanced as possible.

The paper concentrates on developing countries that have significant scientific and technological capability. Its focus is thus quite different from that of the report of the UK Intellectual Property Rights Commission (2002), which concentrated on the poorest nations, for which the most important effects of intellectual property rights (in addition, of course, to their role in fostering innovation in the developed world in areas that may benefit the developing nations) are increased market power and often increased prices for certain products such as pharmaceuticals. It is widely recognized that the impacts of intellectual property rights (IPR) systems vary with the per capita income of developing nations and are most likely to be positive at middle-income levels, with nations generally adopting stronger intellectual property systems on their own at about the USD 8 000 per capita income level. (Maskus, 2000, p. 108)

Patents and foreign direct investment

The question of whether patent systems in the host countries contribute to increased FDI is controverted. The benefits of patents in encouraging FDI are often touted by industry and hope for such investment was one of the factors that moved developing nations to accept TRIPS. Nevertheless, the economic studies, although generally supportive, are somewhat less persuasive than one might expect.

This paper concentrates on developing countries that have significant scientific and technological capability. Its focus is thus quite different from that of the report of the UK Intellectual Property Rights Commission (2002), which concentrated on the poorest nations, for which the most important effects of intellectual property rights (in addition, of course, to their role in fostering innovation in the developed world in areas that may benefit the developing nations) are increased market power and often increased prices for certain products such as pharmaceuticals. It is widely recognized that the impacts of intellectual property rights (IPR) systems vary with the per capita income of developing nations and are most likely to be positive at middle-income levels, with nations generally adopting stronger intellectual property systems on their own at about the USD 8 000 per capita income level (Maskus, 2000, p. 108).

The various studies

The studies fall into two categories: interviews with industry executives and cross-national correlations. The early interview studies, exemplified by Mansfield (1994 and 1995) reveal effects that are radically different from industry to industry, with patents crucial in the pharmaceutical and chemical industries, significant in some other high-technology industries, and insignificant in many other industries such as textiles and motor vehicles. A more recent interview study, concentrating on European transactions in China, reflected business concern about that nation's weak intellectual

property system, but also suggested that firms compensate by reserving core technologies and by maintaining a rapid rate of development of new technologies (Bennett *et al.*, 2000).

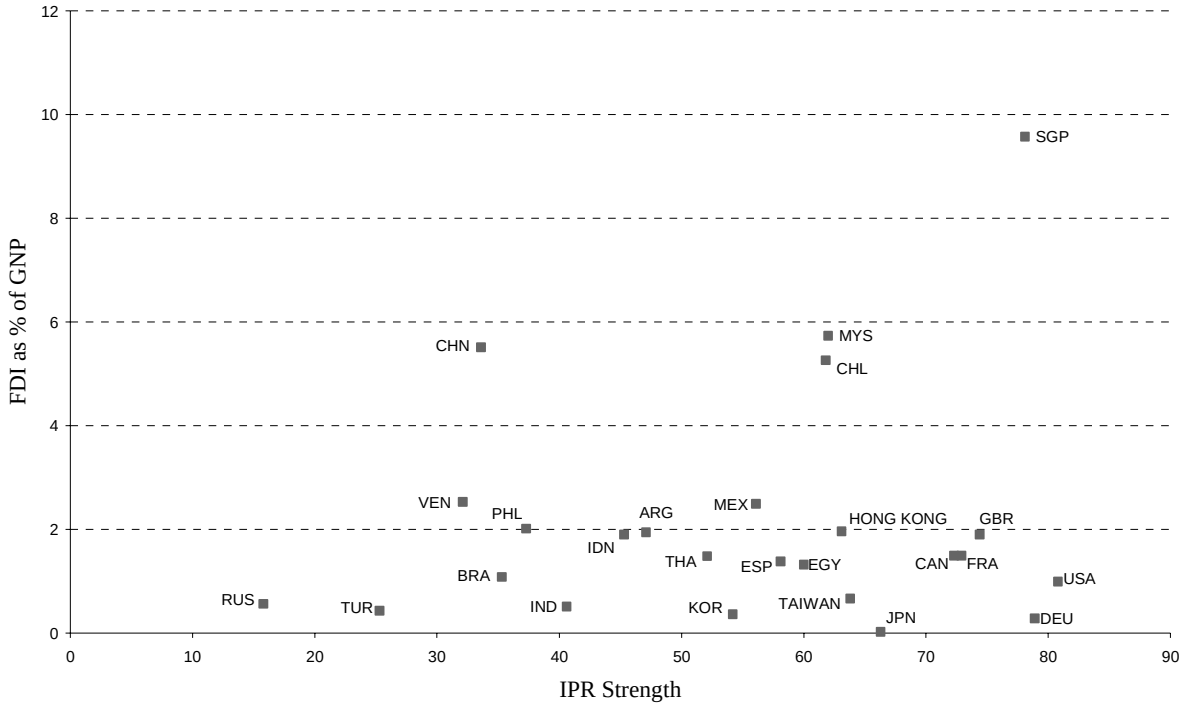
A number of the correlations are reviewed in Maskus (2000). (There are more than can be reviewed in this paper.) After some earlier studies finding no effect, Mansfield (1995) found a significant impact of IPR on FDI. Maskus (2000) reports on two studies in which he was involved, one (Maskus, 1998) finding that sales of US affiliates rise with increased IPR levels, implying more productive activity in the country by the affiliates, and one, based on a general equilibrium model, that found significant coefficients for IPR in three out of four cases. A more recent study by Smarzynska (2002), using Eastern European data, found impacts in the specific industries for which IPR was expected to be significant, but not in other industries – but found a broader effect when the IPR measure was modified to include enforcement, presumably because this signaled a better business climate. Another recent effort, Branstetter, Fisman and Foley (2002), based on firm-level data, concluded that firms receive increased royalties from their affiliates when the affiliate's host nation strengthens its patent system, but not from unaffiliated entities, and concluded also that the increased royalties represented both increased market power and increased technology transfer and therefore presumably investment.

Certainly, the impact varies from sector to sector – but it also varies with a nation's general economic strategy and appeal, as may be seen by looking at raw data. The work of Lall and Albaladejo (2002) provides normalized measures of FDI for individual nations. By comparing these numbers with the IPR strength numbers presented in the World Competitiveness Report, it is possible to make a simple comparison, shown in Table 21.1 at the end of this chapter (see page 330) and plotted in Figure 21.1.[1] (A simple regression of the numbers in the table, using no control variables, yields an r-square way below a significant level.) What is clear is that FDI is heavily concentrated in a few nations – the peaks in the chart are China (at the low-IPR end), Chile, and Malaysia (at the mid-IPR range) and Singapore (at the high-IPR end). Presumably many of the underlying differences are reflected in the additional variables included in the more careful regression studies, but it is clear that each of these high-FDI nations is a special case with a number of unique features and policies affecting FDI and technology transport (such as market size in China, hyper-economic openness in Chile, and enormous government support and educational capability in Singapore). The technology transfer processes of Japan and Korea are not reflected, because these nations emphasized local firms and severely restricted FDI.

A stronger IPR regime will therefore be helpful in attracting FDI in some sectors. But, it is not a necessary condition (as indicated by China) and absolutely not a sufficient condition for foreign investment. Underlying attributes such as educational levels and general business climate are necessary conditions (depending on the FDI sector), whether or not there is a strong IPR regime (Saggi, 2002).

1. The x-axis is the World Competitiveness Report coefficient of IPR strength for selected countries for 1995, as reported in Maskus (2000). The y-axis is the Lall-Albadejo measure of FDI as a percent of GNP, chosen since, in contrast to the measure of FDI as a percent of GDI, it measures the general attractiveness of the economy to foreign investment.

Figure 21.1. **FDI & IPR**



ARG = Argentina, BRA = Brazil, CAN = Canada, CHL = Chile, CHN = China, DEU = Germany, EGY = Egypt, ESP = Spain, FRA = France, GBR = United Kingdom, HONG KONG = Hong Kong (China), IDN = Indonesia, IND = India, JPN = Japan, KOR = Korea, MEX = Mexico, MYS = Malaysia, PHL = Philippines, RUS = Russian Federation, SGP = Singapore, TAIWAN = Chinese Taipei, THA = Thailand, TUR = Turkey, USA = United States, VEN = Venezuela.

Analysis: investor incentives

These insights can be integrated by attempting to analyze the incentives facing a foreign direct investor. There are two important cases, depending on whether the investor's motives are to serve the host-nation market or to serve a global market – and the fact that the latter motivation is becoming much more common reflects a major change in the technology transfer world from the era of the 1970s when many economists proposed *dependencia* theories and developing nations proposed a New International Economic Order and a Code of Conduct for Technology Transfer. And the economics are likely to be different for product patents and for process patents. The product patents will initially be emphasized in the following analysis.

In the older pattern of import substitution, the investor's interest was to obtain a profit in the local economy – in many cases, particularly in sectors such as pharmaceuticals, a patent would be helpful in increasing the return available from the market. Without that return, an investor would be relatively uninterested. With that return, the investor would consider whether the scale of the market justified serving the market through import of product or through local manufacture – this of course depended on such factors as the economies of scale of manufacture, the differences between the product designs for different markets, the transportability of the product, the political pressures to manufacture locally, the operating costs of transferring the technology as detailed in Teece (1977), and the possibility of imitation of the production process. Maskus (1998) presents a more detailed and complete analysis of these factors. Certainly, there must have been and must still be cases in which the increased returns through patenting of the product and the decreased likelihood of imitation under a patent regime bring the calculation positive. It seems likely that these cases will be those, such as pharmaceuticals, in

which patents protect a market against imitators, and that there will be little effect where imitation is unlikely or where product patents cannot effectively be used to increase the volume, as in areas such as motor vehicles or farm machinery. There is good reason why patents matter more in some industries than in others.

The incentives are completely different for globalized production. This is the typical case today save for products that are not readily transportable – but it should be recognized that some developing-nation markets, such as China, are likely to become increasingly important in their own right. Here, the patent that increases profit is the patent in the market nation – typically a developed-world nation. The factors that lead to investment in the developing nation to serve this developed-world market have nothing to do with patents on products. A host nation's comparative advantage in this situation is based instead on its investment climate, its special resources such as minerals or a particular agricultural climate, and most of all its people – ranging from low wage labor (as in the textile world) to sophisticated scientific capability (as in computers). Hence, it is hard to see how local product patents matter at all, save perhaps as an indicator of general business climate.

Patents on processes raise different issues. Here, an investor's fear is that it will lose control over important production technologies. These technologies could then be used by another firm to compete in whichever market the firm is serving (domestic or global), and could possibly be used to gain an advantage in other markets that the firm has not yet entered. For these technologies to be an issue, the host nation has to be sophisticated enough technologically that copying and imitation are possible – and the technology has to be important to the production process. Clearly, under these circumstances, firms are more willing to invest when there is an effective patent system.

In these circumstances, trade secrecy may be as important as patent law – and it is surprising that there has been so little discussion of the role of trade secrecy law in facilitating FDI (save for objections to overly-narrow trade secrecy laws of the past). Trade secrecy law allows one to obtain damages and an injunction against an investor's employee or contract partner who takes a trade secret and used it against the investor. Thus, insofar as processes are concerned, it helps protect against imitation and serves much the same purpose as patents.

The history of trade secrecy law reveals important policy balances that should be considered carefully by developing nations. One example is the balance of the rights of the employee with those of the employer. In California, a contract provision requiring the employee not to go to work for a competitor is unenforceable[2]; in much of the rest of the United States it is enforceable under appropriate circumstances. The result is that, in California, there is much more cross-fertilization of ideas as employees move more readily from firm to firm, and some feel that this is part of the reason for the success of Silicon Valley (Saxenian, 1996). But the likely cost is that employers may be less willing to invest in the education of their employees. A similar balance is that of reverse engineering – to what extent should a firm be entitled to tear apart a competitor's product to understand and possibly copy the trade secrets inherent in the product? This was long regarded as a nearly inalienable right at least in the United States, as exemplified in Keewanee Oil Corp. v. Bicron Corp., 416 US 470 (1974), but there are now frequent attempts to restrict the right by agreement and, in the case of software, by technological means. Moreover, the Digital Millennium Copyright Act of 1998 prohibits certain forms of reverse engineering in the digital area. Clearly, proper resolution of these balances is important for developing nation. Stronger trade secrecy law may encourage firms to bring new technology into a nation – but among the ways such a nation is likely to develop indigenous firms is through creations of

2. It is still possible to obtain an injunction against the new employer's use of technologies that are improperly taken from the former employer.

new industry by employees who gain experience in the FDI industries, and through reverse engineering of products on the market. This process of technology transfer from FDI to indigenous firms is an area explored by Saggi (2002) and requiring significant study.

Patents and indigenous firms

Most technologically sophisticated nations want to encourage their own firms as well as obtain FDI from foreign investors. The role of patent law here is much more complex. It will be considered under three headings – first, the acquisition of technology by license or agreement; next, the independent development of technology by an indigenous firm, and finally, the development of technology by a developing-nation public sector entity hoping to apply its innovations domestically. The license and independent development strategies were the basic pattern in nations such as Japan and Korea, where technological sophistication evolved without substantial FDI. The public sector issues are most significant in the medical and agricultural sectors in nations such as Brazil, where a large share of the research in these sectors in carried out by public-sector institutions.

Licensing to and agreements with indigenous industry

Licenses and similar agreements (*e.g.* joint ventures, which typically include license provisions) are among the most standard ways of obtaining technology. These arrangements assume that there is an indigenous firm with enough capability that licensing is feasible. In some cases, this capability may derive from knowledge or contacts into the local market – the traditional pattern exemplified in product cycle models. But, in today's era of globalization, it may also derive from a local expertise that complements a foreign firm's global expertise. The clear example is suggested by the Chinese Taipei semiconductor manufacturing firms that have developed enough experience and capability that the global industry turns to them, under contractual arrangements, to manufacture semiconductors for global markets. As suppliers, they are in a strong enough position that they are able to negotiate reasonable terms for obtaining any additional technology they need.

In this kind of arrangement, local patent systems assist in the negotiation process. Parties to the licensing agreements need to exchange data about the technology if they are to be able to make reasonable decisions on entering licenses and on the terms of the licenses. Patent law supplements trade secrecy law in minimizing the risk of loss of technical advantage in negotiating the transaction – even the filing of a patent permits greater freedom in the discussions, since the priority date of the patent application becomes a basis for recognition of rights in the invention involved. However, the empirical evidence in this area is even more mixed than in other areas. As noted above, Branstetter, Fisman, and Foley (2002) did not find an increase in licensing with stronger patent systems. On the other hand, Yang and Maskus (2000) did "in their preferred estimation" find such an effect, as did Smith (2001). It is hard to draw any conclusions from these studies, but it does seem plausible that the impact of local patents on this form of technology transfer may be less substantial than for technology transfer through FDI.

This is suggested by the factors that a firm must take into account in making a licensing decision. The factors are very parallel to those in an FDI investment decision. They depend on whether the license is intended as a way to serve the local market or as a method of global production. In the local market case, the putative licensor must weigh the factors involved in FDI, along with several new factors. Favoring the license approach over the FDI approach is the possibility that the licensee will bring significant value to the transaction, perhaps in the form of capital or of risk sharing, perhaps in the form of local expertise or complementary knowledge. Opposing the license is the possibility that the practical costs of transferring the technology to an unrelated firm (*e.g.* costs such as training costs) along with the difficulties of managing through a contractual relationship rather than administratively

may be too great. There is also the possibility that the licensee will become a competitor. And the same factors must be taken into account in the license oriented toward a global market, although what is likely to dominate here is the possibility that the licensee has important complementary capability – this is the Chinese Taipei semiconductor example. For the developing country economy or firm, this implies a strategy based on finding a niche in which a firm's capabilities (and perhaps patent position) are so strong that global firms are interested in finding cooperation arrangements – that will almost certainly bring additional technology.

Finally, an important phenomenon should be noted – as nations adopt patent systems, their indigenous firms appear more likely to be absorbed by global firms. This is clearly the case in the Italian pharmaceutical industry as described in Scherer (2000) and seems likely to be the case in other nations and perhaps industries as well. To the extent that patents do favor FDI and do restrict imitation, they of course favor multinationals over the indigenous firms. Moreover, the multinationals may well make some of their FDI through purchase of existing indigenous firms. This brings concentration, with implications for prices and for decreasing the number of innovative entities; it also brings the multinational's technology, which may be more advanced than the indigenous firms' technology. It is necessary to be careful with respect to this point about the effects of IPR on mergers, for there are many reasons beyond IPR why firms amalgamate or purchase local affiliates, but IPR seems likely to have some effect.

Independent operation

Entry into a global industry as a licensee is likely to leave one a less-than-dominant player in the industry – what is typically not available by license is access to and reputation in the global (fundamentally developed-world) market. Thus the Indian software industry is a vibrant industry providing technology under contract, and gaining technology in the process, but it will be very difficult for it to compete independently in the developed-world market. As a licensee, one is unlikely to end up displacing an industry leader. Kim (2002) compares Hyundai, which developed its technology on its own and from multiple sources with Daewoo, which was a joint venture with General Motors until 1992 – Hyundai was significantly more successful during this period. Hence, there is reasonable developing-nation interest in firms that develop their own technology and successfully compete with the global firms in the global markets.

Historically, such firms gained their technology by imitation. As described in Wilkinson (1963), this is clearly the case for the US textile industry in the early 19th century, in spite of efforts by Europeans to prevent the export of technology. It is probably the case for the Japanese and Korean industrial giants that began by copying simple technology and then moved to more and more advanced technology, and, finally, for some products, were developing technologies ahead of anyone else (Kim, 2002). And in another example, the Indian pharmaceutical industry would not today be as strong as it is had it not had a period during which it could imitate foreign products. In such a situation, patent rights hurt rather than help. Indeed, the patent system in Korea was weak during that nation's period of boom growth, and the patent system in Japan during its boom period was a weak one that was designed to facilitate technology transfer from firm to firm. As described in Helfand (1992), patents were granted for very incremental inventions, firms read the patents granted to competitors, and designed around the details described in the patents.

Today's stronger global patent system may thus greatly complicate if not prohibit the entry of new firms into existing industries. Would-be new firms can, of course, still learn about existing technologies by reading patents from the developed-world. But, the product patents now required in the local market can be used against these firms to protect the global incumbent industry from new local competition.

With globalization, the real issue becomes patents in developed-world export markets, which can be used to protect these global markets against new entrants. Obviously, not all products are covered by patents in ways that create this form of bar to entry into an industry. However, the trend is toward such coverage – the major judgments in the Kodak and Texas Instrument litigations in the United States in the 1980s have compelled firms in almost all sectors to develop portfolios of patents to use defensively, *i.e.* to be able to threaten countersuit against any competitors that bring suit against them for patent infringement. These portfolios protect against litigation by competitors and create what amounts to tacit cross-licenses among competitors. A new entrant without a substantial portfolio, however, is susceptible to exclusion through litigation by the incumbents (Barton, 2002). Indeed, it is clear that patent litigation has already been used to attempt to exclude imports or to gain royalties (which may impact new entrants particularly hard) in sectors such as computers, semiconductors, and other manufactured products. For example, 12 of the most recent 21 patent cases brought in the US International Trade Commission under § 337 were against products from industrializing nations.[3] Use of patents in this way is likely to become increasingly important as defensive patent portfolios are used in more sectors, such as telecommunications, agricultural biotechnology, and financial service industries. The presence or absence of patent systems in the developing world is relatively unimportant here; to have a chance to compete, a developing world firm needs to build a portfolio of patents in key developed-world markets, including business method patents and software patents in markets such as the United States.

Obviously, this situation poses competition-law concerns, although they will be hard to address, both because the appropriate balance between the competition and patent concerns is hard to define and because the developed nations may resist changes in legal arrangements that protect their own firms against foreign competition. The patent system increases the entry barrier to new firms – they presumably must find niches as licensees and then, if very successful, build a strong enough product and patent portfolio to be able to challenge the incumbent firms. One may wonder, then, whether the greatest opportunities for developing world firms are today in new industries where there are no incumbents – it may take an evolution like the one that brought the steel and rail industries to the United States and Germany or the semiconductor industries to the Pacific Basin.

The public sector and research tool issues

Finally, the role of patents in the developing-world public sector should be noted, because this sector is so often the most highly funded research area and prime locus of scientific and technological innovation in middle-income nations. There are two issues: the commercialization of public sector innovation, and the ability of the public research sector to use patented inventions.

Patents, and here it is the national patent system that matters, can be useful in transferring technology from the public sector institution to national firms that actually apply it. In order to do this well, there needs to be more than a national patent system – it is also essential that there be arrangements between the public sector institutions and their employees so that the institution is free to license the inventions, there need to be legal arrangements to choose licensees and negotiate fair license terms, and there needs to be an institutional capacity such as a technology licensing office. The patent helps in defining the technology to be licensed. It may also be essential to the licensee, who may need exclusivity as an incentive to invest in developing the technology to a marketable level. This

3. The numbers are based on the most recent page of 30 § 337 cases listed on the ITC Web site on 11 August 2003. They include, for example, batteries from China, tool sets from Chinese Taipei, and semiconductors from Korea. Among the 30 cases, there were also a number involving trademarks, trade dress, and trade secrecy.

approach, patterned on the US Bayh-Dole legislation, is being widely copied throughout the world, and is sometimes essential if technology is to be commercialized. But it should be remembered that the approach is unlikely to provide enough income to replace public sector budgets; it risks distorting the research incentives of the institutions; and technology is often distributed more effectively simply by publishing it (UK Commission, 2002).

The other issue is the "research tool" issue, under which many basic research methods and findings (*e.g.* certain gene sequences) have been patented. (UK Commission, 2002). The result is that a sophisticated research program risks committing acts of infringement. Certainly, only some of the relevant patents applicable in the developing world will have been sought in developing countries – yet it is the more scientifically-sophisticated middle-income countries in which patents are likely to have been sought. Although there is question as to the magnitude of the problem (Walsh, Arora and Cohen, 2003), it may prove serious in biotechnology, both agricultural and medical. It may also become a problem for software, where the growth of software patents provides a tool through which open-source software can sometimes be attacked. At least some of the problems can be avoided by strict subject matter and utility standards to restrict the number of research tool patents issued. Others can be avoided through a research exemption in infringement legislation. But it may be necessary to go further and create a dependency license that permits use of research tool inventions in return for a reasonable royalty (Barton, 1997).

Conclusions

Patents are used in different ways in different industries, and international industry structures are different in different industries. Hence the impact of patent law on technology transfer will also vary – patent systems are very important in chemicals and pharmaceuticals; historically they have been much less significant in semiconductors and transportation equipment.

Strengthening of developing nation patent systems will probably strengthen technology transfer through FDI and possibly through licensing – but only in certain industries and in nations that have appropriate complementary capabilities. It will thus not benefit the poorest. And, it will slow technology transfer through imitation, as suggested by Lai (1998).

Finally, the strengthening of patent systems throughout the world appears likely to strengthen the position of incumbent multinationals and disfavor the independent development of technology by indigenous firms in developing nations. Under a patent system, such firms cannot imitate as readily; they may not benefit greatly from licensing; and they may be absorbed by multinationals as patent systems strengthen. There is another important policy balance here. Part of the role of patents is to enable incumbents to gain the rents needed to support research. At the same time, it seems likely that both the developing world and the world as a whole benefit from a certain amount of flexible entry into the industrial economy in order to bring in new ideas and to encourage incumbent firms to maintain their innovation rates (Barton, 2002). TRIPS is likely to have shifted the balance by restricting this flexible entry (Nicholson, 2002).

Table 21.1. **Raw FDI/IPR data**

	IP strength 1995	**FDI as % GNP**
United States	80.8	0.99
Germany	78.9	0.28
Singapore	78.8	9.57
United Kingdom	74.4	1.9
France	72.9	1.49
Canada	72.3	1.49
Japan	66.3	0.02
Chinese Taipei	63.8	0.66
Hong Kong (China)	63.1	1.96
Malaysia	62	5.73
Chile	61.8	5.26
Egypt	60	1.32
Spain	58.1	1.38
Mexico	56.1	2.49
South Korea	54.2	0.36
Thailand	52.1	1.48
Argentina	47.1	1.94
Indonesia	45.3	1.9
India	40.6	0.51
Philippines	37.3	2.01
Brazil	35.3	1.08
China	33.6	5.51
Venezuela	32.1	2.53
Turkey	25.3	0.43
Russia	15.8	0.56

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Chapter 22

A MULTILATERAL VIEW OF CHANGE IN THE PATENT SYSTEM

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The relationship between patent policy and other areas of public policy has become much more complex and interactive in recent years and the work programs of an increasing number of international organizations include intellectual property components. This paper presents the views of the Deputy Director General of the World Intellectual Property Organization in charge of patents and global intellectual property issues about the determinants and consequences of this shift in the international public policy of the patent system, in particular its effect on the future multilateral development of the patent system.

For the first one hundred years of their existence, from 1886 to 1994, intellectual property and patents were a largely self-contained policy at the international level, responding essentially to the needs and demands of the objectives underlying those policies, which, in the case of patents, consisted principally of the provision of an economic incentive to investment in the creation and commercialisation of new knowledge in the form of inventions. More complexity existed at the national level, where the sometimes competing demands of competition policy, *ordre public* and national security were recognised as reasons to limit or modify the scope and exploitation of patent rights.

This unimodular system changed with the conclusion of the Agreement on Trade Related Aspects of Intellectual Property Rights (the TRIPs Agreement) in 1994, which, for the first time at the international level, recognised that patent policy was related to, or could have an influence on, other areas of public policy. Most notably, Article 27 of the TRIPs Agreement[1] recognised certain subject matter flexibilites in connection with the application of patent protection, particularly the right of a Contracting Party to exercise judgement in relation to the exclusion of patent protection where necessary for "*ordre public* or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment", and to exclude plants and animals from patent protection. While these provisions represented a very significant change in the international public policy of the patent system, it remained the case that the interface between patent policy and other areas of public policy was primarily[2] treated from the perspective of the patent system and within the framework of instruments concerned with intellectual property.

Yet a further stage was reached at some point in the period of time that has elapsed since the entry into force of the TRIPs Agreement. In this third phase, the relationship between patent policy and other areas of public policy has become much more complex and interactive.

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1. Article 27

"Patentable subject matter

1. Subject to the provisions of paragraphs 2 and 3, patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application.[1] Subject to paragraph 4 of Article 65, paragraph 8 of Article 70 and paragraph 3 of this Article, patents shall be available and patent rights enjoyable without discrimination as to the place of invention, the field of technology and whether products are imported or locally produced.

2. Members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which is necessary to protect *ordre public* or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment, provided that such exclusion is not made merely because the exploitation is prohibited by their law.

3. Members may also exclude from patentability:

(a) diagnostic, therapeutic and surgical methods for the treatment of humans or animals;

(b) plants and animals other than micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, Members shall provide for the protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof. The provisions of this subparagraph shall be reviewed four years after the date of entry into force of the WTO Agreement."

2. The Convention on Biological Diversity, concluded in June 1992, constituted the principal exception. See, in particular, Article 16.5: "*The Contracting Parties, recognizing that patents and other intellectual property rights may have an influence on the implementation of this Convention, shall cooperate in this regard subject to national legislation and international law in order to ensure that such rights are supportive of and do not run counter to its objectives.*"

One can now find that the work programs of an increasing number of international organizations include intellectual property components. In addition to the World Intellectual Property Organization (WIPO) and the World Trade Organization (WTO), both which have core jurisdictions relating to intellectual property, one can now find programs concerned with intellectual property underway within the framework of the Convention on Biological Diversity (CBD), the Food and Agriculture Organization (FAO), the International Telecommunication Union (ITU), the United Nations Education, Scientific and Cultural Organisation (UNESCO) and the World Health Organization (WHO).

A significant shift represented by the inclusion of intellectual property programs in these other international organizations, which do not have core jurisdictions in intellectual property, is that intellectual property is considered, at the international level, from the perspective of other public policies. The furthest point in this shift is represented in the international discussions and debates concerning access to genetic resources and benefit sharing, an area regulated at the international level principally by the CBD.[3] Here, one finds a demand on the part of the developing countries, in particular, for the addition of a requirement in patent laws that a patent applicant disclose the origin or source of any genetic resources that are used in the invention that is the subject of the patent application. Discussions concerning the appropriateness of establishing an international rule imposing this requirement continue in both WIPO and WTO. An interesting feature of the proposed requirement is that it represents an attempt to use the patent system to achieve the objectives of a public policy different from those underlining the patent system, namely, the objectives that underlie the CBD.

What are the causes of this shift in the international public policy of the patent system, and what are the consequences of the shift, particularly for the future multilateral development of the patent system? First, let me make some remarks about the underlying causes of the shift. In my view, the shift that has occurred results from the combined effect of three developments in particular.

The first of those developments is the central position that intellectual property now occupies in the knowledge economy as a consequence of the increased importance of the conceptual element of production. The source of wealth creation in the knowledge economy has shifted increasingly away from physical capital towards intellectual capital and, just as physical property controls physical capital, so intellectual property controls the source of wealth creation that is represented by intellectual capital. In consequence, demand for intellectual property rights has increased over the course of the decade of the 1990s at an unprecedented rate. On one measure, the total number of patent applications worldwide increased from 1.5 million in 1990 to 9.5 million in the year 2000.[4] While these figures may be exaggerated in certain respects as a result of some distortion in the collection of data, it nevertheless remains undoubtedly the case that both the number of new inventions, which rose from around 560 000 in 1990 worldwide to around 870 000 in the year 2000, and the number of patent applications filed around the world to protect those new inventions, have increased dramatically. This centrality of intellectual property in the knowledge economy naturally has caused increased attention to be focussed on intellectual property, in general, and patents, in particular, from all segments of the community.

3. See, also, the International Treaty on Plant Genetic Resources for Food and Agriculture.

4. See the Trilateral Statistical Reports.

A second cause of the shift in patent policy at the international level is, no doubt, the rapid development of radical enabling technologies, notably, the Internet and biotechnology. Neither the Internet nor biotechnology is a branch of industry in itself, in the sense of representing a defined segment of industry with a particular output. Rather, both are enabling technologies which are used across a broad range of industries and which, in turn, have brought the question of property rights in relation to those technologies to the attention of a very wide industrial and commercial audience, as well as a very wide range of consumers and users.

Thirdly, an undoubted cause in the change in patent policy has been the emergence of the networked society, largely as a consequence of the Internet and the empowerment that the Internet has conferred on a broad range of non-State actors or non-governmental organizations. This new class of participant group in policy discussions relating to patents at the international level is additional to, and different from, the traditional participant groups from the non-State sector to which the international intellectual property community is accustomed. Whereas once, the non-governmental sector was principally represented by professional and industry groups, it is now also represented increasingly by consumer groups, organizations and other interested coalitions. The discussions that have taken place with respect to HIV/AIDS, access to essential medicines and the impact of patent protection are a good example of the influence that these new groups can exercise.

Patent protection is no longer a specialist domain dealt with by specialists, but a matter of interest and concern to all in society. There is no reason to lament this development. It is a natural consequence of the importance of intellectual property in the knowledge economy.

Let me now turn to some of the consequences of the shift, particularly, as I said, for the further multilateral development of the patent system. Here, I should like to mention five consequences.

The first consequence is that any practitioner of intellectual property, or, indeed, any enterprise with intellectual property assets, must now dealt with an increasingly complex institutional architecture relating to intellectual property. I have mentioned the range of organizations at the multilateral level that are now have work programs or an interest in intellectual property. Following developments in all of these organizations is a task in itself. In addition, however, a practitioner or an enterprise must also be familiar with a similarly complex range of regional institutions, either in the form of regional trade and integration arrangements, such as the European Union or the North American Free Trade Agreement (NAFTA), or in the form of regional intellectual property offices responsible for procedures for obtaining intellectual protection. Furthermore, policy concerning patents and intellectual property at the national level reflects the complexity that we have seen emerge at the international level. As this complexity is multiplied in the future, there will always be a danger that the patent system becomes overloaded and itself too complicated to serve the basic economic purposes for which it was designed. Enterprises will cease to use patent protection if the transaction costs associated with obtaining and maintaining patent protection are too high to justify the benefits conferred by that protection.

A second consequence of the shift is the expanding horizon of intellectual property. The more one talks about the knowledge economy, the more forms of knowledge people desire to bring within it and to see protected by property rights. The discussions occurring at the international level with respect to the intellectual property protection of traditional knowledge and folklore are a good example of this tendency. In addition, in other areas, one sees demands for a form of intellectual property protection with respect to geographical terms such as country names, as opposed to geographical indications, within the domain name system. Then there is the relationship between genetic resources, which are physical property, and intellectual property rights obtained on the basis of those genetic resources, to which I have already alluded. None of these demands is unwarranted. However, it will

always be important to ensure that we do not overly encumber the knowledge economy by too many forms of intellectual property rights or by intellectual property rights that are too expansive in their scope and application.

A third consequence of the shift is the tendency for patents and intellectual property to become a convenient battleground for other issues. As the relationship between patents and other areas of public policy becomes more interactive, it is easy for a confusion to set in between a debate about the underlying technological developments to which patent protection relates, on the one hand, and property rights, on the other hand. The life sciences furnish a good example of the possibility of this confusion. When the first patent on a higher organism was granted for the Harvard mouse there was considerable outcry in some quarters about the ethics of patent rights on higher organisms. Yet, people all around the world eat higher organisms on a daily basis and wear them as clothing. People also exercise rights of dominion over domestic pets that are far more extensive than the limited patent right to prevent another from reproducing and using commercially an invention covered by a patent. So was the real concern about the direction of technology, which enabled higher organisms to be manipulated, or about the property rights in relation to the manipulation made possible by new technologies? There are, no doubt, proper questions of an ethical nature to be asked about property rights in connection with higher organisms. But those questions, from the point of view of intellectual property, should be directed at the property rights, as opposed to using the property rights as means of attacking certain orientations in technological development. Other mechanisms exist in public policy to exercise control over the proper scope of scientific research.

A fourth consequence of the shift is that the interconnectedness of patent policy and other areas of public policy is making it increasingly difficult to make progress on issues of functionality. I have already mentioned the prodigious increase in demand for patent protection. As a consequence of increased demand, backlogs in the processing of patent applications are accumulating and processing times are lengthening. Ultimately, the cost-, time- and resource-effectiveness of the patent system is at risk, as well as the integrity of the system in the sense of its capacity to ensure that only inventions of the right quality receive patent protection.

Various projects are under way at WIPO to create the conditions for a more rational resource allocation in the international patent system and to enable Patent Offices around the world to cope with increased demand. I refer, in particular, to the negotiations for a proposed treaty on substantive patent law harmonization and to reform of the Patent Cooperation Treaty (PCT). The former project is directed at creating the conditions for greater mutual exploitation of search and examination results in Patent Offices, while the latter exercise is directed at achieving greater simplification and streamlining in the operation of the PCT as an efficient method for applying for patent protection in multiple countries around the world. Both of these exercises, particularly substantive patent law harmonization, have encountered the difficulty of determining the extent, if any, to which issues concerned with other areas of public policy ought to feature in exercises designed to achieve greater efficiency in functionality. Arguably, on one view, before one moves to consider the impact of patent protection on other areas of public policy and to take any necessary corrective measures, one must ensure that patent protection exists, in other words that patents can be granted and can serve the basic purpose for which they were designed. This is not to say that there is no proper scope for consideration of other areas of public policy in the formulation of patent policy.

A final consequence of the shift that I should like to mention is the complexity and difficulty of identifying, separating and managing the different types of tensions that affect the patent system in the new environment that has emerged. There are many tensions and their sources are often different. In some cases, tensions arise as the result of changes in business models. When such changes occur, property rights are often obtained in connection with commercial activity under the new models. An

example is the field of electronic commerce, where patents on business methods used in the electronic environment have been a matter of controversy. It is always appropriate to question the application of patent protection to new areas of business and commerce, but, again, from the point of view of intellectual property, the question that arises is the appropriateness of the property rights, and property rights should not be a means of attack of a new business model by a entrenched interests. A second source of tension is the interface between patent protection and other public policies. A third source of tension derives from the outright non-acceptance of intellectual property in some quarters. And a further source of tension results from inequities in the distribution of wealth around the world and the proper role of intellectual property in development.

All of these sources of tensions are legitimate in liberal, democratic societies. They do, however, place strains on the intellectual property system and require careful management to ensure that discussion does not degenerate into a confusing morass.

So the challenges are many. Intellectual property has been globalised in a certain sense. But I do not believe that the multiplicity of the challenges should be a cause to dishearten those concerned with the development of intellectual property policy. On the contrary, the development of policy in the area of intellectual property is now much richer and more varied that it ever was before, although, at the same time, more demanding.

INTELLECTUAL PROPERTY RIGHTS (IPR), INNOVATION AND ECONOMIC PERFORMANCE

OECD, Paris
28-29 August 2004

CONFERENCE AGENDA

THURSDAY, 28 AUGUST 2003

Welcome and Introduction: Herwig Schlögl, Deputy Secretary-General, OECD

Session 1. Patents and Economic Performance: Establishing the Links

Chair: Sung Chul Chung, Science & Technology Policy Institute (STEPI), Korea
Vice-Chairman of the OECD Committee for Scientific and Technological Policy

Introduction of issues

- *Patenting trends across countries*
  Samuel Kortum, University of Minnesota
  Jonathan Eaton, Boston University
  Josh Lerner, Harvard Business School

- *Japan's patent system and business innovation: reassessing pro-patent policies*
  Kazuyuki Motohashi, Hitotsubashi University

- *Scope and nature of the patent surge – A view from Germany*
  Jakob Edler, Knut Blind, Rainer Frietsch and Ulrich Schmoch
  Fraunhofer Institute for Systems and Innovation Research

- *Understanding business patenting and licensing: Results of a survey*
  Dominique Guellec, Catalina Martínez, and Jerry Sheehan, OECD

Stakeholders and policy makers' views

- Stephen A. Merrill
  Executive Director, The National Academies, United States

- Thierry Sueur
  Vice-President of IPR and Vice-President of European & International Affairs, Air Liquide

Discussion: Have firms increased their patenting propensity? Is the surge in patenting a generalised phenomenon across sectors and countries? What drives the increasing importance of patents for business and economic performance?

Session 2. Changes in Patent Regimes

Chair: Andrew Christie, Director of the Intellectual Property Research Institute of Australia (IPRIA)

Introduction of issues

- *Co-evolution of patent system and technology in Japan*
  Akira Goto, University of Tokyo

- *Legal challenges to patent validity in the United States and Europe*
  Dietmar Harhoff, University of Munich

- *Overview of recent changes in patent regimes in the United States, Japan and Europe:*
  Dominique Guellec and Catalina Martínez, OECD

Stakeholders and policy makers' views

- Ulrich Schatz
  Former Principal Director for International Affairs/Patent Law, European Patent Office

- Francis Gurry
  Assistant Director General, World Intellectual Property Organization (WIPO)

- Bruce Lehman
  President and CEO, International Intellectual Property Institute (IIPI)

Discussion: What have been the most important changes recently experienced by patent regimes? What have been their determinants? What have been their effects? Have similar changes in the strength of patent protection occurred at the same pace across countries and sectors?

Session 3. Patents and Entrepreneurship

Chairman: Mozelle Thompson, Commissioner, US Federal Trade Commission

Introduction of issues

- *Patents, competition and entrepreneurship*
  Bronwyn H. Hall, University of California at Berkeley

- *Enforcing patent rights and competition*
  Mark Schankerman, London School of Economics

Stakeholders and policy makers' views

- Jean-Bernard Schmidt
  Chairman, European Private Equity & Venture Capital Association (EVCA)

- Thane Kreiner
  Senior Vice President, Corporate Affairs, Affymetrix, Inc.

- David Ellard
  European Commission Internal Market DG

Discussion: Do large firms have a comparative advantage with respect to small ones as regards patent enforcement? Do patents generate asymmetries among large and small firms? Are the impacts of patents on competition the same across sectors and markets? What is the effect of patents on the performance of start-ups?

FRIDAY, 29 AUGUST 2003

Session 4. Patents and Diffusion of Technology

Chairman: Manuel Desantes, Vice President DG 5, Legal/International Affairs, European Patent Office (EPO)

Introduction of issues

- *Technology licensing*
  Nicholas S. Vonortas, Director, Center for International Science and Technology Policy, The George Washington University

- *Effects of research tool patents and licensing on biomedical innovation*
  Wesley Cohen, Duke University
  John Walsh, University of Illinois at Chicago and University of Toky
  Ashish Arora, Carnegie Mellon University

Stakeholders and policy makers' views

- Richard A. Johnson
  Arnold & Porter, Vice-Chair of BIAC Technology Committee

- Sandra Thomas
  Director of the Nuffield Council on Bioethics

Discussion: Do patents facilitate the diffusion of technology among firms? Are transaction costs for the diffusion of technology higher in some sectors than in others?

Session 5. IPR for Software and Services

Chairman: Richard Simpson, Industry Canada, Director General Electronic Commerce Branch, Chairman of the OECD Working Party on Information Economy

Introduction of issues

- *Through the lens of intangibles: What software and services reveal about the patent system*
  Brian Kahin, School of Information, Gerald R. Ford School of Public Policy, and Department of Communication Studies,University of Michigan

- *Patenting in services: evidence from European innovation surveys:*
  Pierre Mohnen, MERIT, University of Maastricht
  Jacques Mairesse, INSEE

- *An empirical look at software patents*
  Robert Hunt, Federal Reserve Bank of Philadelphia
  James Bessen, Research on Innovation and Visiting Scholar, MIT Sloan School of Management

- *How do firms leverage their knowledge assets?*
  Complementarity and substitution between types of legal intellectual property in software
  Stuart Graham, Georgia Institute of Technology
  Deepak Somaya, University of Maryland

Stakeholders and policy makers' views

- Harald Hagedorn
  Patent Attorney, SAP AG

- Hartmut Pilch, FFII & Eurolinux Alliance

- Marie Therese Huppertz, Director, Corporate Affairs (Europe, Middle-East, Africa) Microsoft

Discussion: Does patenting play a different role in protecting IP or in enhancing competitive advantage in services and manufacturing? Are there alternative means of protection for software and services more effective than patents? What is the effect of patents on diffusion and further innovation in software? How does the emergence of open source software change the IPR discussion in this sector?

Session 6. Current and Future Policy Challenges

Chairman: Francis Gurry, Assistant Director General, WIPO

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- Manuel Desantes
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- John H. Barton
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Discussion: What are the major challenges ahead for IPR policy in OECD countries? What is the effect of sectoral differences on patenting behaviour and on patent policy?

INTELLECTUAL PROPERTY RIGHTS (IPR), INNOVATION AND ECONOMIC PERFORMANCE

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