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Intellectual Property Rights, Innovation and European IPR Policy

Intellectual property rights are a central elements of EU innovation policy. This contribution shows that the conventional wisdom that strengthening IPRs will increase innovation and growth is not supported by economic theory and empirical evidence. Thus the creation of an EU patent should not be accompanied by a further tightening of IPR regulatio

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Intellectual property (IP) and innovation are closely related. Intellectual property rights (IPRs) protect innovators from exploitation of their knowledge. Primarily, product and process innovations are protected through patents. In some instances, copyrights and trade secrets are also used for such purposes. Intellectual property rights provide important incentives for innovation, but granting an IPR is equivalent to conferring a monopoly, with the associated welfare loss. The design of an effective regime of intellectual property rights therefore seems to be an important policy instrument to foster innovation.

Over the last decade, there has been a sharp increase in the level of worldwide IPR activities. The surge in patenting across the world reflected the increasing importance of patents and copyrights in a knowledge-based economy as well as changes in IPR regimes. Indeed, the last decade witnessed a tightening of IP protection. Intellectual property rights have been tightened in terms of, first, an extension of patentable subject matter, new types of inventions – software, genetics, and business methods – are now deemed patentable subject matter by some patent offices, second, exclusive rights on pure ideas (e.g., genetic codes, some mathematics), third, increased length of period of protection, and fourth, strengthening the ability of IPR holders to protect and enforce their rights.

At the EU level, the harmonisation of IPRs provides a clear-cut mechanism for reducing trade barriers and for a simplification of existing national regulations. It seems that some of the proposed changes are motivated by the idea that stronger regulation of IPRs enhances innovativeness in the EU. This is closely related to the growing emphasis on exploiting patents and other IPRs in the strategic management literature. In a knowledge-based economy, generating value from intellectual capital and knowledge-based assets is vital.

There can be little doubt that policies to tighten the IPR system have helped to create markets for technology to diffuse patented knowledge and to channel private-sector funding into R&D, thus being instrumental in the biotech revolution. On the other hand, the strengthening of IPRs has raised new concerns and exacerbated older ones (*Andersen,* 2004). The downside of IPRs is that they confer some degree of monopoly power to the holder, leading to welfare loss and encouraging rent seeking. Concerns were raised whether patentability might hamper the diffusion of knowledge and innovation and whether existing IPR systems provide an efficient reward for innovation. Thus, traditional rationales for granting IPRs were called in question[1].

[1] For an extreme position against IPRs see *Boldrin – Levine* (2002, 2004).

This paper is structured as follows: The following section gives an overview of the different types of IPRs. Section 3 discusses the economic rationales for and against IPRs. Section 4 provides a survey of the empirical evidence regarding the use of IPRs. Section 5 provides a brief overview of recent changes in the international patent regimes. Section 6 discusses the role of the EU in IPR. Concluding remarks close the paper.

Intellectual property rights and innovative activities

The primary role of IP for innovation policy is to enhance the private appropriability of ideas in order to strengthen the incentive to innovate. IPRs represent the legal mechanism for protecting intellectual assets. The most important IPRs are the following:

- A *patent* is the grant of an exclusive property right to the inventor for a limited period of time in exchange for disclosure of the innovation. Patents confer the right on their holders to exclude others from using an invention. A patent must reflect a technological novelty, be inventive and susceptible of industrial application.
- *Copyrights* protect original works of authorship, such as writing, music, art, recordings, and software. The basis for issuing copyrights is originality, not the criteria of novelty and inventiveness as for patents. Copyrights confer exclusive rights on the specific expression, generally from the time of creation of the work until seventy years after the author's death.
- *Trademarks* protect words, names, symbols, or colours that distinguish products. Trademarks can be renewed forever.
- *Trade secrets* refer to business information that is not known or readily ascertainable by the relevant public. Trade secret protection is primarily governed by contract law, and no novelty or originality criteria are required.

In addition, there are specific sui generis IP protection regimes for specific goods, e.g., semiconductors, plants or databases, middle of the road IPRs, such as utility models and design patterns, and informal protection mechanisms for IP, such as trade secrets (which can be enforced by the courts), lead time, complexity and secrecy.

Although the protection of symbolic material and creative expression has increased the scope for copyrights, patents are still of primary importance for most sectors of the knowledge-based economy. The criteria of novelty and inventiveness indicate that patents remain the IPR that is most relevant to innovation policy, while copyrights are important for creative industries.

IPRs are crucial to recover the sunk cost of innovation and decisive for small firms in these sectors as a signal to attract investors or research partners. This has led to the conviction that the strengthening of IPRs is necessary to foster innovation. Such a view neglects two important aspects: first, that patents are not the only appropriation mechanism available to firms; and second, that patents are associated with welfare loss due to monopoly rents.

Economic rationales for intellectual property rights

The primary economic rationale for intellectual property is that it encourages the development of new products and processes, thereby increasing social welfare. While it is common knowledge that strong property rights for rival goods are conducive to economic growth, the economic rationale is less clear for non-rival goods, such as ideas. For non-rival goods, property rights involve the trade-off between incentives and monopoly distortions (*Nordhaus,* 1969, *Romer,* 2002, *Andersen,* 2004).

The incentive theory of IP maintains that the function of IP is to provide a remuneration scheme for successful innovators in order to give them an incentive to incur the costs of innovation. Inventions are essentially combinations of tangible goods and ideas, i.e., information. Information is essentially a public good. Therefore, competitive markets may not be conducive to innovation. IPRs are believed to stimulate innovative competition by providing strong incentives to innovate and are deemed necessary as a mechanism to stimulate a competitive dynamic environment. However, it is well known that IP systems also have drawbacks. An obvious defect of IP systems is the welfare loss due to monopoly pricing. The trade-off between incentives and welfare loss is crucial for an economic evaluation of IP systems and explains why IP protection is only temporary[2].

Two issues dominate the economic literature on IPRs. The first is whether the IP system is efficient in aligning decentralised innovation incentives with social incentives. The second issue concerns the optimal design of IP systems. Recent research has come to the conclusion that, in general, the IP system is superior to alternative solutions, as it provides a screening mechanism to encourage investment innovation projects of high value. The Box "Alternative Incentive Mechanisms for Innovations" provides a short overview of alternative incentive schemes aligning private and social incentives.

Alternative Incentive Mechanisms for Innovations

Alternative incentive mechanisms for rewarding innovators are discussed especially with regard to applied pharmaceutical research. It is being argued that in this area the patent system fails to align private and social incentives and provides inadequate incentives for innovations of high social value (*Kremer,* 1998; *Stolpe,* 2003). The alternatives proposed range from prizes to procurement mechanisms. The World Health Organisation and the World Bank suggested the use of prizes for developing vaccines that would not be developed or distributed widely enough under the patent system. Procurement is a mechanism that allows getting an efficient invention at minimum cost. Procurement is typically used in government-sponsored research, such as military R&D. Both prizes and procurement have their drawbacks. Prizes are unable to use all the decentralised information of firms, and it is difficult to see how prizes can efficiently limit the wasteful duplication of effort of patent races. Procurement requires an ex-ante selection of firms, which reduces the patent race problem, but increases the risk of regulatory capture. Newer proposals use IP but avoid the social costs of a monopoly by considering patent-buyout mechanisms (*Kremer,* 1998, *Shavell – van Ypersele,* 2001).

Overall, these alternative mechanisms are not suited as horizontal policy instruments. They are vertical policy instruments tailored to steer innovative effort into particular directions. Public prizes, public procurement and public sponsorship all have their advantages when it comes to knowledge and information that serve society better if put in the public domain (*Maurer – Scotchmer,* 2004).

This draws largely on *Gallini – Scotchmer* (2001), *Maurer – Scotchmer* (2004) and *Stolpe* (2003).

The breadth of patents is very important for understanding the monopoly effects of patent systems (*Merges – Nelson,* 1994). Narrow protection favours secondary follow-up inventions, but sacrifices the economic incentives for expensive and uncertain breakthrough innovations. Broad patents have the opposite effect and increase the monopoly power, as follow-up invention is made illegal. It is difficult to determine the optimal length and breadth of IPRs to protect innovation. Research suggests that the results are conditional on the nature of technology and on the existence of a market for technology. Markets for technology (feasibility of private contracting via licensing) affect the effectiveness of IP systems in a variety of ways (*Arora – Fosfuri – Gambardella,* 2001, *Gallini – Scotchmer,* 2001, *Gambardella,* 2002):

- they reduce the amount of wasteful R&D duplication by encouraging faster diffusion of patented knowledge,
- they reduce the deviations from marginal cost pricing in downstream markets,
- they encourage specialisation in R&D, as complementary knowledge can be contracted in,

[2] This literature survey concentrates primarily on patents. On the one hand because patents are still the most important formal IPR for innovation policy, and on the other hand because most of the conclusions apply to IPRs in general.

- they increase the incentives for innovation, as revenues can be generated even for innovations that are not used in-house.

Markets for technology are neither a recent phenomenon nor are they limited to patented knowledge. The last decade has seen an expansion of licensing of patented knowledge and an increase of licensing revenues. Estimates for the USA suggest that revenues from licensing increased from $ 10 billion in 1990 to $ 1,000 billion in 2000 (*OECD,* 2004). The growth of markets for technology has its origin in two developments: the increased patenting and strategic use of patents following the tightening of patent protection, and the resulting changes in business IP strategies. Small technology-based firms need IPRs in order to attract venture capital and to participate in innovation networks of other firms, while large firms begin licensing in order to generate revenue from unused patents. In order to be viable, markets for technology require a relatively broad patent scope and strong IPR enforcement to reduce the incentives for patenting around and imitation. However, licensing also has its disadvantages: prices in the market for technology are monopolistic and such markets generate externalities associated with complementary R&D (*Gambardella,* 2002). While it is not entirely clear under which circumstances markets for technology work or fail, it is obvious that they have a strong influence on the optimal design of patent systems: if licensing works, patent systems should provide broad and short IPRs; in case licensing fails, IPRs should be narrow and long. Licensing is likely to fail, if transaction costs are high or if multiple licenses must be contracted (*Bessen,* 2004).

Competition policy issues increasingly do not only address failures in product market competition, but also failures in the markets for innovation. This fact challenges the view that stronger protection promotes innovation. If technological change is regarded as a cumulative process in which each innovation is built on knowledge previously acquired and possibly patented by forerunners, the benefits of innovations are not only enjoyed by consumers and current inventors, but also by future innovators building on these innovations[3]. *Scotchmer* (1991) and *Bessen – Maskin* (2003) argue that in case of sequential innovation, patent protection can even be counterproductive. Such cumulative processes of innovation are apparent in various industries, such as software, biotechnology, semiconductors, and the Internet. Overly broad patents may block subsequent innovations. This danger is reduced by licensing, cross-licensing, patent pools and joint standard setting. However, the possibility remains that the incentives to innovate non-infringing follow-on products are lower with broad than with narrow patents. Patent pools and cross-licensing are generally considered pro-competitive, but they can reduce incentives to innovate in industries with cumulative technological change, if they are used by firms with the market power to exclude rivals, or if firms pool technologies to raise rivals' costs. In industries where network effects are important, broad IPRs and network effects reinforce each other by favouring market dominance, which in turn reduces the incentives to innovate (*Encaoua – Hollander,* 2002).

With cumulative technological change, a third aspect of IP systems becomes relevant: the patentability criterion. An invention is considered to be patentable according to the European Patent Convention (EPC), if it involves an inventive step, i.e., the invention, having regard to the state of the art, must not be obvious to a person skilled in the art. Higher patentability requirements provide incentives to direct innovative efforts towards more ambitious inventions. The drawback of stronger patentability requirements is that they create incentives for innovation in early stages of research, while diminishing them for follow-up innovations. Recent research by *Hunt* (2004) indicates that weaker patentability standards are more likely to increase innovative efforts in industries that innovate slowly, and that the patentability standard should be increased for industries that innovate rapidly.

Disclosure is a second argument in favour of IP systems limited to patents (*Denicoló – Franzoni,* 2004; *Bessen*, 2005). Patenting requires the disclosure of the technical idea. After the expiration of patent protection, anyone can use the innovation. In this re-

[3] *Baumol* (2002) estimates that 80 percent of the value of innovations is not captured by innovators, but by consumers and competitors.

spect, patent databases can be regarded as a clearing house for new knowledge, fostering markets for technology. However, empirical evidence suggests that patent databases are used only moderately by firms (*Arundel,* 2000). Positions taken against the disclosure argument abound in the literature, as it is not entirely clear whether patent disclosure is necessary for the diffusion of knowledge. First, given the cumulative nature of technological change, it is very likely that the undisclosed idea is also developed by somebody else. Secondly, it is essentially impossible to keep valuable ideas secret for a long time. Ideas are public goods and imitative efforts (e.g., reverse engineering) are usually much cheaper than creative efforts. Thirdly, mechanisms such as licensing are also possible for innovations that are not protected by patents, if imitation costs are high and trade secrets are protected.

To summarise, on average IPRs are probably the best available mechanism for screening innovation projects, compared with other public policy measures, such as subsidies or rewards, if values and costs are not observable. IPRs have the advantage of concentrating costs among the users. Prizes, procurement and public sponsorship of research are of advantage when it comes to knowledge, information and ideas that serve society better if put in the public domain, as this eliminates the deadweight loss of IPRs and maximises possible uses (*Maurer – Scotchmer,* 2004). The question whether IPRs are the cheapest way to implement incentives for innovation depends crucially on their design. The design of the IPR system also influences other social costs, e.g., costs associated with rent seeking. From the literature, the view has emerged that the optimal design of property rights depends on the nature of technology, the costs of imitation, and the feasibility of private contracting. The optimal design of IP regimes in terms of breadth, length, and inventive step differs according to subject matter.

How do firms use IPRs to protect innovations?

Tighter patent regimes induce higher propensities to patent. However, this does not necessarily induce higher innovative efforts, although it might lead to a redirection of effort towards patentable subject matter (*Sakakibara – Branstetter,* 2001, *Hall – Ziedonis,* 2001, *Lerner,* 2002, *Moser,* 2005). In order to establish whether IP regimes are too weak, too tight or necessary at all, an assessment of the actual uses of IPRs to protect innovations by firms and an understanding of the motivations behind their uses are required.

The inclusion of trade secrets among the list of IPRs shows that firms have an array of different mechanisms to protect innovations. Beside patents, firms also employ secrecy, lead time, complexity of design and other IPRs (copyrights, trademarks, and design patterns). Figure 1 presents the uses of different methods to protect innovations by firms with innovative activities. The data has been derived from the Community Innovation Survey (CIS3). The results show that overall, European enterprises relied much more on informal methods than on formal IPRs to protect their innovations. The single most important method was lead time. Lead time describes the possibility of a head-start profit for the innovative enterprise, while it enjoys a monopoly because competitors cannot offer the same product. Secrecy ranks second in the list of methods to protect innovations. On average, both lead-time advantages and secrecy are more important than formal methods of protection based on the IP system. This holds for both services and industry. The main difference between services and industry is the greater reliance of industrial enterprises on patents and the more frequent use of copyrights in services.

Similar results are documented by surveys conducted in Japan and the USA (*Cohen et al.,* 2002). Secrecy and lead time are consistently regarded as better protection mechanisms than IPRs by most firms, with the notable exceptions of the pharmaceutical, chemical and mechanical industries (see *Arundel,* 2000, *Cohen – Nelson – Walsh,* 2000) and those industries in which products, such as digital products and processes (e.g., software, music or computer games), can only be marketed by issuing an IPR. Interestingly, *Cohen – Nelson – Walsh,* (2000) are able to document an increase in the importance of secrecy relative to patents for US manufacturing firms. To some extent, this may be due to the strengthening of IPRs following the TRIPs

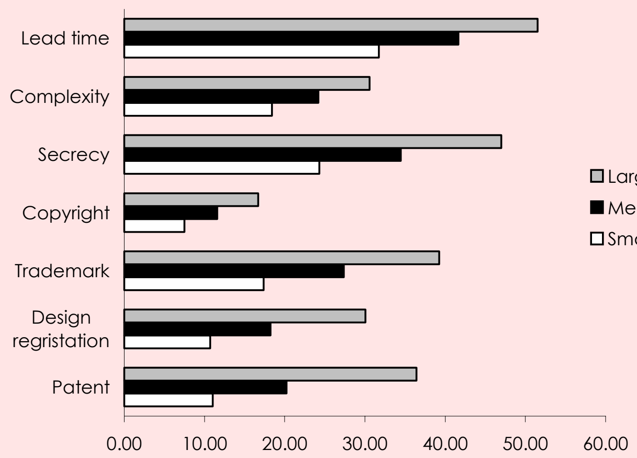
(Trade-Related Aspects of Intellectual Property Rights) chapter of the WTO Uruguay Round in 1994, which also strengthened trade secret protection.

Figure 1 shows that all protection methods are utilised to a greater extent by larger firms. This is particularly true for formal protection mechanisms, such as patents and design registrations. The effect of firm size is probably due to the fact that larger firms have in-house IPR offices, which means that using IPRs, such as patents, design registrations and trademarks, is a matter of routine for them (*Arundel,* 2000). For small firms, the use of formal IPRs is relatively more expensive.

Figure 1 suggests that informal and formal appropriation strategies are complementary. Secrecy can be used in the early stages of innovative activity to ensure lead-time advantages, while IPRs, especially patents, can help maintain lead times once the product is on the market. On the other hand, firms will sometimes protect an innovation by using one or more patents on the different parts of the innovation, while keeping other elements secret. Although firms may judge patents to be relatively ineffective (*Cohen – Nelson – Walsh,* 2000), they use them nevertheless, as they may add sufficient marginal value when used in conjunction with other mechanisms.

Figure 1: Choice of protection methods for firms with innovation activity according to firm size

EU, 1998 to 2000, in percent



Source: Eurostat, NewCronos (CIS 3). The calculations use data for the EU-25 countries except Poland, Ireland, and Malta. Small firms are firms with 10 to 49 employees; medium-sized firms are firms with 50 to 249 employees; and finally, large firms have more than 250 employees.

These results do not imply that formal IPRs are unimportant for small firms. In specific sectors, such as biotech or ICT, IPRs are needed to attract venture capital and prospective partners, which makes them essential also for small firms. Research by *Gambardella – Giuri – Luzzi* (2004) on the use of patents in Europe reveals that larger firms have a much higher number of unused patents than small firms, suggesting that small firms' patents are more valuable[4]. Research for the USA and Europe on firm level data shows that the effectiveness of IPRs, particularly patents, varies considerably by industrial sectors and fields of technology. In the pharmaceutical, chemical, and mechanical industries, patents are particularly important means of protection (*Arundel – Kabla,* 1998, *Cohen – Nelson – Walsh,* 2000).

Cohen – Nelson – Walsh (2000) analysed the importance of strategic motivations for patenting. They found important differences between industries where products are protected by numerous patents (e.g., computers) and industries where products are protected by relatively few patents (e.g., pharmaceuticals, chemicals). Blocking

[4] The fraction of overall unused patents in their sample was approximately 35 percent.

competitors was much more important in industries with discrete products. Using patents as a means of negotiation was prevalent in complex product industries.

Granstrand (2005) found that the IPR system was not of major importance for ICT industries in the early stages of development. Evidence for patent races was found by *Hall – Ziedonis* (2001), who studied the effect of the 1982 changes in US patent legislation on innovative activity in the semiconductor industry. They found that the increase in patenting in the field of semiconductors was primarily due to defensive strategies aimed at avoiding litigation and providing for patents for cross-licensing, leading to an increase in the cost of innovation. The strategic use of patents raises important policy considerations, especially for complex product industries with cumulative technological change. The social costs of the patent system are higher if patents are used to deter entry and raise the cost of innovation. Research by *Gambardella – Giuri – Luzzi* (2004) confirms these results for Europe: innovation races and patents used to block competitors are more likely to remain unused.

Overall, the evidence from the Community Innovation Survey (CIS3) and other empirical evidence available show that many innovations are not patented. The use of IPRs by firms depends on the sector of activity, the IP strategy of the firm, its size, and the IP strategies of its competitors. The empirical findings confirm the positions taken in the theoretical literature, maintaining that the optimal design of IPRs can only be determined by considering IPR strategies in the context of the overall appropriation strategy.

Recent changes in IPR regimes

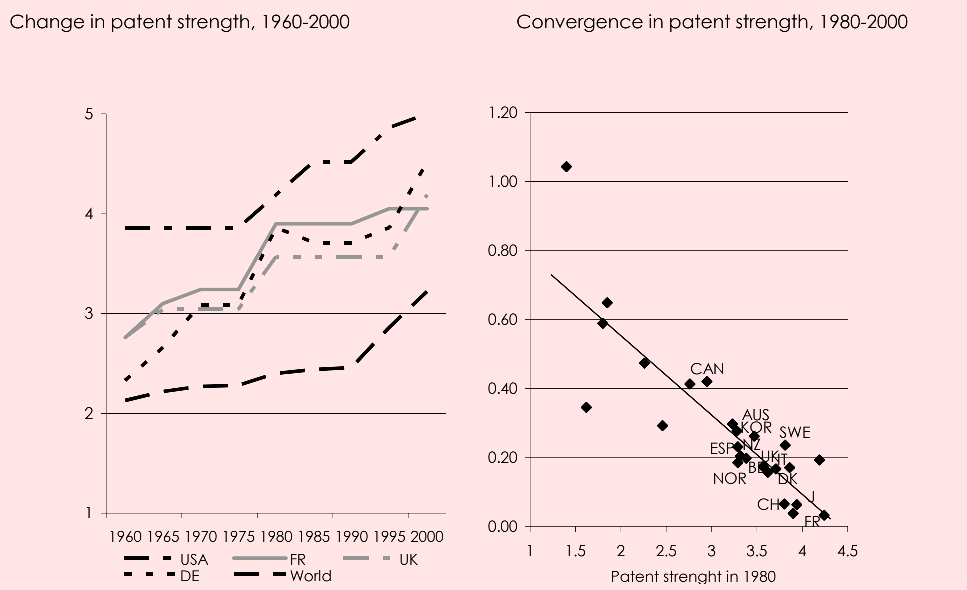
For many years, the general tendency of IP policy in the EU has been to offer ever greater protection for IPRs. The harmonisation of IP across the EU and worldwide has been clearly upwards, reinforcing the rights of the IP holder, based on the common belief that stronger IPRs are better suited to foster innovation, R&D and economic growth. Legislative changes have made IPRs easier to enforce, broadened the scope of patentable innovations, and lengthened the period over which many IPRs may be granted. These changes have been complemented by moves to encourage greater use of IPRs by universities and other public research organisations.

The central policy question is whether the strengthening of patent protection leads to higher R&D output. The index of patent strength developed by *Ginarte – Park* (1997) and updated by *Park – Wagh* (2002) is a comparative index of patent protection widely used in empirical studies. The index is based on an assessment of five elements of patent regimes: 1. coverage (subject matter that can be patented), 2. duration of protection, 3. enforcement, 4. membership in international patent agreements, and 5. restrictions on the use of patent rights. Figure 2 presents the development of patent rights using Park's patent strength index. The left panel shows that the trend in patent strength was increasing over time. The USA reached the maximum value of five in 2000. The right panel of Figure 2 plots patent rights in 1980 against changes in patent rights between 1980 and 2000. This figure suggests that countries with lower patent protection in 1980 increased the strength of their patent protection much more than countries that already had a high level of patent protection in 1980.

Ginarte – Park (1997) reported a significant positive relationship between the patent strength index and economic growth for a large group of countries. *Kanwar – Evenson* (2003) report a significant positive relationship between the IP strength index and R&D intensity. However, these findings should be regarded with some caution. The strength of IP rights may be partially endogenous to the level of R&D and innovation. This is confirmed by *Falk* (2006), who reports that the significant relationship between the patent strength index and R&D breaks down when dynamic panel methods are used. The relationship between the strength of IPR systems and innovation is also called into question by *Sakakibara – Branstetter* (2001), who found that the expansion of patent breadth in Japan in 1988 only had a small effect on R&D investment by Japanese firms. *Hall – Ziedonis* (2001) show that the increase in patenting experienced in the US semiconductor industry had little to do with increased innovation; it was primarily caused by defensive strategies to avoid litigation in response to a strengthening of patent legislation. In their study on the impact of software patenting on R&D in the USA, *Bessen – Hunt* (2003) found that the correlation between R&D and software patents has been significantly negative. *Lerner* (2002) finds that a strengthening of the patent system leads to higher patent rates in this country, which is primarily accounted for by foreign applications. Domestic inventors do not patent more.

Overall, the available empirical evidence shows that there is a strong relationship between strengthening IP protection (lengthening the term, increasing the breadth, broadening subject matter, or lowering patentability criteria) and propensities to use IP. However, it is much less clear whether such changes increase innovative activity. Therefore, let us take a closer look at the issue of software patents.

Figure 2: Changes in patent strength



Source: *Ginarte – Park* (1997), *Park – Wagh* (2002). The patent strength index values range between 0 and 5. A higher value indicates higher patent strength. The ordinate in the left panel displays patent strength. The ordinate in the right panel displays change in patent strenght between 1980 and 2000.

Software

Software is usually protected by copyrights. Patentability began to open up to software in the USA in 1981; in 1995, the USPTO confirmed the position in its examination guidelines for computer-related inventions. The situation is different in Europe. The European Patent Convention explicitly excludes the patentability of software innovations. The patentability of software and business processes has been controversial in the EU since a draft proposal for an EU directive on the patentability of computer-implemented inventions was issued in February 2002. On 7 March 2005, the directive was approved by the Competitiveness Council and sent to the European Parliament, which rejected it.

The controversy about software patents stems from three interrelated issues. First, software is the prototype of cumulative technology, where incremental innovation is prevalent. Second, open source plays an important role in software development. Third, software is pervasive. From an economics point of view, the cumulative character of the software development process suggests that software requires different rules than patenting to provide incentives for follow-up invention and to reduce wasteful rent-seeking (*Scotchmer,* 1991, *Bessen – Maskin,* 2004, *Hunt,* 2004).

Software development has a tradition of sharing and cooperation (*Lerner – Tirole,* 2004). When the software industry began to emerge, no efforts were made to delineate property rights and to restrict the reuse of software. With the enforcement of IPRs, different systems of open source developed. The most important systems are the General Public License (GPL) and the Berkeley Software Distribution (BSD). The GPL is a restrictive license which requires that all modifications of software under this license be free to use, modify, and redistribute. Any improvements and uses are subject to this license. BSD is less restrictive on the uses of source code. Open source is shaped by copyright rules, as they prohibit specific uses of the product. Open source projects have become quite important and pervasive. As of April 2004, the website soundforge.net, which provides free services to open source software developers, listed over 98,000 open source software projects. The most important products are Linux, which accounts for approximately 23 percent of operating systems of all servers, the dominant server software Apache, and the dominant scripting languages PERL and PHP. Recently, Linux has even outstripped Microsoft Windows as the operating system embedded in products ranging from mobile phones to video recording devices.

Large firms, such as IBM, SUN Microsystems and HP, as well as small firms use and support open source to provide products that are complementary to open source products, such as consulting or tailoring applications to specific uses. Open source is also central to many small- and medium-sized software consultancies and IT service firms. Proprietary software and open source have different incentives and dynamics (*Edwards,* 2005). *Franke – von Hippel* (2003) provide evidence that open source offers advantages for heterogeneous users, as it is easier to customise.

The implementation of software patents in the USA was characterised by low patentability requirements (*OECD,* 2004). The empirical evidence provided by *Bessen – Hunt* (2003) indicates that software patents increased from fewer than 5,000 patents a year to 20,000 patents in 2000. This is approximately 15 percent of all patents granted in the USA. Compared with other fields of technology, a larger share of software patents is held by large firms (*Bessen – Hunt,* 2003). *Bessen – Hunt* (2003) found that the surge in software patenting is primarily related to a sizeable rise in the cost-effectiveness of software patents. They found a significant negative relationship between software patents and firm-level R&D intensity. This result is difficult to reconcile with the incentive theory of patents. The available evidence suggests that the answer to the question why software running in a computer is different from a machine producing the same effect is the cumulative knowledge base of the software innovation process, which may not alter the legal case for patents. However, it weakens the economic case for pure software patents expanding to business processes and algorithms. The danger of software patents with regard to open source software is that software patents may create hold-up problems, associated with rent-seeking activity and blocking of competitors. Defensive patenting can have negative effects, as it increases the cost of innovation.

The argument for the patentability of software in Europe is often based on considerations of competitiveness. Software patents are felt to be central to Europe's ability to position itself on this market, which will have a substantial impact on its economy. In the absence of such patentability, it is commonly argued, Europe risks losing the global innovation race in this high technology sector and the software market will be dominated by Europe's main trading partners, in particular Japan and the USA. Three facts speak against such an argument: first, patents are territorial rights subject to national treatment. Thus, European actors wishing to patent their software are not barred from obtaining software patents abroad; second, as *Bessen – Hunt* (2003) document, software patents are used more frequently by larger firms than by small ones. Therefore, the introduction of software may foster concentration in a fairly competitive industry; and third, there is not much evidence to suggest that software patents increase incentives for innovation[5].

IPR policy of the EU and at the international level

In Europe, the creation of the European Patent Office (EPO) in 1973 was instrumental in creating centralised application procedures and standard rules for patents. However, several limitations in the European system still exist, associated especially with the national phase that follows each EPO application. Although none of the EU trea-

[5] This last argument has also put forward with regard to the recent strengthening of copyrights. *Hui – Png* (2002) claim that the extension of the term of copyrights in the USA appears "to have been a giveaway to owners of existing creative work, while having relatively little impact on new creative activity" (p. 219). There is even less evidence to assess possible welfare effects (*Romer,* 2002, *Towse,* 2005).

ties envisaged the regulation of IPRs as such, the harmonisation of IPRs has been related to the legal harmonisation for the internal market. Since the 1990s, the European Commission has launched an agenda to harmonise IPRs in the EU. The Action Plan for the single market, which was adopted by the Amsterdam European Council in June 1997, identified intellectual property rights as a sphere where action needs to be taken in order to increase its effectiveness.

Several characteristics of the European patent protection system have proved problematic. It is generally agreed that the structure of the European patent system is too complex and costly, especially for small firms. In response to the existing complexity, on 5 July 2000, the European Commission proposed the creation of a Community Patent to provide a uniform system of patent protection with community-wide effect through the filing of one single application. However, disagreement between countries delayed the implementation of the Community Patent.

The proposed Community Patent will automatically cover the entire territory of the European Union. In comparison with the traditional European Patent, this is an advantage. Important cost savings are associated with reduced translation costs for countries that renounce the need for translation. Community Patent holders will benefit from the single centralised system of litigation. This will lead to important cost savings. Under the current European patent system, patentees may have to defend and/or assert their rights in several national courts, each with its associated representation and other fees, and the possibility of different outcomes.

While the introduction of the Community Patent was delayed, the Community Plant Variety Right, the Community Trademark, and the Community Design have already been implemented. These Community protection systems work as alternatives to national titles and are valid throughout the EU. Copyrights, which do not require registration, were harmonised through the EU Copyright Directive (2001/29/EC) finalised in 2001.

Harmonisation at the European level is mirrored by harmonisation at the international level. The World Intellectual Property Organisation (WIPO) administers the Paris Convention of 1883 on patents and industrial property and the Berne Convention of 1886 for literary and artistic works. These treaties have been revised several times. The WIPO has only few enforcement powers, while TRIPS administered by the WTO has enforcement powers. The Trade Related Aspects of Intellectual Property Rights (TRIPS) went beyond the principle of national treatment by specifying a minimum set of rights that each member state must provide. It was argued by a number of commentators (e.g., *Ryan,* 1998, *Lanjouw – Cockburn,* 2001) that TRIPS has extended IPRs beyond what is optimal because trade negotiators were "captured" by industry. In an interesting contribution, *Scotchmer* (2004) compared the incentives for private and public innovative effort under regimes of asymmetry and harmonisation of IPRs. *Scotchmer* (2004) shows that harmonisation does not cure all problems arising from independent policy making. She argues that harmonisation may lead to an international R&D system that relies more on IPRs than is efficient.

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Intellectual Property Rights, Innovation and European IPR Policy – Summary

The review of the economic literature on the relationship between IPRs and innovation, economic growth and social welfare shows that IP is a controversial and complex matter. The conventional wisdom that strengthening IPRs will increase innovation and economic growth is not confirmed by theory and empirical evidence. Especially when it comes to cumulative innovations and basic research, which is essentially cumulative, a further strengthening of IPRs could even hamper technological progress and the diffusion of ideas. As IPRs are not neutral with respect to innovation, changes in IP regimes should be used cautiously and assessed by careful economic evaluation, weighing the social costs and benefits of proposed changes. An excessive tightening or weakening of IPRs might well result in less innovative activities, an outcome that European innovation policy tries to avoid. At the present stage, the available evidence suggests that a further strengthening of IPRs is most likely to be counterproductive.

From the discussion of the role of IPRs for innovation, a number of policy recommendations emerge:

The theoretical results suggest that licensing has an important influence on the optimal design of IP systems. The better markets for technology work, the less problematic are broad patents. Fostering markets for technology is especially relevant to academic patents. Policies to foster markets for technology need to take account of possible drawbacks with regard to competition policy.

As IPRs play an essential role in the market-centred system of innovation, IPR systems need to be evaluated in terms of economic criteria, especially in terms of the ability of IPR systems to provide effective incentives for innovation and the ability to encourage the diffusion of new ideas. Interestingly, the recent changes in IPR systems were not based on findings obtained through a systematic economic evaluation of the proposed changes. However, the proposed Community Patent provides an important opportunity for Europe. It is absolutely essential to combine the introduction of the Community Patent with a Community IP court. This would reduce both uncertainty and the costs of litigation. This is especially important for small and medium-sized firms.

The rent-seeking attributes of strategic patenting could be lowered by introducing high inventive steps so that firms self-select other forms of IP protection with lower social costs for minor innovations. The setting up of a credible public domain alternative to patenting could be useful to reduce some forms of defensive patenting.

Taking a longer-term perspective of the IP system, the "one size fits all" principle of the current patent system should be revisited. As economic theory suggests, optimal patent (and IP) protection is likely to differ according to classes of technology. The necessary strength of IPRs in terms of enforcement of rights depends crucially on the rate at which new ideas can be copied. The higher the rate, the more protection is needed in order to provide incentives. Furthermore, the optimal design of IPRs in terms of breadth and duration depends crucially on the nature and pace of technological change.