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Intellectual Property Rights In A Knowledge-Based Economy

Robin Cowan and Elad Harison

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MERIT – Maastricht Economic Research Institute on Innovation and Technology
PO Box 616
6200 MD Maastricht
The Netherlands
T: +31 43 3883875
F: +31 43 3884905

http://meritbbs.unimaas.nl
e-mail:secr-merit@merit.unimaas.nl

International Institute of Infonomics

PO Box 2606
6401 DC Heerlen
The Netherlands
T: +31 45 5707690
F: +31 45 5706262

http://www.infonomics.nl
e-mail: secr@infonomics.nl

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Robin Cowan and Elad Harison

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Abstract

Intellectual property rights (IPR) have been created as economic mechanisms to facilitate ongoing innovation by granting inventors a temporary monopoly in return for disclosure of technical know-how. Since the beginning of 1980s, IPR have come under scrutiny as new technological paradigms appeared with the emergence of knowledge-based industries.

Knowledge-based products are intangible, non-excludable and non-rivalrous goods. Consequently, it is difficult for their creators to control their dissemination and use. In particular, many information goods are based on network externalities and on the creation of market standards. At the same time, information technologies are generic in the sense of being useful in many places in the economy. Hence, policy makers often define current IPR regimes in the context of new technologies as both over- and under-protective. They are over-protective in the sense that they prevent the dissemination of information which has a very high social value; they are under-protective in the sense that they do not provide strong control over the appropriation of rents from their invention and thus may not provide strong incentives to innovate.

During the 1980s, attempts to assess the role of IPR in the process of technological learning have found that even though firms in high-tech sectors do use patents as part of their strategy for intellectual property protection, the reliance of these sectors on patents as an information source for innovation is lower than in traditional industries.

Intellectual property rights are based mainly on patents for technical inventions and on copyrights for artistic works. Patents are granted only if inventions display minimal levels of utility, novelty and non-obviousness of technical know-how. By contrast, copyrights protect only final works and their derivatives, but guarantee protection for longer periods, according to the Berne Convention.

Licensing is a legal aid that allows the use of patented technology by other firms, in return for royalty fees paid to the inventor. Licensing can be contracted on an exclusive or non-exclusive basis, but in most countries patented knowledge can be exclusively held by its inventors, as legal provisions for compulsory licensing of technologies do not exist.

The fair use doctrine aims to prevent formation of perfect monopolies over technological fields and copyrighted artefacts as a result of IPR application. Hence, the use of patented and copyrighted works is permissible in academic research, education and the development of technologies that are complimentary to core technologies.

Trade secrecy is meant to prevent inadvertent technology transfer to rival firms and is based on contracts between companies and employees. However, as trade secrets prohibit transfer of knowledge within industries, regulators have attempted to foster disclosure of technical know-how by institutional means of patents, copyrights and sui-generis laws. And indeed, following the provisions formed by IPR regulation, firms have shifted from methods of trade secrecy towards patenting strategies to achieve improved protection of intellectual property, as well as means to acquire competitive advantages in the market by monopolization of technological advances.

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MERIT, Universiteit Maastricht, P.O.Box 616
6200MD Maastricht, The Netherlands
r.cowan@merit .unimaas.nl ; e.harison@merit.unimaas.nl

1. Introduction: Intellectual Property Rights - The Socio-Economic Rationale

Intellectual property rights are well-known legal mechanisms in the history of economics. The earliest IPR regimes arose in Venetian patent law, accepted by the local Parliament at the end of the 15th century; and in 1623 the Statute of Monopolies, which included recognition of patent rights, was approved by the English Parliament. Both reforms were influential in the creation of intellectual property rights in their modern forms (David, 1993). Though the details of these laws vary from modern IPR laws, their economic, social and legal rationale has not been significantly modified over the years, and the paradigms they created form the basis for modern IPR doctrine.

Intellectual property rights are essentially based on a balance between two sources of value. Public welfare is furthered when new knowledge is disseminated and widely used, both in production of goods and in production of further knowledge. Private incentives to innovate are high when the inventor is able to reap the rewards from his efforts. On the one hand, the inventor is granted a temporary monopoly over an invention and its derivative applications, thereby gaining protection from unauthorized exploitation of his technical know-how and a strong incentive to innovate. On the other hand, if technical knowledge were disclosed for public use, its accessibility would stimulate the generation of knowledge spillovers and the transfer of technical know-how throughout the economy. Accordingly, IPR legislation aims to optimize social welfare and to strike a balance between monopoly and disclosure.

In the current IPR regimes there are two types of rights: those associated with patents and those associated with copyrights. Patented inventions enjoy protection for between fifteen and twenty years in most countries. Copyrighted works are protected for a longer duration — the author's lifetime plus fifty to seventy years. Licensing and trade secrecy are additional components of an IPR regime. They serve different roles: the former increases the rents accruing to an inventor without reducing his property rights, the latter prevents intellectual property from spilling out of the firm, for example through employees moving to rival firms. Unlike either patents or copyrights, both of these are implemented through bilateral contracts either between two firms or between a firm and its employee.

Since the early 1980s legal scholars, economists and policy makers continue to investigate intellectual property rights and how their effects change as a result of the evolution of knowledge-based industries. Current views of IPRs often criticize the various regimes as both over- and under-protective, and have emphasized a shift from an axiomatic perception of intellectual property rights as **the** *ultimate* approach to foster innovation, towards assessment of the costs and benefits of previous paradigms. As the *new economies* world-wide transform from traditional industries based on production and development of physical goods the development and production of knowledge-embedded goods, the ability of IPR policies to assure adequate protection for those developing the new technologies is being questioned. As a result, both academic scholars and industrialists have called for modification of the current statutory regime, and policy makers and legislators are responding by evaluating the apparently conflicting claims of over- and under-protection, as well as attempting to change the legal structure to address problems as they are identified.

1.1. IPR in the New Economy: In Search of a New Golden Rule

The peculiarities of information goods, compounding network effects and possibilities for distribution at no cost interact with policy in a rather complicated manner. Arguments surrounding IPRs often see the present regimes as over-protective in terms of the monopoly that

is granted to inventors, but nonetheless admit that they do provide them with effective means to protect their artefacts against what now seems to be wide-spread piracy and unauthorized use.

The new technological paradigm[1] is characterized by heavy use of knowledge-based goods: intangible, non-excludable and non-rivalrous (Cornes and Sandler, 1986). These features imply that the utility of these goods rests in their non-physical characteristics. Knowledge-based goods are quasi-public goods. Copies are produced at zero-marginal cost,[2] and therefore can be distributed to the market and shared among vast numbers of users at very low cost. In this context, current IPR regimes are often seen as under-protective in their inadequacy to guard knowledge-based goods. Because of the cheap re-production (which can often be done by anyone), when knowledge-based products (e.g. software files, electronic journals and databases) are introduced to the market their suppliers face severe difficulties in controlling their distribution and use. The relative ease of unauthorized access, use and distribution of information contents and goods has become an evident threat to the evolving new industries, as piracy rates and evidence from a variety of cases against copyright and patent violators have indicated.

Against this, other opinions perceive IPRs as over-protective creating unwarranted, and often deleterious monopoly power over technical know-how. The issue of monopoly over technology is intensified when we consider technologies developed recently. Advanced technologies, such as a large share of ICT, computer software and operating systems, and Internet-based technologies are based on a network of users in which the benefits to a single user increase with the number of other agents using the same technology. Put in a different way, the returns to each user from investing in a certain technology would increase if more users decided to adopt that technology. This phenomenon is known as *network externalities*. When several technologies with network externalities compete, we can reasonably predict that a single technology will emerge as a *de-facto* market standard. Equally important, when this is the case the technology that will finally dominate is not necessarily the most advanced or best-performing amongst the rivals. However, if intellectual property rights are strong, the possibility to lock in to inferior technologies may be amplified, as monopolies (granted by patents over technological fields) may make it more difficult to create superior alternatives, thus fostering the emergence of less advanced but more available technologies as market standards.

This debate remains unresolved, leaving policy makers looking for clearer insights to guide future legislation as technologies continue to evolve. While the scope of protection granted by patents and copyrights to new technologies is debated, a more fundamental issue should be briefly addressed, namely the role of IPR in advancing technology.

1.2. Do IPR Regimes Foster Technological Diffusion?

The essential social value of IPRs is the joint promotion of knowledge production and knowledge diffusion, as technological advance has a central importance in economic growth and development. Evidence from less developed countries often mentions the lack of stable IPR policies, or the existence of a weakened regime, as a reason for under-development of nations.[3] Nevertheless, a question that is often heard in the context of knowledge-based technologies in industrialized countries still remains unsettled: how important is the role of IPR in technological progress?

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[1] Technological paradigm is defined as "a 'pattern' of solutions of selected technoeconomic problems based on highly selected principles derived from the natural sciences, jointly with specific rules aimed to acquire new knowledge and safeguard it, whenever possible, against rapid diffusion to the competitors" (Dosi, 1988).

[2] Namely, generation of software copies does not carry any additional costs to their producers.

[3] On the globalization of IPR regimes, see our review in section 3.3.

Several studies of the issue were conducted during the 1980s; among them are von Hippel's research (1981) and the *Yale survey* (Levin et. al., 1987). Levin et. al. (op. cit.) examined the reliance of firms on IPRs as a method to acquire better protection for their technical know-how and found that firms prefer to guard their intellectual property by applying other methods, such as trade secrecy and lead times. Their findings are supported by more recent research conducted by Arundel (2000). In his comparative research, American and European firms graded various ways (secrecy, lead times, patents etc.) of protecting intellectual assets. Lead-time and secrecy together are more important than patenting as a means to protect property. They are from 10% (Switzerland) to 120% (Western European and Irish companies)[4] more common than is patenting. (See Figure 1.1 for a representative sample of firm responses to this type of inquiry.)[5] Moreover, firms stated that superior sales or services, learning curves of new technology and lead times were the most common means for appropriation against competitors, whereas patents were found to be the least common method (Levin et. al., op. cit.; Arundel, op. cit.; see Fig. 1.1 & 1.2). This suggests that an exclusive focus on patents as the solution to intellectual property problems may be a mistake. Firms have other means, and do employ them. Patents are only one part, and in some industries, a small part of the toolbox used to capture the rents from innovation.

The second goal of an IPR system is to encourage knowledge diffusion. Patent documents enter the public domain and anyone can search patent archives to find technical knowledge. It has thus been estimated that patent documents contain some 80% of the world's accumulated technical knowledge. Nonetheless, there is a strong tendency among firms, particularly strong among SMEs, *not* to use patents as a source of technical knowledge.[6] Thus a second very important issue in the examination of IPR regimes is how central their role in technological learning of firms is, and whether patents and copyrights do fulfill the expectations of policy makers as a major source of information for innovation.

Comparing the importance of various information sources to the process of innovation, high technology firms were found to rely on information from patent and copyright publications only as a marginal source to acquire technical knowledge (McFetridge, 1995; see Table 1.1). This is particularly the case for high-tech firms. Levin et. al. (op. cit.) found patents to be almost the least important source for a firm's learning (see Fig. 1.3), and Arundel (op. cit.) strengthens their conclusions, since patent disclosures were graded as the least important source for innovative activities of European firms after customers, suppliers, trade fairs and competitors.

The debate on the role of IPR regimes as a means of promoting technological innovation is made more pressing by the evidence of their use as strategic means to block competitors from developing rival technologies and to prevent infringement suits by competing firms (Granstrand, 1999; Arundel, op. cit.); both are uses beyond the original intention of the drafters of IPR legislation and outside traditional rationalization of it.

Our report aims to examine and to evaluate the suitability of IPRs for the needs of knowledge-based economies in the broad context that technological changes, driven by globalization and widely-spanned information networks, raise. The main issues over IPR regimes, as reviewed in this section, spawned a series of other debates, in which the ability of IPR regimes to preserve the balance between monopolistic position created by law and the pace of innovation is questioned. In this light, we review the suitability of IPR regimes in relatively recent technologies: software, biotechnology, Internet and databases. The conclusions summarize main arguments, similarities and variations of legal and technological merits.

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[4] Japanese firms give similar importance to these means.

[5] Figure 1.1 contains only part of the results, the remainder of which can be found in Arundel (2000).

[6] *Innovation & Technology Transfer*, Vol. 1/00, January 2000, p. 15.

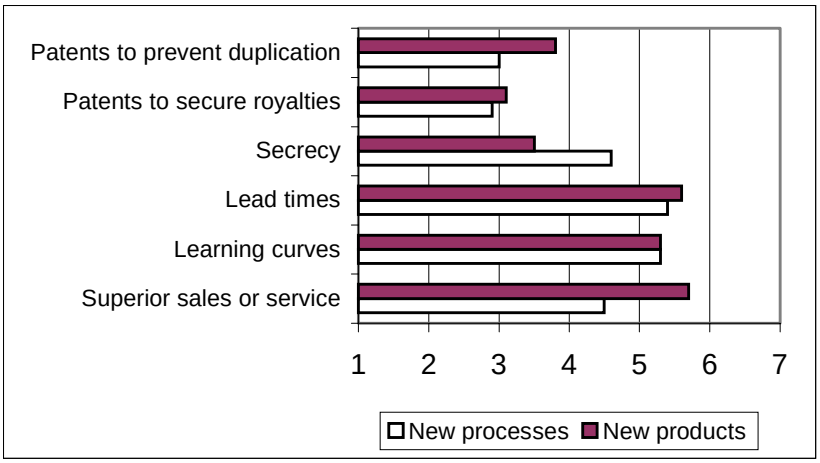

Figure 1.1: Firm's methods of appropriation.
Source: Levin et. al. (op. cit.).

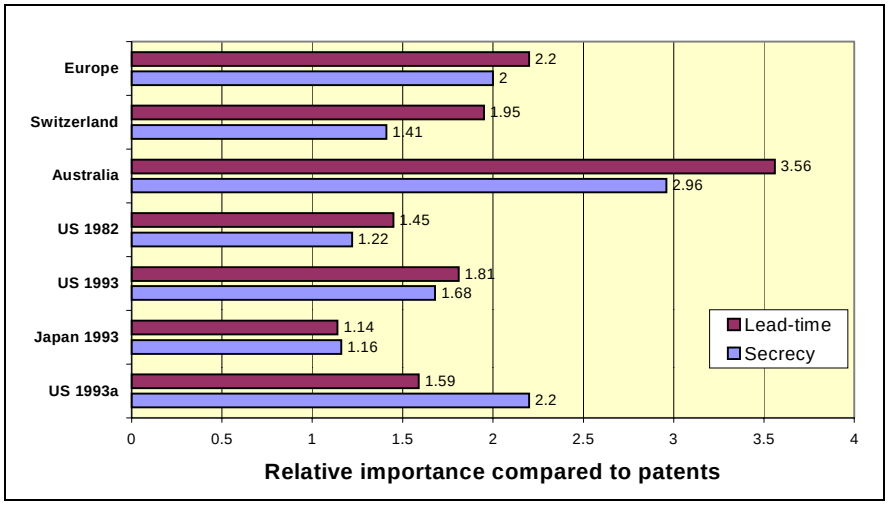

Figure 1.2: Relative importance of secrecy and lead-time for earning competitive advantages from process innovation.
Source: Arundel (op. cit.).

	High Technology Firms	*Medium/Low Technology Firms*
Affiliates	**71%**	**100%**
Trade shows and conferences	**70%**	**56%**
Literature	**68%**	**46%**
Discussions with other firms	**32%**	**26%**
Reverse engineering	**8%**	**1%**
Copyrighted material	**3%**	**7%**
Industrial designs	**3%**	**7%**
Plant breeder's rights	**3%**	**1%**
Patents	**2%**	**13%**
Integrated circuit designs	**2%**	**3%**

Table 1.1: Sources of information for innovation.
Source: McFetridge (op. cit.).

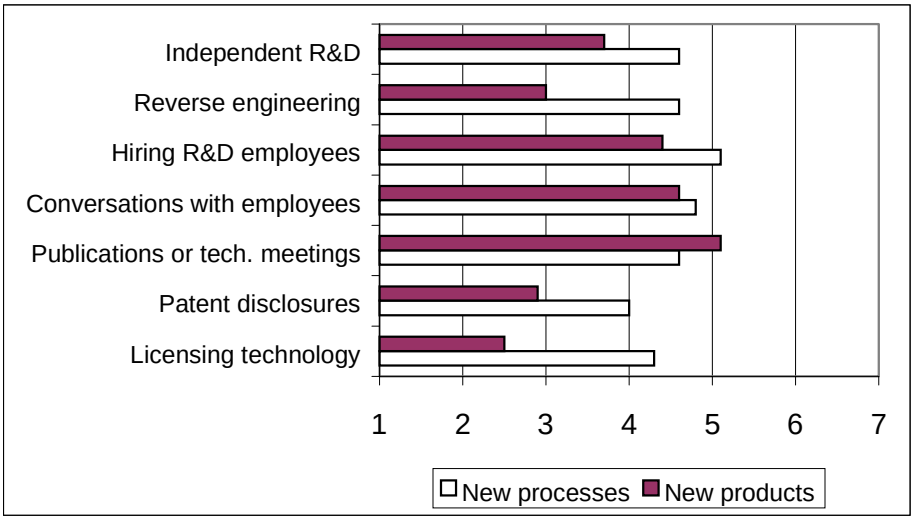

Figure 1.3: Firm's channels of learning (scaled by importance).
Source: Levin et. al. (op. cit.).

2. Legal Description of IPR Regimes

2.1. Systems of Patents and Copyrights

Patents and copyrights are the major institutional means employed to obtain legal protection for intellectual endeavours. They complement each other, but even jointly considered many argue either that they provide too little or too much protection for intellectual property and knowledge-based goods.

Patents are used to protect inventions arising from technological advances in processes and products. Three criteria define minimal measures to judge whether new inventions are patentable:

- Utility: the characteristics of technical knowledge presented in the patent file must enable its technical exploitation in applications, either mentioned explicitly in the patent claims, or potentially *possible* by the industry.
- Novelty: patents are granted for inventions only if they carry minimal steps of originality, compared to the existing body of knowledge *in the world*.
- Non-obviousness: inventions should entail an inventive step, approved by a 'person skilled in the art' (official practitioner who has the necessary knowledge and skills).

If all these criteria are satisfied a patent is granted for the invention.

Illustrated in a stylized way, patents create a three-dimensional monopoly over part of the technological realm; we can thus describe or assess the design of patent regime along those three dimensions: scope (breadth), disclosure and duration.

The scope of a patent refers to what can be patented or protected by means of a patent. It is determined by the technical knowledge disclosed by the inventors, and includes the exploitations of the technical know-how described in the claims, both immediate applications and potential future applications. Inclusion of advanced exploitation in the claims is extremely important for inventors as they attempt to increase their dominance over the use of knowledge. It permits them to obtain and maintain an advantageous position in the market, excluding rivals from implementation of technologies and profiting from royalty fees.

Disclosure defines a minimal level of technical knowledge that should become available for the public. As intellectual property becomes publicly visible when patented, rivals may improve their products more easily than before and new entrants may appear, founded on new, competing innovation. Hence, firms aspire for minimal knowledge disclosure that meets patenting guidelines in order to accomplish the largest possible technological dominance. By contrast, policy makers aspire to increase the level of overt know-how that becomes available for public use. However, knowledge disclosure — employed to promote technological advances at a national level - is commonly perceived as a necessary burden by the firm.

Patent duration determines the length of protection (the legal monopoly) granted to inventors. Commonly, policies guarantee protection for fifteen to twenty years.

Different from patents, copyrights aim to protect artistic and literary works, such as books, photography and phonograms. World-wide copyright legislation is based on the guidelines of the Berne Convention. The Berne Convention defines a minimal term for protection of the author's lifetime plus fifty years, which can be extended when rules are written at the national level. The (non-limiting) scope of coverage by copyrights includes not only literary and

artistic works but also the derivatives of copyrighted works, such as translations and adaptations. The derivative artefacts enjoy copyright protection equal to the terms of protection that original works enjoy. The Convention also enables an optional protection for official, legislative and administrative texts[7], lectures, folklore works and even mailing addresses[8] (WIPO, 1998).

2.2. Additional Mechanisms: Licensing, Fair Use and Trade Secrecy

Licensing, fair use law and trade secrecy are employed to control knowledge spillovers and information flow. As patents supply monopoly for lengthy periods over technologies and their applications, licensing enables the use or production of patented inventions by other firms, mostly on a basis of royalty fees. Licensing can be contracted exclusively — granting only a single firm permits to use inventions, or non-exclusively — allowing several companies to apply. Licensing strategies and their impact on the pace of innovation are extensively reviewed in section 3.2 in the context of biotechnological research tools.

The fair use doctrine attempts to prevent the emergence of *perfect monopolies* over patented technologies and copyrighted artefacts. To avoid slowing the pace of innovation and scientific research, the fair use doctrine creates exceptional allowances for "not-explicitly-authorized" use of patented technologies and copyrighted works. Two legal issues are important. First, the application and use of protected endeavours are permissible for public and non-profit purposes. Categories include applications for scientific research (including basic research conducted by firms), educational activities and examination of core technologies for adaptability of complementary technologies and interfaces. Second, the damages and the remedies from an unauthorized use are judged by the Courts in an *ex-post* manner and on a *'case-by-case'* basis.[9]

As the fundamentals of the fair use doctrine lack generalization by their essence, Courts tend to rely on prior verdicts to determine their rulings. Building on previous judgments to articulate the law for new scenarios and to address recently-evolving technologies may lead to institutional path-dependence, particularly as fair use legislation is narrower than other forms of IPR, and judged on a 'case-by-case' basis. As many of the fair use complaints are made against academic organizations and research institutes, activities in public institutes which lead to technology advance seem to be threatened by the fact that legal precedent is being formed on the basis of outdated analogies.[10]

Trade secrecy interacts with labour mobility in obvious ways. Employees are an essential source of technical knowledge and the ultimate locus of innovative activity in firms (Levin, et. al., op. cit.). However, at the same time, R&D workers may be targets for *business intelligence* and for a leak of research and development results. Therefore, trade secrecy, an early form of IPR, came to protect intellectual property by the formation of contracts between firms and employees to prevent the transfer of commercial information. The definitions of knowledge being transferred to competitors by employees leaving their previous workplaces, permissibility for use of technical information by workers and limitations for recruitment in rival firms are agreed on an individual basis between employers and employees.

Trade secrecy has an ambiguous role, as do intellectual property rights generally. From the point of view of a firm, preventing its rivals from accessing its intellectual capital is obviously desirable. Socially, though, diffusion of knowledge, and in this case the tacit knowledge that

[7] See for example the Dutch case of *Vermande vs. Bojkovski* (section 3.5.4).

[8] US jurisdiction has decided not to follow this extension, as the *Feist* doctrine demonstrates (section 3.5.2).

[9] The impact on current markets and future commercialization of protected technologies and works is evaluated only after violation of IPR has been proven.

[10] For a review of fair use law in the context of information technologies, see for example: NRC (2000).

travels when employees move from firm to firm, is a source of wealth creation. One recent interesting development concerns Silicon Valley. Silicon Valley is renowned for its rapid production of new technologies and for its rapid production of fast-growing firms that create enormous wealth for their owners.[11] One of the explanatory factors underlying this success has been high labour mobility in the Valley, and the effective diffusion of tacit knowledge that comes with it (Saxenian, 1994). From time to time firms have attempted to write labour contracts aimed at preventing the dissemination of their intellectual capital through this means. Until recently, however, judges have been unwilling to enforce these contracts. As intellectual property becomes more actively discussed, though, and seen more explicitly and in more concrete terms as a source of firm profits, there seems to be a change in rulings, favouring a tightening of control over this property. That is, the California legal system seems to be shifting towards enforcement of such contracts. The effects of this sort of change will not be seen immediately, but the change nonetheless is an interesting and potentially very important development (Hyde, 1998).

Use of trade secrecy runs counter to the goal of promoting innovation by knowledge transfer, as information is not shared. However, as intellectual property becomes more and more a commodified asset, subject to valuation, particularly by equity and other capital markets, the means for protection of intellectual property at the firm's level is changing.

With the rising value of technological information and, in parallel, its increasing vulnerability to use by rivals, companies become more encouraged to apply strategic patent *filing* to protect their inventions in the early stages of research. Thus more generic knowledge or technologies are being patented, and this may create a tendency to increase the coverage of any particular patent, making downstream development more difficult. Moreover, patent strategies can efficiently be applied to ban international competitors from key inventions, as the Paris Convention allows the extension of patent filing to other countries within a period of one year from the first patent filing. And indeed, for many firms the possibility to patent inventions for elongated periods and the legislation of complimentary *sui-generis* laws driven by industry are satisfactory substitutes for trade secrets (Granstrand, 1999).

2.3. Monopolies over technologies – between IPRs and Competition Law

Competition Law, also known as Anti-trust Law, is meant to prevent the formation of monopolies and to restrict their influence on consumer choices and competition, thereby assuring the emergence of new, inventive entrants in the market. IPRs, in their turn, aim to generate incentives to foster innovation by granting monopoly power over technological fields, and thus can be seen to be in direct conflict with competition law. The US Supreme Court was aware of the conflict, stating that "*since patents are privileges restrictive of a free economy, the rights which Congress has attached to them must be strictly construed*".[12] This issue is furthermore amplified by the views that patents and copyrights are over-protective regimes, providing monopolistic dominance over inventions in the core of the new technologies and thus impeding innovation, as reviewed in chapter 3.

The relation between competition law and intellectual property rights is not as straightforward as it seems. Gallini and Trebilcock (1998), for example, suggest that it is possible to reconcile the two by perceiving competition laws as promoting inventions throughout free-competition and market entry in the *long run*, whereas IPRs encourage innovation by providing monopoly on technological advances (and thereby incentives to innovate) in the *short run*. This conclusion must be treated with some care, though. A slightly closer look at how technologies

[11] Of course it is also known for the failure of many start-ups.
[12] *United States vs. Masonite* (Supreme Court, 1942).

evolve suggests that permitting monopoly and the consequent monopoly pricing within the not too distant future will reduce short run sales, and thus have a deleterious effect on learning-by-doing and learning-by-using (Arrow, 1962a; Rosenberg, 1982). Reducing this sort of learning, which can be extremely important in technological advance, may slow down the pace of innovation even in the long run.

Under certain circumstances, anti-trust policy permits the creation of technological monopolies. Typically, anti-trust authorities prohibit mergers or acquisitions that create technological monopolies on the grounds that a technological monopoly becomes the basis of a market monopoly by creating a barrier to entry. In the case of the acquisition of *Wellcome* by *Glaxo*, both firms had received FDA approval for a new migraine treatment with oral application. The acquisition of Wellcome by Glaxo was denied in its first stages by the competition authorities in the US in order to prevent creation of a monopoly in migraine-treating drugs. The approval was granted, though, when Glaxo successfully proved that its rivals performed only marginal R&D activities in this technological field (Tom, 1998). The high R&D costs for pharmaceuticals create high barriers to entry such that technological monopolies are within the natural structure of the industry. Since this acquisition was not going to tip any competition over this market segment, and since regardless of whether the acquisition took place other firms were unlikely to enter (due to the high R&D costs) the acquisition was permitted to proceed.

Although the tension between anti-trust laws, deterring monopolies over technological markets, and IPRs forming monopolies over technological fields has not been resolved, both the EU legislation and the US law avoid application of compulsory licensing. The European Court of Justice stated that "*refusal to grant a license, even if it is the act of an undertaking holding a dominant position, cannot in itself constitute abuse of a dominant position*".[13] The US Court has expressed a similar opinion that the refusal by patent holder either to license or to use its patent is not an anti-trust case.

The degree of complexity to which the tension between anti-trust legislation and IPRs has evolved is amplified when technologies of the *New Economy* are included in the analysis. Software technologies, Internet-based communications and accessibility to database contents being applied by vast numbers of users via the Internet or while being massively distributed, generate *network effects*. "Lock-in" to a single technology and its implementation as a market standard (Arthur, 1987) questions the role of competition authorities in markets in which technological merits and not necessarily business strategies of firms lead to monopolistic position.

The legal realm of intellectual property rights offers various means for protection of technological advances and artistic artefacts. Patents, copyrights, and trade secrecy are all meant to provide different methods to protect intellectual endeavours, whereas licensing, fair use doctrine and anti-trust laws aim to encourage information flow and utilization of technical knowledge. However, since the 1980s, voices questioning the suitability of intellectual property rights as preferred legislative means for promoting innovation have increasingly been heard as a result of the emergence of new technologies.

Policy makers, aspiring to encourage knowledge spillovers between inventors and other firms, have faced opposite opinions about IPR regimes. The traditional school of thought suggests providing protection by expansion of the scope of present regimes to include the needs of the evolving technologies. Other scholars have been in doubt, whether monopoly over

[13] *RTE & Anor vs. Commission of the European Communities* (1995).

inventions, by essence, is the most efficient *quid pro quo* for disclosure of technological knowledge to guarantee incentives to innovate.

Apart from the debate about their nature, IPR regimes were found to be in conflict with other legal doctrines. It is quite striking that the fundamental perspectives of IPRs seem to be inconsistent with those of competition law, as both legislative systems have been well-known for a long time. Anti-trust laws have been formulated to ensure free competition and, in this context, to provide legal means for assuring that entrepreneurs can develop and distribute rival technologies and products. Anti-trust authorities attempt to guarantee that monopolization of a market does not hinder either market or technological competition.

Contrary to anti-trust doctrine, patents and copyrights provide monopolistic power to inventors of technologies and to creators of artistic and literary works for relatively elongated periods. Ownership of a technology is guaranteed to the holders of the rights with no constraints, as in most countries no legal guidelines for compulsory licensing of patents or copyrighted works exist. Jurisdiction declines to state that refusal of patent holders to license patented technologies is a violation of anti-trust doctrine, even when their motives of deterring competitors from the use of technologies are clearly observed.

Patents and copyrights, although often criticized as inappropriate methods of fostering technological change, are still the most dominant institutional means of protecting intellectual property. In the following section we review recent issues in intellectual property protection, as well as suggestions for alternative regimes in the light of new, knowledge-based technologies.

3. Intellectual Property Rights in the Knowledge-based Economy

Patents and copyrights are well-known methods to guard technological advances and creative arts. However, these regimes are traditional in the sense that both were articulated when technological advances in physical goods were the norm.

Since the 1960s we see the emergence of a new technological paradigm, namely knowledge-based economies, often called the *weightless economies*. Knowledge-based goods are based in large part on intangible modes of distribution and use rather than on physical elements of technology in the final product. In recent years the growth of patent applications in these new industries shows a growing attempt by innovators to strengthen legal rights over their ideas. Figure 3.1 makes this trend very clear in the software and molecular biology industries.

The development of the personal computer, the Internet and recombinant gene technologies, common representatives of knowledge-based technologies, as well as other new technologies that evolved, have not only opened new scientific and technological avenues but also initiated a debate around the contribution of patents, copyrights and licensing strategies to obtain continuous innovation. Although technical contents differ, some arguments in the debates on the nature of IPR protection are shared.

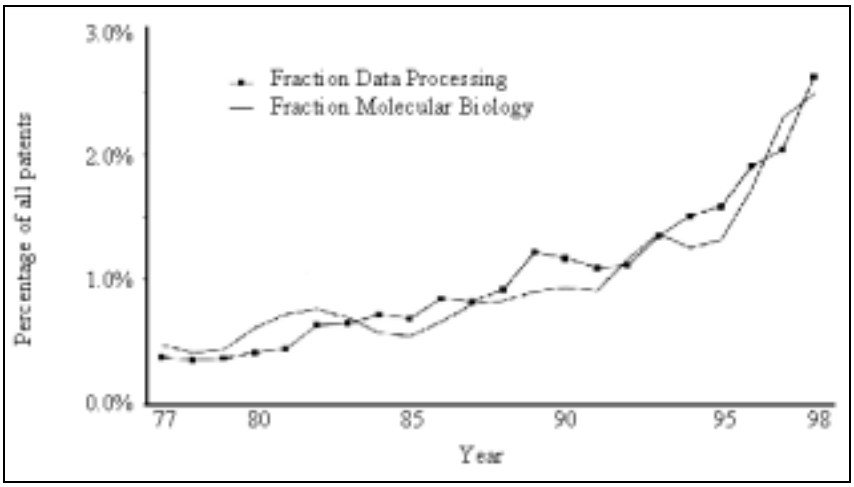

Figure 3.1: Biotechnology and software patents (indicative classes).
Source: Jaffe (2000).

First, the success in preserving the balance between monopoly and disclosure of technical know-how to the public is under doubt. On the one hand, the possibilities for unauthorized duplication, distribution and use of information goods imply that legal provisions are to some extent under-protective. On the other hand, network effects leading to the emergence of single technology as a market standard create monopoly over technology empowered by legal regimes. Second, as information goods have become accessible world-wide, mainly by the Internet as an infrastructure for global communications and retrieval of contents, information providers, such as software publishers, database producers and news agencies have confronted vast scales of copyright violations.

Third, opposite effects that emerge from the development of technological means which restrict accessibility to information, compounded with impacts of strengthened protection by recently formed regimes (e.g. the US Patent Office for software patenting and the EU Database Directive), have been argued to put scientific and technological advance, mainly in public and academic research institutes, at stake by monopolizing the content.

Fourth, and most importantly, policy makers around the globe attempt to resolve these issues by applying old legislative frameworks of IPR to new technologies. Misapplication of current IPR regimes to the evolving technologies may be the result. Moreover, policy changes that aim to provide adequate protection to technologies are often approved a decade or so after radical changes in technology have taken place, whereas in the meantime technology continues to evolve, presenting further puzzles.

This chapter reviews IPR issues in the context of software technologies, biotech, and software patenting and copyrights.

3.1. Software Patenting and Copyrights

The rise of the information society results in enormous changes throughout the economy. The “health” of information sectors will be central to the future economic growth of every country. While the information sector encompasses many different industries, information goods are pivotal. Out of a great variety of information goods, the paradigm example, probably, is software. Indeed, software is now incorporated into so many “other” goods, that it may be the most pervasive sub-sector of the new economy. Its growth certainly attests to a widespread

diffusion — in the OECD countries in the 1990s software sales (excluding bundled operating systems) have been growing at roughly 11% per annum; 12 % if bundled operating systems are included (OECD 2000). Besides this immense growth in sales, we see also enormous amounts of piracy. Losses of sales due to piracy are estimated to be in the neighbourhood of 11 billion USD annually (SPA, 1997,1998; SIIA, 1999). As one can imagine, piracy of this magnitude threatens the development of the industry as a whole, and this is certainly claimed from time to time by software vendors.

Since the mid-1980s regulators have been seriously concerned with issues of infringement of intellectual property rights in relation to information goods and software in particular. The US has been leading the way in determining doctrine for protecting the software intellectual property with EC and Japan's legislation typically following (Karjala, 1990; Brueckman, 1990).

A basic definition for protection of intellectual property in the US legislation distinguishes the "*idea*" and the "*expression*". Patents are granted **only** for technological advances that permit the practical solution of specific problems in the field of technology and fulfil the fundamental terms of being an "*idea*", that is utilization by the application of the technical know-how in products and processes, novelty and non-obviousness of the invention (see review in section 2). Copyrights aim to protect creative endeavours consisting of artistic and literary works and their derivatives which are original by themselves and cannot be **technologically** utilized (although copyrighted works can be presented or performed publicly). Nevertheless, careful examination of the US Patent Office guidelines for computer-related inventions (USPTO, 1996) leads to consideration of computer programs as *hybrid legal entities* which may warrant protection by both regimes, since on the one hand, algorithms, processes and ideas involved in a computer program can be patented, and on the other hand, other elements and concepts of software, such as interfaces, code lines and final copies of software products can be protected by copyrights (Reichman, 1994; Nichols, 1998).

Advances in the technological frontiers of software and information systems raise questions about the ability of the current doctrine to preserve the balance between the guarantee of property rights for inventors of software technologies, and economic inefficiencies from monopoly power.

Recently, the EU has expressed particular concern over the rise in illegal reproduction of digitized works for private use, facilitated by technical advance in communication platforms, and their increased diffusion (EU Green Paper, 1995a). However, implementation of IPR regimes to diminish unauthorized duplications *in the short-run* should be judged not only by their ability to protect the interests of owners of software copyrights and related rights, but also by their ability to avoid pitfalls caused by over-protection that may lead to fragmentation of the Internal Market *in the long-run*.

In many ways the growing medium of the Internet as a distribution channel can foster new types of infringements of intellectual property rights. The share of data communication equipment as a percentage of the total OECD IT market almost doubled in the 1990s, increasing from 2.6% in 1990 to 5% in 1997. The number of world-wide Internet hosts grows rapidly (37.7 million hosts in July 1998, an increase of 23% over January 1998) (OECD, op. cit.). Additionally, the volume of core copyright industries in the US economy was estimated to have a value-added of 254.6 billion dollars in 1994, representing 3.78% of the GDP. The revenues from online software sales were estimated to be 10% of the total revenue of the copyright industries in 1996 (approximately 0.5% of the US GDP) and were predicted to triple by the end of 2000 (OECD, 1998). While the scope for legal distribution of copyrighted material over the Internet seems enormous, so does the scope for illegal distribution, as the recent Napster case shows (or is alleged to show).

The growth in development and use of software products, their contribution to the *New Economy* and the projected emergence of new software markets in electronic commerce have led policy makers and software publishers to re-assess present regimes and their ability to cope with violation of software as intellectual property.

3.1.1. Evolution of Software Intellectual Property Regimes

A shift away from the perception of IPRs as germane mostly to mass-produced physical goods began with the parallel development of the Personal Computer and the shrink-wrapped software[14] market in the mid 1980s. Some computer programs have become mass-consumption goods, as computer applications are now distributed through a variety of channels for purchase (except for, by and large, operating systems which tend to be supplied with hardware, as in the 1960s). This reduces the force of the USPTO's previous rationale. So we see that since 1986, the US Patent and Trademark Office has considered software goods and software-embedded products as patentable.

Policy guidelines, in contrast with the previous period, have considered software goods (and embedded software technologies) as legal entities that are owned by their creators and can be protected through intellectual property rights. The new guidelines have preserved the traditional distinction between an "idea" and "expression", enabling software technologies to obtain patent protection as do other types of technical advances.

Software patenting and copyright legislation has passed through several stages of modification from the 1960s to the 1980s. Until the mid-1980s applications to register patents for software-based processes and computer program algorithms were rejected, following US Patent and Trademark Office (USPTO) policy guidelines. The USPTO justified its decision with the argument that novelty could hardly be estimated in the dynamic field of software development. Furthermore, historically, patent protection has been given to mass-marketed commodities, thus excluding computer programs as they were distributed only in small volumes. As a result, until the late 1970s the software industry relied mainly on trade secrecy contracts and licensing agreements (Branscomb, 1990; Samuelson, 1993). Table 3.1 shows the gradual evolution of the software industry in terms of the nature of software, typical users, IPR mechanisms and regulation. What we can observe from this table is a gradual move away from the open system of the 1950s and 1960s toward the closed system that appears to be emerging today.

Emerging legislation and rulings appear to be a continuation of the regime developed for physical goods, with analogies drawn between various aspects of software, and both traditional technologies are artistic artefacts. This incremental approach has intensified the debate over IPR protection. Indeed, the main issue, debated but unresolved, is the ability of current IPR regimes to address the technical changes presented by information goods. Several suggestions have been proposed to strike the right balance between incentives to innovate (thought extremely important by software industry investors) and freedom of knowledge or information diffusion (thought vital for technology transfer, knowledge spillovers and further innovation). These suggestions frequently appear when new challenges are felt by the market, and are contrasted with inappropriate and in some aspects archaic, economic models (Reichman, op. cit.).

[14] Software products that are physically distributed in packages, accompanied with licensing agreements for their use.

Protection-Free Innovation and Growth

Though IPR regulations for software did not exist in the 1970s, rapid innovation took place nonetheless (Stolpe, 2000). Further, information technologies have shown stable growth in both mainframe and mini-computers since 1960, in spite of leaving the essential complementary technologies of software free of legal protection for intellectual property.

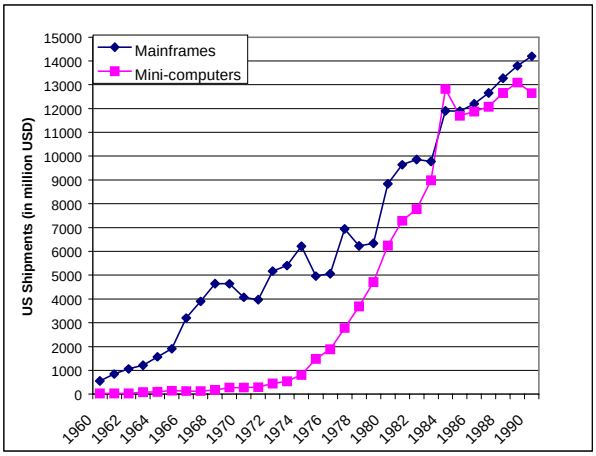

Figure 3.2: Estimates of US Mainframe and Mini-computer Shipments by Value, 1960-1990.
Source: Steinmueller (1996).

A striking aspect of this evolution is that software is being treated as both patentable and copyrightable. Previous techno-economic paradigms built a dichotomy between copyrights and patents as regulatory mechanisms. Patents apply to the ideas and processes underpinning the inventive step, whereas copyright applies to the expressions of creative works, basically in literary or artistic forms. But as noted above, the USPTO guidelines divide the protection given to software, such that algorithms and processes are patented, while interfaces, code lines and final products are copyrighted.

The legal overlap between software patents and copyrights to protect the same product is claimed to be over-protective, and likely to result in a monopolistic dominance of technological know-how in software development. IPR regimes aspire to promote high levels of creativity, both for "art" (copyrighted works) and "utility" artefacts (patented inventions). As new technologies present new economic paradigms, implementation of both regimes is claimed to supply a broader protection than the one which IPR regimes originally aimed to provide (Mennell, 1989; Samuelson et. al., 1994; Reichman, op. cit.; and others). Examination of aircraft and radio industries in their infant stages shows that patents registered by market dominators created barriers to entry for new inventors and potential market entrants, thus slowing the pace of innovation at a stage critical for development (Nelson, 1994).

Mackaay (1994) expresses a concern for the software industry stemming from similar phenomena. He argues that software innovation is hampered by existing intellectual property regimes which supply a broad protection, and do so for lower levels of creativity than is appropriate for this (relatively) new industry. His explanation is that the adaptation of the legal regime of intellectual property rights lags technological changes and fails to keep up with changing peculiarities of new and rapidly changing technologies. While developed in the context of software, this argument will obviously apply to any rapidly changing industry, but it is especially strong when the industry is at the heart of a shift in technological paradigm.

The following subsections review legal *modus operandi* employed to protect software goods, the issues and constraints of the existing methods of software IPR.

Period	Software Applications	User Profile	Type of Protection	Regulated by…
1950s-1960s	Bundle of hardware & software for central machines	Researchers, Academics	No protection: informal exchange	No Regulation
Early 1960s – Late 1960s	More diverse and complex program for Central Computers	Researchers, Academics & Earlier Market	Trade Secrecy and Licensing	Fair Use Law Trade Secrecy and Contract Law
Late 1960s-1970s	Commercial venture software projects, based on scientific research	Industry & Academics	Trade Secrecy and Licensing; Patents and copyrights rejected	Fair Use Law Trade Secrecy and Contract Law
1980s	Personal Computers (PC) and industrial processes / equipment	Industry, Business, Academic & Home users	Trade Secrecy Copyrights Patents "Shrink Wrap" Licensing	Copyright Act[15] ("*expression*") Patent Law[16] ("*idea*") [17] Berne Convention
1990s	Personal Computers and Internet (World Wide Web) / LAN / WAN[18]	Industry, Business, Academic, Home and Net users	Hybrid character of software International Copyrights and Patents Laws New economic models (as "Sharing" and "Bundling")	EU "Green Paper" (EU, 1995a) TRIPs Agreement (EU, 1995b) Suggested *Sui Generis*[19] Law for Software Linking, Web Caching and Browsing - *"on a case by case" basis* ruling.

Table 3.1: Taxonomy of the development of software IPR, 1950s-1990s.
Based on: Samuelson (op. cit.); Reichman (op. cit.); Holderness (1998); Morisson (1999).

[15] Adapted to software IPR by CONTU (National Commission on New Technological Uses of Copyrighted Works, 1980)
[16] A change in US Patent and Trademark Office (USPTO) policy occurred after the U.S. Supreme Court's decision in *Diamond vs. Diehr*, 1981, by which software involved in an industrial process can be considered patentable.
[17] See *Whelan vs. Jaslow* ("Whelan Test") for the "expression / idea" ruling.
[18] LAN – Local Area Networks.
WAN – Wide Area Network.
[19] Sui Generis – Latin: "of its own kind", used to describe something that is unique or different.

3.1.2. Patents

Background

From the very first stages of computer and software technologies, US industries have dominated global software markets. This continues as the US holds 47% of the global packaged software market and 36% of global ICT markets (OECD, op. cit.). Hence, US legislation has prevailed in the formation of software IPR regimes since the first commercial applications were released, and has been determining the attitude towards patent protection world-wide.

The most important event in software patenting in the US, later influencing legislation in the EU as well as in other parts of the world, occurred in 1986. A verdict given by the Supreme Court in *Diamond vs. Diehr* found a rubber curing process involving a software element in the chemical process **patentable**, and thus approved the patent claims. The verdict was important in two ways. First it created a precedent by permitting a piece of software to be patented. Second, it defined a distinction between the patented "ideas" and the unpatented (but copyrightable) "expressions" embedded in software technologies and goods.

In 1996, the USPTO wrote guidelines to steer the evolution of software IPR (officially in the US and *de facto* in most other countries). The Patent Office adopted an evolutionary rather than a revolutionary approach and so has created its software policy based on existing IPR legislation and rulings. Notwithstanding, part of the examination procedure has been adapted specifically for software innovations and clearly shows an attempt to accommodate the hybrid aspect of software as both an "idea" and "expression". The procedure is illustrated in Figure 3.3.

In the European Union, the EU Council Directive on the Legal Protection of Computer Programs (91/250/EEC) presented guidelines for future legislation and instructions for adaptation of national software IPR regimes by the Member States on the basis of key principles adopted from US ruling. The terminology for legalization is taken from US guidelines, and a similar distinction between an "*idea*" and an "*expression*" exists.[20] According to the Directive, the legal term "computer programs" includes, apart from a source code, preparatory designs (similar to the *SSO principle*).[21] The aim of software patenting is to protect ideas and principles embedded in software that are not covered by copyrights (as also stated in the USPTO guidelines; see Figure 3.3). With the adoption of major parts of the US doctrine, the EU has consequently left the door open to the emergence of legislative issues in the protection of software similar to those that have emerged in US (Brueckman, op. cit.).

As shown in Figure 3.4, patenting has become a much more common method by which software developers protect their technological advances. Note that numbers of software and software-related patents have been increasing rapidly since 1992.[22] An annual growth rate in the number of patents in class 395 ("information processing system organization" — the major class for software-application patenting), between 1992 and 1999 was on average 33%. To compare, the equivalent annual growth rate in the total number of US patents between 1992 and 1999 was 6.3%.

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[20] Differences between the Directive and the US doctrine mostly relate to the broader permissions for reverse engineering allowed by the Directive.

[21] The "*structure, sequence and organization*" of a computer program enjoy copyright protection, as do final software products (also known as the "Whelan test").

[22] Stolpe (op. cit.) mentions in his survey that the vast majority of software publishers in Germany prefer protection of their products by legal means such as an application of technical methods against unauthorized use.

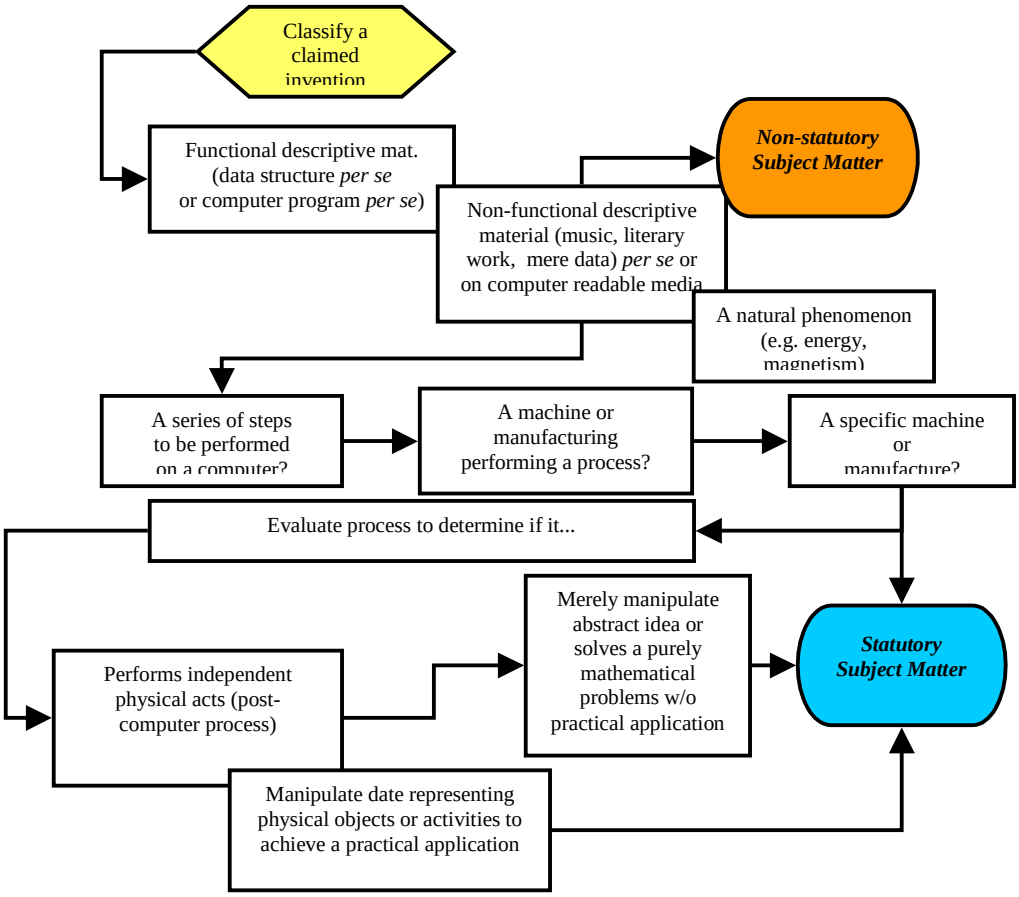

Figure 3.3: Guidelines for software patenting.
Source: USPTO (1996).

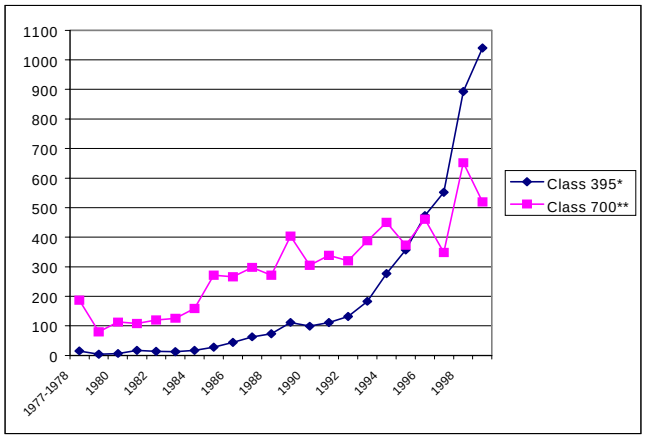

Figure 3.4: Number of Software Patents in the US, 1977-1999 (original classifications only).[23]
Source: USPTO (2000).

[23] Class 395: information processing system organization (the main class for software patenting, created in 1991 to replace class 364 - Syrowik, 1996). Data presented here includes the joint class 395; Class 700 includes data processing - generic control systems or specific applications.

While it has been possible to patent software technologies for more than a decade, arguments for, and in particular against the present doctrine have been heard throughout this period. However, scholars differ in their opinions about whether the present statutory regime is over- or under-protective and what possible consequences may be for the software industry and its technological trajectories. Most importantly, preferred regimes needed to replace the present legislation which guarantee efficient protection and incentives, yet avoid monopolistic impediments to innovation, are still under debate.[24] Nevertheless, from this debate we may conclude that, to some extent, drawbacks of current over-protective regimes outweigh the advantages arising from implementation of a strengthened legislation.

Are present IPRs an under-protective regime?

Advocates of strengthened IPR regimes argue that protection should be increased in order to guarantee incentives to innovate (Clapes, 1993) and to protect small firms against predatory imitation by large firms (Heckel, 1992). Other arguments based on effective resource allocation claim that the scope of patent protection should be *broadened,* that is, a single patent should provide protection in a wider technological sphere, in order to allow co-ordination between inventors and to allocate effectively resources and investments in R&D as new entrants adopt agreed technological standards for development of advanced applications (Cohen, op. cit.). Furthermore, protective regimes not only co-ordinate efforts to innovate, but also encourage firms to introduce products early in order to achieve advantageous market positions of "first-movers". The firms are thus forced to foster their R&D efforts and to accelerate the pace of innovation.

Even technological lock-in is seen as a reason for stronger IPRs. A lock-in to single software platform is an advantage and a contributor to standardization. Consumer's choice of a single technology from several available technologies is influenced not only by its technical merits, but also by the number of users that have adopted the technology. As the number of users increases, so does the possibility for interaction using a single standard ("*network externalities*"). Market standards allow "secondary markets" (application developers) to devote more resources for development of a wider variety of applications for a single (standard) platform, instead of allocating resources for development of similar functionality for rival technologies, interfaces and converters (Farrell and Saloner, 1992).

Standardization is certainly valuable in creating static efficiencies: economies of scale in production, installed base economies and network externalities. In software, in particular, scale economies in the production of complementary applications are important. Given the possibility that a market will standardize on an inferior technology (Arthur, op. cit.; Arthur, 1996), the 'static efficiencies' argument is justified only if "any standard is better than none". But this neglects dynamic issues and makes perhaps an unrealistic assumption that the quality of a platform technology does not restrict the technical qualities of its complementary applications.

Are present software IPRs an over-protective regime?

As innovation and diffusion both have social value, if the relative social values change, in principle the regime should be changed in response. For example, if the social value of knowledge diffusion increases, then the IPR regime should be altered to facilitate (or place fewer restrictions on) the diffusion, which will necessarily be at the cost of incentives to innovate. One

[24] Contrast, for example Schumm (1996) with Cohen (1999).

can argue that in the case of software (and information goods in general) this has indeed happened.

Net benefits of diffusion increase if the cost of it decreases, all else equal. This has clearly happened with the growth of the Internet as a distribution channel for all sorts of information goods.

Software is in many ways a "general use" technology. That is, it is an input to or a component of many other technologies or goods. In particular it is a very important input into the generation of further innovation. Thus, if it were widely diffused, it would have very large positive effects on further knowledge creation, and would reduce costs of production of many goods in the economy.

It may also be the case that the costs of strong protection have increased. That is, the net benefit of the monopoly given to innovators while still strong at the individual level, is at the social level less so. The argument here is that monopoly prevents entry. When a technology is changing rapidly, entry is vital in continuing innovation. An over-protective regime prevents just the type of entry that causes and is caused by rapid advance (Samuelson et. al., op. cit.; Davis et. al., 1996).

As a classic example of a general use technology with the potential to create extremely strong market power consider the *bubble-sort* algorithm. The *bubble-sort* method is an algorithm for effective classification and sorting of objects (such as records in a database). It was presented in the 1960s, and since sorting is used in very many applications, it has become a very common and widely-used algorithm in computer science and throughout the software industry. Had its (anonymous) inventor registered a patent for the mathematical method, most of today's software development activities and products would have been dominated by a single person. We can easily imagine the harmful influence of a monopoly, had it been granted to a *bubble-sort* patent, on today's software development and innovation, as no alternative has been invented (Schumm, op. cit.). This suggests a new test for examination of software claims. Patenting an idea or an algorithm should be accompanied by claims for future applications of the algorithm, which would be an integral part of the patent scope. Thus, patent protection would be limited to future applications that were mentioned in the claims. Disclosure of technical know-how allowing implementation in unclaimed fields would then be achieved. Although the proposed test does not restrict broad claims from being registered, it is an initial attempt to improve the present situation in which wide allowances are granted to software inventions by limiting the scope of protection to explicit applications that were registered in the patent claims.

These sorts of arguments suggest that if it were possible, software should have a less restrictive IPR regime than many other goods. *Sui-generis* regimes may be (politically) difficult to create, but at this point in time, since the regime is now being constructed, there is an opportunity to resist calls for stronger protection or, alternatively, to demand compulsory licensing.

3.1.3. Copyrights

As in the case of patent regulation, the US is leading the way in revising copyright regulations to fit the new technologies. The rights of the owner of a copyrighted work are well defined in section 106 of the Copyright Act, approved by the United States Congress in 1976. Its definitions include the right for reproduction of a copyrighted work by its right holder, the right to prepare derivative works that are based upon the copyrighted material, the right for distribution of the work, and the right to perform and display it publicly. Additionally, an eligible work must be presented on or in a tangible medium to receive copyright protection (Diotalevi, 1998).

Copyrights are considered as a *"half baked cake"* when used to protect software from misappropriated use. The copyright system is being adjusted in light of the hybrid character of computer programmes, and to complete and complement the changes taking place in patent regulations. Nevertheless, software copyrights have not yet successfully addressed the character of the technology in general, and are frequently examined in Court on a "case by case" basis. Reichman (op. cit.) argues that application of copyrights to protect software products in an overlap with patent ("*utility*") protection of the embodied ideas and algorithms, as eventually legislated in most of the countries, may lead to an over-protective ("*narrow*") regime. Reichman advocates a *sui-generis* law that would be tailored to the technical characteristics of software goods and reduce the level of protection that software currently enjoys.

A major juridical test was created by the precedent of *Whelan vs. Jaslow*, and it drew explicit guidelines for software copyright infringements. In *Whelan*, the Third Circuit ruled that copyright protection would be available for the "*structure, sequence and organization*" of a computer program, thus nicknamed the *SSO principle.* The *SSO principle* significantly widened the scope of software copyrights, formerly granted only for the source code.[25] The Court concluded that copyright protection that follows the *SSO principle* is essential to supply enough incentives for investment in software development. Moreover, the "*Whelan Test*" prescribes the perception of *functionality* of a computer program module as an **uncopyrightable** part, different than other aspects of software, which are copyrighted as an "*expression*" (Samuelson, op. cit.).

Criticism published after the ruling objected to the decision as over-protective. The monopolistic dominance over patented technical know-how was argued to contrast with the incremental evolution of the software industry, based on knowledge transfer and technological spillovers, and the term of copyright protection was also indicated as unnecessarily outstretched compared with the average life-cycle of software applications (Menell, op. cit.). Indeed, interpretation of the ruling led to a conclusion that a new computer program, applying what are by now relatively common procedures and user interface design, such as word processor fonts[26] and methods for real-time data input[27] may violate the *SSO principle.* Thus, owners of rights may not only dominate software *technologies* by obtaining patents, but also software *designs* for elongated periods by copyrighting.

In the EU Member States, legislation is applied nationally, under a uniting legal framework supplied by WIPO's Berne Convention.[28] For example, the Dutch law is based on the Copyright Act (1912), which was modified in 1985 by law according to the Paris Act of Berne Convention.[29] Although the Directive for Legal Protection of Computer Programs contained explicit guidelines for adaptation of national regimes (software copyright regimes, in particular), there are substantial gaps in policy implementation which have slowed the legal harmonization among Member States. Two examples of such gaps are seen in the Dutch case.

A report on the implementation and effects of the Directive in Member States found that the Dutch policy for software IPR differs from the instructions of the Directive by prescribing a wider scope for "expression" which is unclearly defined (EU, 2000).

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[25] The statements and instructions that a programmer writes while creating a program.

[26] *Adobe Systems vs. Southern Software* (Federal District Court, 1998) - fonts were approved to be copyrighted subject matter.

[27] *Interactive Network vs. NTN Communications* (California Court, 1995) – "real-time data feed" methods were approved to be protected by copyrights.

[28] WIPO – World Intellectual Property Organization; WTO – World Trade Organization.

[29] By *Staatsblad* no. 307 (30.5.1985).

The second gap concerns differences in restrictions on de-compilation of software goods between the Directive and the Dutch law.[30] Article 4 in the Directive includes the following limitations for de-compilation of computer programs:

1. *"The permanent or temporary reproduction of a computer program by any means and in any form, in part or in whole. Insofar as loading, displaying, running, transmission or storage of the computer program necessitates such reproduction, such acts shall be subject to authorization by the right holder.*

[This would include for example making a second copy on a hard drive.]

2. *The translation, adaptation, arrangement and any other alteration of a computer program and the reproduction of the results thereof, without prejudice to the rights of the person who alters the program.*

[This would include for example translating the dialogue boxes from English to Dutch, even for private use.]

3. *Any form of distribution to the public, including the rental of the original computer program or of copies thereof. The first sale in the Community of a copy of a program by the right holder or with his consent shall exhaust the distribution right within the Community of that copy, with the exception of the right to control further rental of the program or a copy thereof."* (EU, 1991).

[This would include, for example, re-selling a piece of software if it had previously been installed.]

These are all Directive limitations on de-compilation. However Article 6 of the Directive makes an exception aimed at increasing innovation and product development: de-compilation of computer programs is permitted if the purpose is to achieve interoperability of the software with other applications (a process prohibited by US law). The Netherlands did not validate this exception, thus restricting the scope for software de-compilation. It is worth mentioning, however, that the report considers the overlap between software copyrights and patents as non-problematic, as it is mostly concerned with a guarantee of broad scope of protection for software goods (EU, 2000). Hence, the authors of the report hold an opinion that expansion of software IPRs by the application of a more protective copyright regime, despite an overlap in legal protection between patent and copyright regimes, is the favoured decision.

3.1.4. Trade Secrecy, Licensing and Fair Use Law

Trade secrecy, licensing and the fair use law complete a set of legal measures that have gradually been customized to the needs of software IPR protection. Whereas the first restricts diffusion (through actions that the firm and its employees can take), licensing and fair use law encourage transfer of technical knowledge *vis-à-vis* strategic and institutional means.

Trade secrecy is based on the perception of knowledge as a commercial good giving competitive advantage. In the very first stages of software technology, free and unrestricted exchange of computer programs and knowledge was the norm among the academic community. Later, as technology developed towards commercialization of software applications, forming a basis for the software industry, methods of trade secrecy were applied.[31] This form of protection was based on a contract between a firm and its employees aiming to prevent transfer of technical knowledge during the period of employment and for defined periods after leaving the job, and could be seen as the earliest legal means to protect intellectual property in the software industry. Quite interestingly, trade secrecy is highly influenced by social norms; for example, compared to

[30] Notice that the Directive has an extremely broad definition of "de-compilation".

[31] Raymond (1999) and McKusick (1999) present historical reviews of the shift from freely-distributed sources towards commercialized applications.

American firms Japanese firms are less strict in implementing secrecy agreements (Karjala, op. cit.).

Since the first and second stages of computer program development, the software industry, initially based on sales and distribution of central computer machines and bundled software applications, was facing problems that resulted from infringements of commercial property rights. The infringements mainly included unauthorized copying and use of software, de-compilation of program files, and reverse engineering intended to imitate sequence, functionality and interfaces of the modules. Trade secrecy and licensing were legal aids adopted by the software industry during the 1960s and the 1970s to prevent unauthorized use of technological advances and software applications. As a result, firms established a joint policy of contracting their employees for trade secrecy and changing the definition of software purchase from "selling software" towards "licensing software use", meaning that computer programs are used by consumers under restrictive conditions which are defined by the software producer. The development of Personal Computers and the rapid growth of PC users among broader parts of the population resulted in large-scale software IPR infringements. In order to reduce the commercial damages of those phenomena, software companies started using a "shrink-wrap" license, printed on the package and based on the acceptance of license conditions by the act of opening the package. As distribution of software via Internet diffuses, the ability of legal aids to supply protection (such as "shrink-wrap" licensing — originally aimed to protect physical verbatim media from copying), dissolves. However, several precedents[32] have led the way to judicial recognition of "click-wrap" agreements, in which the user is able to download contents from the Internet only by acceptance of licensing terms that define the user's liability and wrongful acts (as software files) as alternative to the traditional "shrink-wrap" agreements.

Fair Use Law also serves a major role in the protection of commercial knowledge-based goods and technologies. Fair Use Law is a complementary legal means to evaluate damages to the developer by infringement of copyrights and further effects on his potential markets, **only** after copyright violation has been proved. The purpose and the characteristics of use (of a commercial nature or for non-profit purposes), the portion used in comparison to its functionality possibilities as a whole and the effect of the use upon a potential market describe a framework for a fair use and the value of damages in unauthorized use (Diotalevi, op. cit.). A main issue in the examination of damages is whether the use of copied software was non-profitable for its user. A use of software which aims to assist research and educational activities is commonly considered as a fair-use under copyrights and license terms, as it contributes to the utility of the public and it is not meant to create personal benefit. Nevertheless, copying that infringes copyrights on a large scale, though targeted for scientific research, is banned (*American Geophysical Union vs. Texaco Inc.*, in: Hammond and Meyerhoff, 1997).

As stated in the beginning of this chapter, regulations are found to be far from being water-tight against software piracy. The nature of software goods, as well as other intangible goods, confronts policy-makers with evolving needs of the software industry not only to explore new methods for enforcement, but mostly to adapt the current regimes to the technological dynamics.

[32] *Hotmail Corporation vs. Van Money Pie* (Northern District Court of California, 1998); *Caspi et al. vs. The Microsoft Network* (N.J. Court of Appeals, 1999), and others.

3.2. IPR and the Formation of Technological Trajectories in Biotechnology

In recent years the patent system has been repeatedly criticized as failing to adapt to the general context of knowledge-based industries. While it is true that all industries that comprise the "*New Economy*" face problems when their own peculiarities are confronted with the existing IPR regime, impacts differ from industry to industry due to industry specificities, trajectories of evolution and the degree to which they have advanced along the industry life-cycle towards technological maturity.

Biotechnology has developed relatively recently compared with other knowledge-based industries. In its modern form, molecular biology and genetic research were established only in the beginning of the 1970s. In 1973, Stanley Cohen of Stanford University and Herbert Boyer of the University of California discovered the process of recombinant DNA, a first keystone for the new scientific field. The first patent application was submitted by Stanford University in 1974, and in 1976 Cohen and Boyer founded Genentech, which eventually became the first biotech firm. Since the patents for the Cohen-Boyer process were registered, licensing agreements have generated more than $140 million in royalty fees. This episode demonstrates both the significance of technology transfer from university research to the private sector and knowledge diffusion from the stages of basic research to its exploitation in commercialized applications.

Patenting the artefacts of public research, mainly university research, as in the case of Cohen-Boyer, has marked a shift from a previous and common perception that results of publicly-funded research should be disclosed at no cost. Advocates of this approach mention Arrow's celebrated work (1962b) which argues that markets will under-invest in basic research due to its public good nature. This argument had been used to support the public finance of basic research, but has as a premise that the results of basic research are, indeed, public. Patenting the results of publicly funded research removes it from the public domain, which in turn puts a strain on the original rationale for support of the research with public funds. We point this out to emphasize that legislation related to IPRs and the activities of scientists in this line are connected with other important public policy issues. These issues and connections are extremely important in the case of biotechnology, as will become clear below.

Again, we see the US leading the way with two important events or trends. In 1980, the US Congress passed the Bayh-Dole Act.[33] This act marks a new approach to publicly funded research, and one key element is to permit institutions performing publicly-funded research to patent the results of it. Previously, part of the agreement for receipt of funds was that the results be put into the public domain. The goal of the Bayh-Dole Act was to expand the use of scientific discoveries, to foster research and development based on them, and to promote industry-academy co-operation.

The second lead provided by the US is related to what can be patented. Beginning in the 1970s (when genome sequences and molecular biology databases began to receive patent protection) and spurred by the Bayh-Dole Act, (as scientists attempted to patent their results, many of which could be considered discovery rather than creation) a new doctrine emerged under which it has become possible to patent **discoveries**. Traditional doctrine restricted patents to the results of **creation**.

There seem to be two results from these trends in the US. The first is an increase in industry-academy co-operation. These changes in doctrine have reduced the traditional tensions

[33] For review of the influence of the Bayh-Dole Act on industries and patenting see: Mowery et. al. (1999).

over intellectual property that have plagued attempts at industry-university co-operation. Industry typically reaps rewards by keeping property secret or by asserting strong rights over it. University researchers are rewarded by publishing and diffusing their findings (in the hope that they will be widely used). The two trends described here have pushed universities closer to industry in this regard. And indeed, McMillan et. al. (2000) found that 71.6% of patent citations in biotechnology patents are based on papers originating in public institutes, and only 16.5% of the citations refer to papers written by private sector scientists. Further, since the approval of the Bayh-Dole act, universities have established "technology transfer offices" for patent registration and licensing, new biotechnology companies have been established in co-operation with academic researchers, and pharmaceutical firms (e.g. Merck) finance basic research, even though applied derivatives are not guaranteed (Ernst and Young, 1999).

The second result of these trends is to raise serious issues for science in general and for disciplines like biotechnology in particular, having to do with access to and use of scientific results in further scientific research. If results of science are routinely patented, this represents an enormous change in the traditional way science has proceeded, based on publication of knowledge. The ability to patent discoveries, and even databases, makes it difficult to access parts of knowledge that may be building blocks for future research. Further, in biotechnology especially, many of the results of research are not merely discoveries of facts but creation of research tools (such as gene manipulation, gene mapping and analysis of sequences). To patent a vital research tool, now treated as an advanced technology in and of itself, forecloses the possibility that others can pursue research in the fields that need it. As tools can be very basic and generic, this seems to pose a serious threat to scientific progress, at least as we have known it.

3.2.1. Patents, Licensing and Innovation in Biotechnology

Many argue that results of scientific research hold potential for industrial development that would increase economic growth and welfare. This may be true. But to realize that potential, the newly generated knowledge must somehow be passed to the industrial sector. There are a variety of mechanisms: scientists-entrepreneurs, joint university-industry ventures or licensing. The first two have the problem in principle of either distracting from the scientific endeavour or distorting it (Joly and Looze, 1996). Licensing, then, is typically seen as the most benign form of technology transfer from that point of view.

For licensing to be feasible, though, ownership of the ideas must be established, and this demands that universities be able to claim property rights over (that is, to patent or copyright) the results of their research. This has begun to happen in the United States. Unlike Europe, which still considers publicly funded research to create public knowledge, in the US universities are explicitly permitted to assert private ownership over their results. The Bayh-Dole Act defines licensing as necessary for transfer of technical knowledge from universities to private firms and regulates terms for licensing patents (including *exclusive* licenses). Hence, in most cases, innovation needs not be impeded when results of academic research are patented.[34] There must be a proviso of course, noting that there must be mechanisms to prevent *idle patenting.* Registration costs and the need to prove technological utilization of the invention in the process of examination can serve this role.

[34] But high royalty fees, lack of compulsory licensing policy and exclusive licensing to a single firm (as discussed below) may create barriers for entry to technological fields. In addition, licensing is not compulsory, except in cases involving public health, safety or regulation in which the federal government, as granting agency can either license or take ownership of the technology.

A positive industrial response to academic patenting seems to have become the case in biotechnology. The majority of significant advances in biotechnology have been achieved in public laboratories (McMillan et. al., op. cit.), and the new regime has been designed, in part, to bring those advances to the industrial sector for exploitation.[35] Different types of licenses differently affect the use technology, research and development, and the pace of diffusion:

Exclusive licensing of a patent grants to a single firm monopoly over an invention, and the terms of the contract can define or restrict its legal right to co-license and to share the technology with other firms. Under an exclusive license the licensor benefits by receiving agreed payments from the licensee and by not needing to negotiate with several parties over time. On the other hand, the licensee receives dominance over a patent. From a social welfare standpoint, exclusive licensing is often perceived as non-optimal and even harmful to the evolution of infant industries, as major technologies (namely, inventions that often result from basic research) are monopolized by single firms, and hence restrict the opportunities of other companies to conduct research in these fields.

Non-exclusive licensing is meant to obtain profits by disseminating technology to a wide range of users. Indeed, a licensor is obliged to negotiate with many applicants over the use of a patent and to charge lower royalties, compared with exclusive licensing. However, formation of a wide basis of "technology consumers" might be more beneficial in the long-run as, apart from potential adoption of the technology as a *standard*, the technology will foster future developments and be applied in research and development of secondary products. An example for successful implementation of this policy is Stanford's licensing terms, which strengthened the evolutionary path of the biotechnology industry by charging (relatively) low royalty fees for the Cohen-Boyer process and thus helped establish new trajectories that continue to employ this technical knowledge. Three characteristics distinguish the recombinant DNA as a technological success story. First, the invention was at that period a unique technology, having no competing methods to conduct a similar process and products. Second, the technology that was presented was inexpensive to use and easy to implement. Third, most importantly, the Cohen-Boyer process was a core technology that served as the foundation for a wide range of applications and opportunities for developments in the established field of molecular biology (NRC, 1997).

"*Reach-through" licensing* is the less common method among the three, as licensor's profits are related to the success of the products in the market. The licensing is based on a certain percentage of the revenues from the products that have been developed using the technology. However, both patent holders and biotech firms rarely agree to contract on a "reach-through" basis for a variety of reasons. Patent holders tend to be risk-averse, and hence do not wish to jeopardize their rewards by linking them to downstream sales. On the other hand, research tools being applied in the exploitation of biotechnological knowledge, as well as profits that are yielded from the fruits of research, are both unpredictable *ex-ante*. Therefore, biotechnology firms, being aware of the possibility that more research tools and technologies than planned may be needed to complete their activities, highlight the advantage of *risk-less* agreements in the short run to avoid payment of substantial portions of their revenues as royalties in the long run.

As shown above, license agreements have the potential to affect the trajectories of development in key technologies. These findings call to establish a comprehensive policy framework for licensing, complementary to the statutory mechanisms of knowledge transfer. Clearly, the possibility that *exclusive licensing* of inventions (previously disclosed to the public at

[35] Evidence suggests that academic patenting has indeed facilitated the formation of research networks between public laboratories and firms. Accessibility of private firms to the competence and state-of-the-art results of basic research in biotechnology is then obtained, safeguarding the fruits of conducted research and incentives for future collaborations (NRC, 1997).

no cost) by publicly-funded institutes might hamper private and academic research contradicts not only the intentions of the Bayh-Dole Act legislators but also the goals of university research. It is rather surprising that even though the originators of the Bayh-Dole Act were aware of the possibility that long-term knowledge flows may be hindered by the presence of *academic patenting*, legal means to guarantee knowledge transfer by compulsory licensing are provided only in extreme cases, [36] and no legal parallels have been formed to support dissemination of technologies for the vast majority of mainstream episodes.

3.2.2. Patenting Research Tools

Unlike in the traditional industries in which research tools are established means, in biotechnology, in particular in the field of molecular biology, research tools themselves advance rapidly, staying at the forefront of the technology. Thus, the development of research tools for biotechnological research is itself a branch of advanced research. As the industry evolves, the appearance of new tools may open new technological frontiers which previously were limited by the lack of inputs needed for research. For example, the process of automated sequencing, invented by Larry Hood and Cal Tech laboratories, enabled the expansion of basic and applied research by introduction of DNA and protein sequencers to the market.

To protect the research environment and the ability of researchers to do their work, legislators world-wide specified the *experimental use exemption* (also known as the *research exemption*).[37] The experimental use exemption defines terms to apply patented technologies for research purposes when research is driven purely by scientific interests and is not applied research geared towards a generation of commercial value. As Judge Story expressed:

> *"It could never have been the intention of the legislature to punish a man who constructed a [patented] machine merely for philosophical experiments or for the purpose of ascertaining the sufficiency of the machine to produce its described effects"* (*dictum*, Whittemore vs. Cutter, 1813).

The research exemption enables the use of patented technologies for the sole purpose of mere research of patent-protected contents. Thus, rights of patent holders are not infringed while patented know-how is being contemplated as a subject, in itself, of non-applied research. Nevertheless, had patented products and processes been applied as a part of other research activities, including not-for-profit and basic research, patent rights would have then been violated. It is indeed difficult to determine in the judicial theory the criteria by which academic institutes or private laboratories that apply technologies in research do or do not violate patents, that is, what constitutes pure research. However, patent violation of research tools rarely happens in any case, as firms and organizations prefer to purchase them "off-the-shelf" rather than to violate the law by re-inventing them in-house.

A key issue in all of this is being able to draw a distinction between research tools as the subject of pure research, versus research tools as being an objective, or even an object, of applied research. All researchers in biotechnology are eventually consumers of (patented) research tools. Since a large number of the research *results* in the biotech field are in effect research *tools* which

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[36] The "March-In" authority was included in the Act to enable compulsory licensing of patented inventions, owned by universities and public institutes, in cases when technologies are vital for public health and safety or to meet public regulation.

[37] Research exemptions in biotechnology were approved as part of the WTO's agreement on trade-related aspects of intellectual property rights (GATT/TRIPs).

are by their nature of potential use to other researchers, the exemption applies in principle to many patents taken out. If research tools were included in the experimental use exemption, only by being means of research, firms couldn't have protected them by patenting from imitation for academic/private use and therefore would profit neither from the introduction of advanced technologies to the market nor from royalty fees. The experimental use exemption, being limited to pure and not-for-profit research, has reduced monopolistic power over technology, in return for higher degree of freedom to conduct research. Nevertheless, had the framework of the experimental use exemption been expanded to include research tools applied in research activities, even in part, incentives to innovate would substantially decline.

For example, in the case of *Roche Products vs. Bolar Pharmaceutical Company* (US Court of Appeals for the Federal Circuit, 1984), the defendant conducted clinical experiments during the patent term. *Bolar* argued that the experiments were merely held for research activity that could not be carried out without using the embodied technology in *Roche*'s tools in order to reveal further experimental stages. However, the Court accepted the *Roche*'s arguments that no pure curiosity or mere interests to promote scientific research were involved. Differently put, the experiments were performed in order to develop rival product that would be released to the market when the patent would expire (NRC, op. cit.).

Patenting strategies in the two main sectors of the biotechnology industry, namely pharmaceutical firms and pure biotech firms are motivated by different concerns. Biotechnology firms rely to a great extent on finance raised from private investors, venture capital funds and IPOs in order to finance their research and development. In this context, one important role of intellectual property is to demonstrate the firm's ability to carry out its plans successfully. Patents enable the firm to present its technical know-how without need for trade secrecy and in this way it can demonstrate the peculiarity and value of its inventions. Therefore, a biotech firm is more likely to widen its intellectual property portfolio by submitting patent applications for observatory inventions from the very first stages of the research. This method of *upstream patenting* may restrict the abilities of other firms to invent and therefore may slow down the pace of innovation, since this rationale for patenting implies that a firm will patent everything possible and in particular the results of basic research.

In the more established pharmaceutical firms, R&D for new products is financed by cash flow from sales of current products. Patenting in this case creates a monopoly of 15-20 years and thereby ensures continuous incomes during this period, which can be used to finance the next generation of research. Pharmaceutical firms prefer to patent their inventions in final stages of product development (i.e. in a *downstream* manner), as R&D budgets are available for full conduct of the research, and firms prefer to reduce indirect costs (such as patent registry fees).

Patents in general tread the fine line between incentives for innovation and diffusion of knowledge. In biotech, the latter issue is perhaps more prominent than it is in other fields. Here the balance can be seen as being between incentives to innovate and the pace of innovation, since so many innovations themselves serve as research tools for further knowledge advance. While patenting strategies have important effects in every industry, in biotechnology and other, especially young, science-based industries, the ability of firms to patent the results of basic research, and to patent outputs that themselves are research tools — inputs to future knowledge generation — can have a large impact on future R&D.

3.2.3. Protecting the Genetic Endeavour

Until 1998, patenting in the area of biotechnology fell under national legislation. In July 1998, ten years after the European Commission's first draft of proposed guidelines for patenting

biotechnological inventions and the emergence of public debate over its contents, the EU Directive on Legal Protection of Biotechnological Inventions (98/44/EC) was finally approved by the Parliament.

The 1988 draft referred to the "uses of plant or animal varieties" and to "microbiological processes" as its subject matter in general terms, without mentioning special allowances or prohibitions in the issue of *human* biology or processes. This issue of the subject matter, and in particular the lack of a "special place" for humans caused a lengthy debate and eventual rejection of the Directive in 1995. In the final version of the Directive, however, patenting of human body parts is explicitly prohibited (van de Graaf, 1997; Perdue, 1999). Moreover, the Directive addresses issues currently being contemplated in the US in patenting discoveries that resulted from basic research, and distinguishes between a patentable "invention" and unpatentable "discovery":

> *"Whereas patent law must be applied so as to respect the fundamental principles safeguarding the dignity and integrity of the person; whereas it is important to assert the principle that the human body, at any stage in its formation or development, including germ cells, and the simple discovery of one of its elements or one of its products, including the sequence or partial sequence of a human gene, cannot be patented; whereas these principles are in line with the criteria of patentability proper to patent law, whereby a mere discovery cannot be patented"* (EU Directive, section 16).

The Netherlands' appeal before the European Court objected to the implementation of substitute guidelines to its national regime, and attempted to declare the invalidity of the Directive. However, the Directive was re-confirmed by Court, hence Member States were required to complete its implementation by July 2000.

The US legislation prohibits the patenting of the human body as a whole. However, in contrast to the EU Directive guidelines, separated human genes or nuclide DNA sequences[38] are patentable by themselves (van de Graaf, op. cit.). However, over time US jurisdiction has expanded the legislation to permit the patenting of breeds of animals. These decisions are still regarded as controversial, though, on social and ethical grounds.[39]

While the moral debate about the inclusion of living species and human genome in the scope of patenting in the US continues to grab headlines, other issues relating to the influence of genetic sequences patenting on the nature of innovation in biotechnology have also emerged (Spiegel, 1998a; Spiegel, 1998b).

First, gene sequences are often used as important research tools. The problematic aspects of restricting the development of the tools by a broad scope of claims and the monopoly that the patent owner may achieve are reviewed in section 3.2.3.

Second, the wide coverage of protection that patents grant to a sequence and its applications (by broad claims), as the present US doctrine permits, is harmful for the development of biotechnology in the long run. The general manner in which claims are submitted and approved may guarantee monopoly for a term of seventeen years over a wide, almost unlimited range of applications in which the sequence is implicated.

Third, lacking a uniform doctrine for patenting in the US, the measures for disclosure of information about the DNA sequence differ from case to case. In reply to the National Institutes of Health about the insufficiency of a description of sequence structure alone, the USPTO

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[38] DNA sequences are also known as *cDNA* or *EST* (Expressed Sequence Tags).

[39] The first patent on genetically-engineered animal was granted to Harvard University *onco-mouse* (Weitz, 1993).

indicates its efforts to expand the required documentation to include chromosomal sites, unique expression of the tissue or polymorphism for mapping, tissue typing and forensic use. The change in the requirements for patenting implies the beginning of a shift in the USPTO policy towards more restrictive doctrine, and, to some extent, to a recognition that patents should give protection to "inventions" and not to "discoveries", similar to the EU Directive.

Fourth, and most importantly, the US doctrine does not distinguish between *discovery* of a sequence and *inventions* that involve its use. Thus, patents are granted to subject matters that do not carry any *innovative* steps in their discovery. Yet, this very permissiveness regarding patenting preliminary stages of basic research creates the possibility of domination of wide areas of downstream research and its results.

To conclude, the restrictive policy towards patenting of human genes and gene sequences in animals in the EU was driven by ethical views, while the scope of the US doctrine is much more extensive and includes both. Comparing the EU Directive with the US regime, one notices that the EU legislation attempts to avoid the pitfalls of the present US patent doctrine and its effects on the pace of innovation in biotechnology by applying guidelines that distinguish *discoveries* from *inventions*. Yet, the implementation of the Directive may cause a slowdown in fields that apply human DNA, since the lack of patent protection lowers incentives to invest in R&D and other innovative efforts.

3.3. Consequences of Globalization

The complexity of differing regimes applied in different countries can easily be demonstrated by the following example: a hyperlink on a webpage is located on a server in France and points to a server in Brazil that contains material protected by German and French (but not Brazilian) copyright law. The content was downloaded to a server in the US and then re-distributed in a Usenet group world-wide. According to which copyright regime can violations and remedies be determined? (Post and Johnson, 1999; see also Robert W. Lucky's remarks about the *rising complexity* in: Evenson, 1993).

Different from the public's common perception, harmonization in trade-related regimes, and for our discussion, IPR regimes, does not necessarily mean a full adoption of a singular doctrine by countries, or in its extreme, conversion of national systems to an international standard of IPR regulation.

Basically, harmonization is an ongoing process, including two different paths. First, countries that have never applied IPR regimes, or alternatively, have lax enforcement, guaranteeing only partial protection of intellectual property, are encouraged to strengthen their legislation often both by domestic industries and by the international community, as reform is often a pre-condition to joining international trade agreements such as the WTO. Second, the ability of present regimes to meet the needs of new technologies is under continuous examination. International activities are taken as a benchmark in creating legal protection at the technological frontier or for existing technologies that are affected by changes in international trade, such as the evolving *e*-commerce. Regulatory adaptations are led by WIPO and by WTO to establish a single framework according to which members' national IPR systems should be altered and expanded.

The general purpose of the harmonized regime of IPR is to diffuse agreed definitions of the scope, the contents and the terms for protection of patents, copyrights, trademarks and trade secrecy.[40] WIPO's conventions determine, for example, a minimal duration for patents and

[40] The following conventions regulate international policies of IPR:
TRIPs agreement (approved by WTO in 1995) – Agreement on trade-related aspects of intellectual property rights. The agreement was formed under the framework of the GATT agreement.

copyrights, general scope for patenting and special provisions for new technological fields such as plant variety protection in biotechnology. Although a uniform regime provides guidelines for regulation world-wide, each country may formulate its own detailed specifications in its national regime, in principle, of course, conforming to international treaties.

To evaluate the efforts underlying the formation of harmonized regimes, we first present the motives to apply homogeneous regimes in contrast with preservation of differentiated legal mechanisms across countries, and present the effects of both regimes on technological development at the national level.

3.3.1. Characteristics and Evaluation of Uniform Regimes

Application of harmonized IPR systems in the national *canon* means that internationally accepted, comprehensive legal mechanisms are implemented to protect a wide variety of forms of intellectual property (e.g. patents, copyrights, trademarks and others) and on a basis of experience accumulated by international authorities and by other countries. Implementation of harmonized guidelines would mean in most cases adoption of efficient public administration models for registration and enforcement of IPRs. International legal frameworks would also enable less developed countries (that lack experience and knowledge of IPR policies) to formulate adequate judicial means. In the presence of a uniform policy, emergence of new technologies would enable advanced countries to form new IPR legislation, whereas less-experienced countries can relatively easily adopt the guidelines to benefit their national regimes.

Consequently, implementation of a uniform regime may promote the preservation of domestic entrepreneurs (mainly in developing countries), as legislation may facilitate local agglomeration of technical know-how and attract foreign direct investments. The increased "safety" of intellectual property makes the country a more attractive place in which to develop it not only for its nationals, but also for foreign firms or entrepreneurs wishing to take advantage of some local resource. Technical know-how and scientific knowledge are powerful sources of innovation. If regulations permit only the authorized use of both, economic incentives to innovate are assured and returns on investments are guaranteed. Hence, when a uniform regime is employed, the institutional aim is to articulate a legal environment that would stimulate and foster innovative activities by protecting invented artefacts (David, 1993).

In order to apply a harmonized regime efficiently, national IPR systems need not be identical but do need to satisfy two primary conditions: congruence and stimulation. By congruence we mean that various regimes, though different by the details of legislation, would yield similar outcomes in their implementation. Thus, identical statutes across participating states is not a necessary condition. However, an international framework for regulation should be implemented to enable reasonable predictions of the results of IPR systems, and to create an ability to judge whether outcomes of application of different regimes are in fact identical.

Stimulation, as a second condition for a successful implementation of international IPR regimes, means that legal frameworks, when adopted and applied nationally, should aim to foster innovative activities at the national level, generating knowledge spillovers and technology transfer within the local industry. Implementation of international regimes assures the use of approved legal definitions and standards of protection to guard intellectual property by

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Paris Act of the Berne Convention (approved by WIPO in 1971) regulates copyright protection of literary and artistic works.

Patent Co-operation Treaty (PCT; approved by WIPO in 1978) provides filing and registration services for patents, recognized by 87 countries.

(WIPO, 1998).

institutional means. Thus, foreign investors as well as domestic inventors are able to invest in local firms and to co-operate with affiliates at high levels of certainty that their technological endeavours would not be purloined by rival firms.

Nevertheless, national regimes, compared with international doctrines, are better adapted to the peculiar needs of the nation. Moreover, national IPR systems, if well-tailored to address the characteristics of dominant and evolving industries within a country, would support the nation's abilities to adopt, exploit and foster its technological competence and therefore to generate economic growth.[41]

Further, as the argument goes, when the development of niche technologies is thought to be important, stronger national regimes may attract inventors and researchers to those fields and thus benefit social welfare by technological progress. While it may be tempting to arrange a national IPR system to facilitate innovation in a particular technological niche in which an economy has an advantage, there may be mechanisms that have less pervasive effects.[42] As an alternative, governments could consider more focussed means to encourage specialized research themes, such as grants and tax funds to promote R&D in prioritized fields instead of tightening the level of legal protection (see for example: Teubal, 1993). Indeed, the design of an appropriate IPR regime demands efforts of *social engineering* to enhance technological capabilities of the country and its ability to compete in the international arena.

Differences in regimes applied by various countries result from the stage of technological development in which a country exists, its economic and demographic characteristics and budgetary constraints. Thus, IPR regimes that are differentiated due to domestic and regional attributes may yield, when implemented, improved levels of social welfare, compared with harmonized regimes (Frischtak, 1993). However, prior to implementation of a uniform / differentiated regime, the following arguments should be considered.

According to the theory of entrepreneurship and industrial economics (Baumol, 1993), free-riding technical know-how would permit thorough diffusion of technologies within the population, as knowledge procurement and licensing costs are not involved. Yet local infrastructure for scientific research and technical training are jeopardized, as technology is fully-adopted from external sources, with no economic incentives to fund domestic research.

Lacking a stable IPR regime, trade secrecy is common in these countries. Hence, transfer of technologies, spillovers and technological diffusion is impeded as firms tend to retain their knowledge internally. As a result, several problems may appear. First, university researchers that invent new advances in technology cannot protect their innovation in their home-countries and thus have to commercialize the products in other countries. In this case, not only does the country of origin entertain the fruits of innovation, but also it may consequently suffer a brain drain of scientific and engineering personnel. Second, start-up firms cannot present their intellectual assets and technological developments to venture capital firms, joint ventures and investors in order to raise funds for advanced R&D, as no protection from imitation is guaranteed. Third, research parks that aim to stimulate technological inventions by clustering high-tech firms and by inducing co-operation among them may deter entrepreneurs, as firms are concerned with maintaining their knowledge ownership. Fourth, weak IPR regimes put a heavy burden on the development process, since significant resources are devoted to trade secrecy and commercial opportunities are lost.

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[41] For an empirical overview of national and international spillovers and their effect on economic growth see for example Fagerberg (1996); A more technical approach is discussed in Grossman and Helpman (1995).

[42] An IPR system designed to facilitate innovation in one technology may, in that very design, make innovation difficult elsewhere, not to mention running afoul of WIPO and TRIPs.

By contrast, had uniform regimes been implemented, national characteristics of the previous regime would have been removed in favour of the attributes of international legislation. Although harmonization assures an *international fairness* in guaranteeing similar outcomes from various national regimes, it is argued that a narrow standard, defined by international conventions, is also the lowest common denominator among the regimes in terms of policy guidelines. Globalization, in this context, is characterized by the dominance of influential countries that stand at the forefront of regulation of IPR for advanced technologies over other countries (consider, for example, the role of the US in legislating software patents and the adoption of the statute by other countries, as reviewed in section 3.1). Therefore, a country that wishes to follow an international standard, in the name of harmonization, may diminish peculiar niches in its internal markets (Lipinski, 2000). Put another way, in the process of harmonization there is likely to be a ratchet effect. No country is likely to want to give up rights that it has created. Thus the set of rights in the harmonized agreement will be the union, rather than the intersection of the sets of rights prevailing in participating countries. This can only increase the number of property rights world-wide, and thus make knowledge diffusion more difficult.

3.3.2. The GATT/TRIPs[43] Agreement – Intellectual Property Rights in the Light of International Trade

The TRIPs agreement was formulated during the Uruguay Round of the GATT in 1993. Its final version was later accepted by the WTO in the beginning of 1995. Its objectives are clearly presented in Article 7 of the agreement:

> "*The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conductive to social and economic welfare, and to the balance of rights and obligations*".

The main objective of the agreement, as emphasized in this Article, is indeed to preserve the balance (from social, legal and economic perspectives) between suppliers of a certain traded technology and its users. Also, the agreement aspires to accommodate by appropriate means technology transfer, innovation and technological diffusion world-wide.

The TRIPs agreement was meant to define harmonized and **minimal** standards for intellectual property rights in international trade. It creates a standardized framework, which is built on the following legal mechanisms: copyrights and related rights, trademarks, geographical indications, industrial designs, patents, layout designs (*topographies*) of integrated circuits, protection of undisclosed information and control of anti-competitive practices in contracts and licensing (Gorlin, 1993; WIPO, 1998). To some extent, the agreement defines both the lower and the upper boundaries for national regimes, as stated:

> *"Members shall give effect to the provisions of this Agreement. Members may, but shall not be obliged to, implement in the law* ***more extensive protection*** *than is required by the Agreement, provided that such protection* ***does not contravene*** *the provisions of the Agreement"* (Article 1; emphases added).

[43] TRIPs - Agreement on Trade-Related Aspects of Intellectual Property Rights; GATT - General Agreement on Tariffs and Trade, which was a basis for the foundation of the WTO.

Since the beginning of the Uruguay Round, developing countries have objected to the principles that were presented in the initial drafts of the TRIPs agreement. Legal scholars and social activists have also criticized the agreement as a regulation that discriminates against developing countries by an expansion of IPR regimes that were previously formed by developed countries. The agreement, this argument goes, was designed to fulfil the legislative needs for protection of intellectual property developed in the developed world, in terms that have largely limited the use of knowledge protected by IPR in the less-developed regions of the world. Hence, the TRIPs agreement may have essentially given dominance in global markets to industrialized nations and created barriers for entry to the less developed countries.

Furthermore, the TRIPs agreement was written largely in the context of the emergence of the *New Economy*. In the new economy there is a strong prevalence of information goods, which have the peculiar characteristics discussed above. Thus, the balance that TRIPs attempts to strike between users and producers of intellectual property has been heavily influenced by concerns arising from "new economies", that is to say, from the economies developing the new technologies: the *North*. To the extent that TRIPs was written with the goal of facilitating trade in information goods, the international agreement reflects concerns of the industrialized world, since less-developed countries lag behind by measures of technological progress and competitiveness, output and trade in the global markets (Correa, 1999, OECD, 2000). Figure 3.5 shows the extent to which an agreement based on the concerns of the new economy is based on Northern rather than Southern concerns.

To conclude, global harmonization of IPR regimes has an in-built asymmetry. We see this here in the context of the North/South divide: weak IPR regimes in the South are forced to be strengthened to meet the standards set in the North. This is an example of a common ratchet effect: harmonization is unlikely to weaken any IPR system for the simple reason that no nation is likely to be willing the give up "rights" that it has already won (or more properly, created). Adoption of the TRIPs agreement is a necessary condition for membership in the WTO, which seems an important prerequisite for non-member countries to improve their international trade performance.[44] Thus, the agreement implies an intervention in national systems of IPR by international regulation that requires compulsory modifications in the country's legislation. Although the adoption of a harmonized regime is essential to simplify complexities of international trade and cross-border regulation, as well as to leverage the level of social welfare, as presented, empirical evidence suggests that implementation of non-differentiated regimes may put developing countries at a disadvantage.

[44] Only member states of the WTO benefit (by being "most favoured nations" (MFN)) from extension of bilateral agreements of trade liberalization to multi-lateral, uniform provisions (such as reduced tariffs), after negotiations between the states. Indeed, as Fig. 3.6 presents, developed countries are becoming more dominant in international trade.

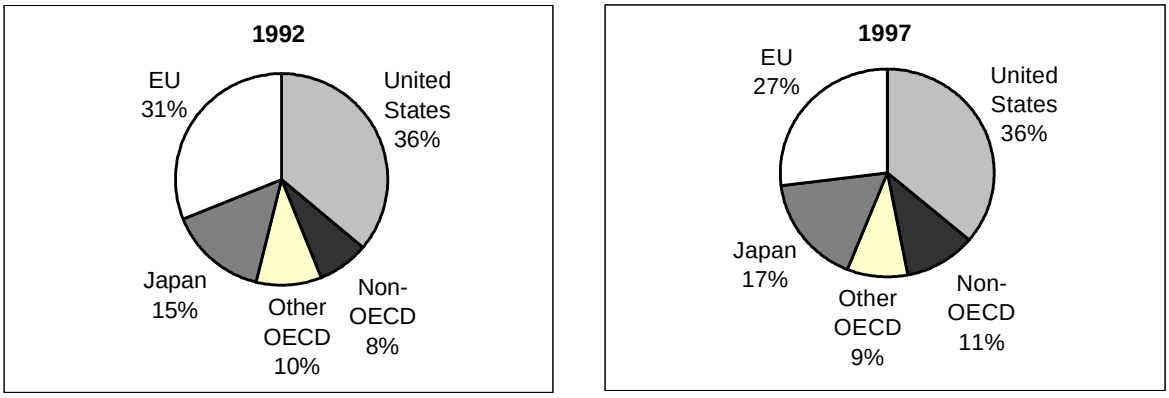

Figure 3.5: Breakdown of world-wide ICT markets by country/region, 1992-1997.
Source: OECD (2000).

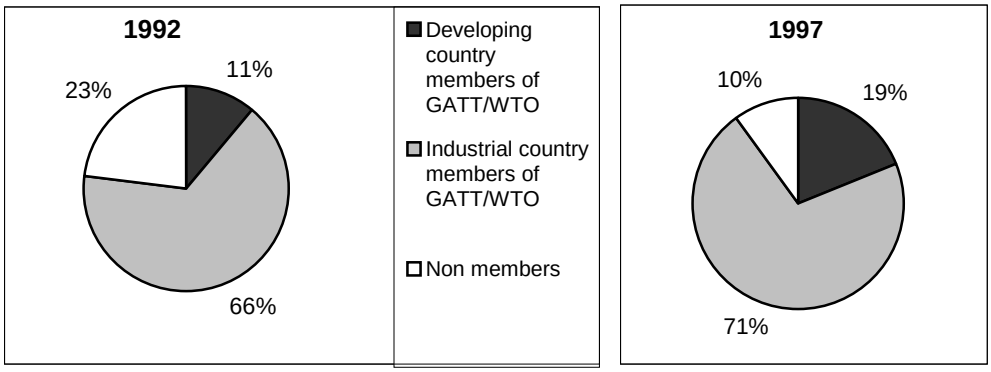

Figure 3.6: Share in Total World Export, 1992-1997.
Source: WTO Annual Report 1997 (brought in: World Bank, 2000).

3.4. Copyright Enforcement over the Internet

WIPO's Paris Act of the Berne Convention regulates a worldwide framework for copyrights. The Convention and the national regimes of its member states provide exclusive rights to control the following activities involving a copyrighted work:

1) Reproducing copyrighted work.
2) Preparing derivative works on the basis of the work.
3) Distribution of the copyrighted work.
4) Public performance of the work.
5) Displaying the work publicly.

(Diotalevi, op. cit.)

While WIPO and the Berne Convention are attempts to standardize the rights granted to the holders of various forms of intellectual property, national differences still do exist. Literary

and artistic works, copyrighted under one national regime may be unprotected by a legislation of another. The Internet, though, as a widespread information channel is almost by its very nature a cross-border medium. The volume of information transactions, webpages and digitized artefacts transferred via the Internet (e.g. articles, photographs and *e*-books) limit the possibility of taking legal action against even large-scale infringements in single cases.

Legal issues concerning copyright management of information transmitted via *the Net* often arise from contrasting perspectives about how the medium should be legally characterized and regulated. Supporters of stronger legal regimes argue that the Internet can only be fully exploited as a distribution channel if stronger copyright rules exist to protect those who put their works on the web. In contrast, other scholars hold the opinion that private contracts between parties of users and providers or, alternatively, licensing terms (and not any form of regulation) are the most preferred means to resolve a wide spectrum of the peculiarities of the Internet, and thus argue that a *laissez-faire* approach should be applied. Advocates of free information flow attempt to show that "information rules" imply the complete elimination of intellectual property regulation over the Internet, freeing information for every user's application, or alternatively that the normative framework ought to be articulated by users of the cyberspace with no governmental intervention (Lipinski, op. cit.).

In the US, the Clinton Administration established a special advisory board, known as the *Information Infrastructure Task Force*, to identify major challenges in copyright protection over the Internet and to propose adaptation in legislation to encounter evolving issues stemming from the technological essence of global information networks. The Task Force aimed to "*accommodate and adapt the law to technological change so that the intended balance [between copyright owners and users] is maintained and the Constitutional purpose*[45] *is served*".

In this section we review the recent issues of copyright implementation over the Internet in the international arena, which emerge *vis-à-vis* the unique evolution of the Internet architecture as an open platform, a medium which accommodates advanced capabilities for global communication and vast volumes of information interchange.

3.4.1. Technical Review of Copyright Infringements

According to the common legislation, copyright infringement is recognized as such if it satisfies two fundamental conditions:

The activity of the infringing party (i.e. user, Internet provider, host owner or webpage designer) resulted in an unauthorized reproduction of copies of the copyrighted work.

1) The copies were fixed (stored over time) in a stable medium.
2) If both conditions are fulfilled, the material is subject matter for legal action on the grounds of copyright violation. The legal jurisdiction is the territory in which the executed duplication is recognized as wrongful.

Even if a copyrighted work were converted to program code (e.g. an HTML document), stored and browsed in its digitized form, it would continue to entertain similar copyright protection in most cases. However, the environment of *micro-infringements*[46] previously present in

[45] According to the definition in the US Constitution, copyright law aims "*to promote the progress of science and useful arts, by securing for limited times to authors and inventors the right to their respective writings and discoveries*" (US Constitution, Article 1, 8).

[46] We define *macro-infringements* as violations that stem from high scales of unauthorized distribution and use of contents. Previously, when computers were used as stand-alone units, scales of copyright violations

stand-alone workstations has been replaced with an era of *macro-infringements* involving a large scale of users and copyrighted material, as the Internet networks enable connectivity between millions of users and web servers.

Copyright violations are derived from the structure and the technical merits of Internet technologies and from the communication "layer" in which a digitized work is stored. To identify the possibilities for "conscious" and "unconscious" violations while browsing the *Net*, we first provide a simplified review of the physical and technical means by which the cyberspace is spanned.

Users apply several tools in browsing the net and downloading information: web browser (e.g. Internet Explorer or Netscape), the computer's RAM[47] and their computer disks. Information is stored in a permanent manner or for intermediate purposes ("*caching*") in web servers. A linkage between all the web servers by worldwide communication infrastructure generates the Internet (see Figure 3.7).

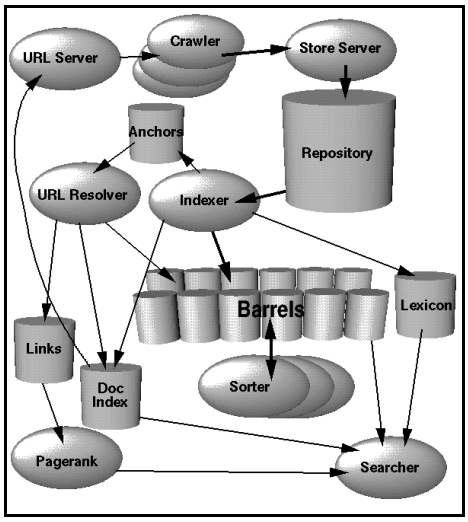

Figure 3.7: The WWW hyperlink structure.
Source: Brin and Page (1998).

Web-surfing activities involve several methods of hypermedia and information retrieval to conduct access to contents over the Internet:[48]

- Browsing: viewing the contents of the World Wide Web on the Internet by a front-end program such as Netscape or Explorer.
- Caching: temporary caches serve as staging areas for storage and retrieval of information. Their contents can be stored or changed in milliseconds. We distinguish between browser caches and Internet caches that hold popular webpages for long

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were limited to unauthorized distribution to individual users, thus generated only *micro-infringements* in comparison to the scales of violations over the Internet.

[47] RAM – Random Access Memory. The computer's workspace, all program execution and data processing takes place in memory. The program's instructions are copied into memory from disk or tape and then extracted from memory into the control unit circuit for analysis and execution (www.techweb.com).

[48] All definitions are adopted from www.techweb.com.

periods of time, and disk caches which are sections of memory on the disk that bridge the disk and the CPU operations.

- Framing: a web browser feature that enables a Web page to be displayed in a separate scrollable window on screen.
- Hyperlinks: a predefined linkage between one object and another. The link is displayed either as text or as an icon. On World Wide Web pages, text hyperlink displays as underlined text, typically blue, while a graphical hyperlink is a small image.

However, those activities imply that web-surfing is a potential source for IPR infringement. Computer and communication-mediated violations involve almost all the technical stages in operating a standard web browser, and computer users become vulnerable to inadvertent violations while browsing the Internet. Unauthorized copying, according to the Copyright Act includes also temporary storage of copyrighted information in the RAM memory of the computer. *In re MAI vs. Peak* (2nd Circuit, 1991), a keystone in the US jurisdiction of copyright violations via computer and Internet use, Rapid Access Memory was found to be an infringing medium in which fixation of re-distributed copyrighted content is available over time. Hence, when an Internet document is viewed, a violating element of non-permissible storage and copying exists. Indeed, the decision in *MAI* was criticized as draconian by legal scholars, implying that a common browsing activity in the Internet may be regarded as an ongoing set of copyright infringements even if only webpage viewing is taking place with no intentional downloading. Yet the *MAI* precedent as a doctrine for copyright infringements prevails, although few exemptions of Fair Use to regulate unintended browsing and unconscious downloading (as in *web caching*) were included in the US enactment (Rieder, 1998).

Similarly, web caching involves unintended reproduction of copyrighted works, as contents are stored on a remote web server or written to a disk cache. To avoid a flood of lawsuits against unintended duplication of material, which are in principle unauthorized by law, the *Digital Copyright Millennium Act* (*DCMA* – HR2281), was passed into US law in 1998, defining regulatory guidelines for Internet use. The Act aims to define guidelines for implementation of the Berne Convention over digital contents, and provides definitions for the scope of protection granted to digitized works, legal provisions against online and offline infringements of copyrights and exemptions for public use of digital contents (similar to Fair Use law). The DCMA has, to a large extent, shifted the locus of liability to copyright infringement from web-surfers and service providers towards online content providers, recognizing that the technology "*consistent with generally accepted industry standard communications protocols*" may lead users and communication operators to an inattentive copyright violation (DCMA, section 202). The DCMA does not explicitly contradict the *MAI* precedent, and yet attempts to limit the scope of liability that web-caching activities hold. However, according to the DCMA, the liability of the parties taking part in copyright infringement should be tested on a "*case by case*" basis, due to the technical complexity of the medium and vast range of possible scenarios (US Copyright Office, 1998).

In frame relay technology an Internet document is divided into small data packets which are continuously transmitted to the desktop, stored, united and displayed by the browser. Two questions arise from the use of frame technology: First, would a packet constitute a substantial part of a copyrighted content and thus enjoy intellectual property protection, and second, is temporary storage of copyrighted material for frame retrieval considered to be violating copyright law (Cavazos and Miles, 1997). These problems, however, have not been discussed further, as other recent issues, like hyperlinking, seem to dominate both lawsuits and public debate.

Technological advances, coupled with digital content, create legal issues stemming from the peculiar architecture of the Internet, and from the fact that it is a medium of very high connectivity between original information items stored in websites of their creators, and commercial content providers. The latter can, as part of their services, point clients to other commercial and private sites. Technologies, such as caching and framing, that were applied to improve the user-friendliness of the browser interface and the rapidity of web-surfing, are now found to be legal drawbacks in daily use of the Internet.

3.4.2. Hyperlinks to News Sites: The US, UK and Dutch Cases Compared

Hyperlinks are the pillars underpinning the World Wide Web architecture and the basis of interconnectivity between related websites or among webpage contents. Every element of a web document (e.g. a picture, video file, a sentence or even a single word) can be virtually linked to other webpages. By defining a link to another web address over a web element, web designers articulate a reference point that leads the user to other web documents by a single click. Hence, major issues in copyright management and enforcement have appeared, as access to protected content is easily available by hyperlinks from unrelated websites

Since the beginning of commercialization of the Internet, websites that are based on linking to external sites without development of original contents, have evolved. Search engines are an example of an activity which generates profits through integrated advertising, but which points "clients" to external contents using hyperlinks.

In order to understand the issues that are reviewed in this section, let us first define possible connection forms between web documents. Hyperlinks can be either *homepage links* or *deep links*. As a user clicks on an object having a homepage link, the browser refers to a web address of the main screen of a website (such as a newspaper) and uploads its contents. Deep links, however, represent a certain content within a website, (a particular news story) and not necessarily the main screen or introductory webpage. To emphasize, contents of a website are available for viewing without approaching them through the homepage.[49]

Various websites offer hyperlinks to news agencies and newspapers, collected and classified in a single webpage designed for friendly use. However, lawsuits submitted by owners of national and international magazines attempt to establish copyright law as a means to protect the contents and to prevent unauthorized linking to their websites and, in particular, deep linking which would directly present news stories and articles on the webpages of other firms, making a profit by providing this service. The problem of *headline citation* appeared as referring websites (news portals) quoted parts of news stories (without stating explicitly where the news stories originated) and presented the information on their webpage, with links to the original items. Were the rights of news providers violated?

According to WIPO's Berne Convention, "*the protection of this Convention shall not apply to news of the day or to miscellaneous facts having the character of mere items of press information*" (Article 2, 8) (WIPO, 1998).

In the UK case of *Shetland Times vs. Wills*, the plaintiff operated a website which included news items and advertisements in order to generate revenues. The defendant operated a website which was based on direct links to Shetland's contents, bypassing the homepage. Moreover, Wills copied headlines from Shetland's news and used them as objects for linking. The Court accepted in an interim interdict arguments of copyright infringement, likening access to website

[49] Nevertheless, access to internal contents in a website can be restricted by technical means, such as passwords or a required route of access that includes the homepage.

contents to transmission of cable programs. However, the issue of headline citation has not yet been settled in the UK due to a licensing agreement that the parties have reached (Morrison, op. cit.).

The US case of *Washington Post vs. Total News* (US District Court, 1997) demonstrates the vulnerability of profit-making operations on the Internet to economic *free-riding*. The defendant, *Total News*, operated a website which included hyperlinks to over 1,000 websites of newspapers, magazines and news organizations (such as: *Fortune*, *Reuters* and *CNN*), using their logos as links. As users connected to external websites via *Total News*, a frame that included contents of linked webpages was opened. It displayed web documents under a frame of *Total News*, and applied technical means to prevent advertisements from being presented. The US Court found that *Total News* violated copyrights by reliance on trademarks, fame and news stories of leading news agencies and firms. *Total News* used "masking" technology, which is based on framing. By masking, links that accessed an external website (e.g. *cnn.com*) presented the contents of news stories under the logo of *Total News* and with advertisements that were purchased from *Total News*, instead of those that were originally published in the *CNN* website. As mentioned in the complaint, the total value of advertising on the Internet was estimated at $150 million. Therefore, a scenario as appeared in *Washington Post vs. Total News* may serve as a case study for the risks that content providers face by new forms of "*cyber-piracy*" over the Internet. Interestingly, as observers anxiously waited for a statutory precedent in *Total*, the parties reached an agreement before jurisdiction began.[50] Framing in *Total News*' website still exists but is not used when *Total News* accesses contents from the plaintiffs' websites. Instead, as agreed in the settlement, direct links to the plaintiffs' websites are used (Kuester and Nieves, 1998; Morrison, op. cit.).[51]

According to the Dutch law adapting the Copyright Act (1912) to the Paris Act of the Berne Convention:

> "*It shall not be deemed an infringement of copyright to reproduce news reports, miscellaneous reports, or articles concerning current economic, political or religious topics, that have appeared in a daily or weekly newspaper or weekly or other periodical, or works of the same nature that have been broadcast by radio or television or have been transmitted by cable by a cable broadcasting organization within the meaning of the 1904 Telegraph and Telephone Law*" (Article 1, B).

In *Algemeen Dagblad and others vs. Eureka Internetdiensten* (Sep. 2000) a similar issue of an Internet provider ("*Eureka*") that presented deep links to news items in news organizations' websites was examined. Six Dutch national newspapers operated websites that included a list of headlines and links to news stories, articles and reports, similar to those published in their hard copies. *Eureka* cited in its website news headlines, as appeared in the original sites of the newspapers. Clicking the text, the browser would upload the webpage with the full story from a newspaper's website. The newspapers argued for copyright infringements by *Eureka* following from deep linking to a chosen content within their websites and by an unauthorized citation of headlines. In its judgement, the Court determined that a use of hyperlinks, and moreover – deep

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[50] The complaint (97 Civ. 1190 PKL) is available in: http://zeus.bna.com/e-law/docs/total.html. A full manuscript of the agreement is available in: http://www.bna.com/e-law/cases/totalset.html.

[51] Quite naturally, the plaintiffs (*The Washington Post*) would be happy that *Total News* is free-riding on rival news organizations (e.g. *The San Jose Mercury*), provided that the activity does not impinge on the profits of the plaintiffs. Clearly, this sort of *out-of-court* settlement, if preventing Courts from ruling on this issue, creates a situation in which, because the lack of statutory means makes legal action extremely expensive. Therefore, firms with pockets deep enough to threaten legal action against piracy have yet another competitive tool to use against their competitors. The need for clarification of the legal issues here is obvious not only to prevent piracy, but also to level the legislative "rules of the game" over Internet contents, when piracy is a technical possibility.

linking, cannot be regarded as copyright violations and the newspapers had not suffered any damages. Technical means that prohibit accessibility to the contents were not applied in any website and profits from advertising were not harmed as the newspapers accepted decisions about placement of advertisements within the websites, embedded in certain webpages. The precedent clearly defines wide allowances for linking to contents that exist in unrelated websites **in the Netherlands**. Further, and different from the agreements that were reached in the US and in the UK, linkage to news webpages, including headline citation, is permitted by the Dutch Copyright Act.[52]

To conclude, the Dutch jurisdiction can be regarded as the most recent statute in regulating issues of hyperlinks to journalistic sites and copyrighted contents. As present legislation of copyrights over the Internet is still in its infancy worldwide, the *Eureka* verdict introduced a clear and relatively permissive measure for use of the technological capabilities of the Internet.

3.5. Aspects of Information Ownership and Legislation Issues in Database Protection

The database industry is currently growing very rapidly. There has been a dramatic increase in the numbers of digitized records and databases world-wide, and a consequent increase in the use of online and CD-ROM-based information retrieval technologies. As Figure 3.8 shows, the number of databases in the US increased by a factor of 19 between 1979 and 1997, and the number of stored records was multiplied by 72. During this period, database producers grew from 221 to 2312. A similar growth occurred in Europe in the 1990s. In financial terms, the turnover of the industry increased from 3.1 billion ECU in 1990 to 62.3 billion ECU in 1997.[53]

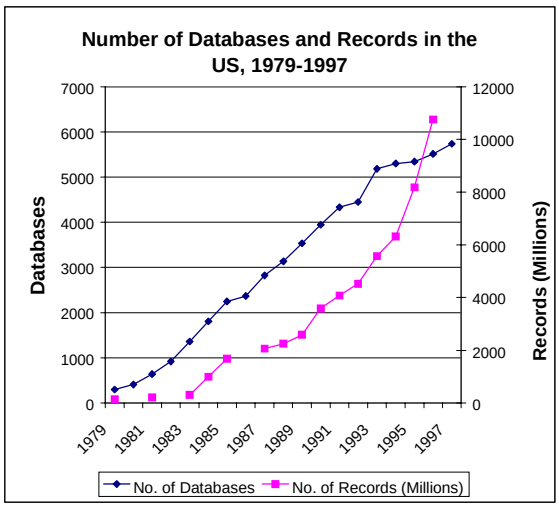

Figure 3.8: Number of databases and digitally stored records in the US, 1979-1997.
Source: Williams (1997).

[52] Court permitted allowances for headline citation as long as titles are listed as news surveys.
[53] The estimations are based on EC COM (93)-156, which defined the guidelines of the EC's IMPACT programme, and on OECD (2000). However, part of the growth can be explained by a rapid growth of Internet databases and their inclusion in the valuations of the OECD.

Before the 1980s, information goods were generally perceived as public domain, freely disclosed for public use. Since then, however, commercialized information commodities have dominated major parts of the consumption and media markets. Quite naturally, as these databases have become commercialized and a source of profits, issues of appropriation have emerged. Other related issues arose from substantial differences between the important US rulings and EU legislation.

Background

A common approach to intellectual property rights and databases distinguishes between contents (such as files, literary art and facts) and the organization, structure and processes embedded in a database (such as access to records, indices and related database management activities and applications). The method of database organization, including structure and processes, is patentable, but the protection of content as intellectual property is still under debate. Whereas artistic works stored in computer databases continue to enjoy IPR protection in their digitized form, facts and information items that have not involved creative effort in their collection are rarely protected by copyrights. Therefore, the accepted international statutory guidelines roughly divide the elements of corporate databases into four types according to the legal means provided for intellectual property protection:

The method for organization of data, facts, items and works is patent-protected. This category includes algorithms for search, indexing and catalogue methods.

Contents of the database, which demonstrate a measure of originality and intellectual product, are protected by copyrights according to the Berne Convention and its derivatives in the EU and the US. Poems and paintings digitally stored in a database serve as examples for this category.

In most member countries of the Berne Convention, elements of contents are not copyrightable if no intellectual effort was involved in their formation (e.g. personal records and news facts). Those database records are protected by a *sui-generis* law in the EU Member States since the approval of the Database Directive by the European Parliament.

Collections and anthologies stored in a digital form in databases are not protected by copyrights, as their contents are copyrighted by themselves. Collections in a database format have become legally protected only after the acceptance of the Directive by the EU Council.

Accessibility of information can potentially foster innovative activities and open new trajectories for research and education. However, the ability of research institutes to connect to databases has gradually become limited as intellectual property rights have become stronger and as databases formerly operated by governmental organizations have been out-sourced and commercialized, with a concomitant increase in licensing and access fees.

This section compares the emerging legislation, legalization and rulings in the US and the EU and their influences on the development of information industries. Related issues, which appear in the international trade arena, as the US and the EU regimes differ, are presented. The section also reviews the consequences for technological development and innovation, scientific research and education of recent policies for IPRs.

3.5.1. Legalizing the Content: US Database Protection after *Feist*

Global information markets are dominated by US producers and publishers of databases. The US industry in 1997 was estimated at 82.4 billion dollars - 29% of the total electronic processing market in OECD countries. To compare, the EU share of the market was 19% (53.4 billion dollars) (OECD, 2000).

Database protection in the US is regulated by the Copyright Act, which defines databases as *compilations* – works, which are an artefact of data collection and its organization, "selected, co-ordinated and arranged in an original way". Copyright protection is granted for the author's lifetime plus seventy years.

However, the interpretation of law by jurisdiction has been relatively subtle. In 1991, the US Supreme Court defined guidelines for protection of database *contents* in the *Feist vs. Rural Telephone Service* ruling. The defendant's actions, copying database records that contained telephones and addresses (similar to the *White Pages*) were found to be legally acceptable, thus **copyright law was not infringed**. According to the verdict, facts "do not become original through association [with each other]", as well, "constitutional mandate [is granted by the Copyright Act] to reward the fruits of the creative process and not the labour involved in the process itself". [54]

Court's decision *in re Feist* is important in two dimensions. First, the verdict clearly defines the necessity of "a minimal degree of creativity" to be involved in the production of a database in order to provide copyright protection to its contents. However, factual databases do not enjoy copyright provisions, as digitization of facts is not a creative activity by itself, and does not differ from other forms of factual collections. As Justice O'Connor argued *in re Feist*: "*Common sense tells us that 100 uncopyrightable facts do not magically change their status when gathered together in one place*" (Section II-A). Second, prior to the verdict, factual contents of databases had, to some extent, an ambiguous status of partially protected information, and thus were open to the legal risks of lawsuits and remedies against unauthorized compilation. The precedent clearly reduced the level of protection that database contents enjoyed, by excluding compilation of factual databases from the wrongful acts.

The *Feist* ruling has created geographical issues in database production and use. European producers of databases may have a competitive advantage over their American rivals since the ruling curtails the protection granted to database producers in the US. Similarly, users of American data (as opposed to European data) gained an advantage due to their easier access as data derived from US sources became available at no cost. Additionally, though, the ruling governed database **use** in the US, regardless of the source of the data, which would include data produced in Europe, or by European firms and distributed in the American market. Hence, European information producers and database publishers were confronted by commercial threats and by a competitive advantage of the American information industry in the US.

Because of the apparent weakening of property rights with the *Feist* ruling, the US Department of Commerce predicted a decline in the pace of developments in the US information industry. Moreover, the suggestion for an EU Database Directive, first raised in 1991[55] and approved by the European Parliament in 1996, seemed likely to give European firms an

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[54] Justice O'Connor explained Court's decision in the body of the verdict: "Many compilations consist of nothing but raw data — i.e., wholly factual information not accompanied by any original written expression. On what basis may one claim a copyright in such a work? … The sine qua non of copyright is originality. To qualify for copyright protection, a work must be original to the author. Original, as the term is used in copyright, means only that the work was independently created by the author (as opposed to copied from other works), and that it possesses at least some minimal degree of creativity." (Section II-A).

[55] Implementation of the Database Directive was recommended by the EC's IMPACT research programme.

advantage through stronger proprietary rights over their databases. A possible exposure of data collections to unauthorized (though now legal) duplication and use was perceived by US policy-makers as a potential threat to the development of their information industry. Major actors in the area presented scenarios of a market failure and a slowdown in innovation in a wide variety of scientific and technological fields (US Dept. of Commerce, 1994).

Proposals for a *sui-generis* regime, specifically designed to protect the contents of databases and to preserve incentives for database production in the private sector were submitted to the Senate and to the Congress. The HR354 was offered as an initial policy paper for discussion, elaborating the consequences of the current legalization, and proposed measures both to safeguard the interests of the information industry and to obtain free flow of information. The Coalition of Commercial and Not-For-Profit Interests submitted a different proposal, elaborating mainly possibilities to preserve free information flow and to guarantee accessibility to databases in the short run. The Senate Discussion Draft is a version based on the HR354 proposal, but introduces different solutions and an alternative regime to the HR354. A comparison between the current regime for database protection and the proposals for change is shown in Table 3.2.

Several disadvantages and hazards may stem from adoption of any single proposal, since each proposal represents a different interest group. A future regime, if finally accepted by the US legislators, will more likely aim to harmonize the strengths that were built on the basis of the initial drafts, than to emphasize aspects of only one of the suggested regimes.

According to the principles of the HR354 proposal, rights for data ownership will be granted to database owners not only for existing shares of the market but also for markets that could be developed in the future on the basis of current databases. Thus, the HR354 may foster the emergence of a monopolistic market structure in which a sole database provider dominates actual market niches and future (potential) markets. Under the market rules that HR354 defines, new entrants may be pre-empted from both actual markets and future markets, as the development of new technologies on the basis of existing databases will become extremely restricted.

The standard of harm proposed by the Coalition may eliminate investments in data collection and organization, as database producers would not have protection against unauthorized reproduction. The Coalition's proposal attempts to preserve accessibility and free use of databases by non-profit organizations with significant needs for information and data processing, but would remove revenues for database producers in the long-run. Although the legal provisions can be perceived as means to obtain a free flow of information, the result may be achieved at the expense of poor quality of data sets, decline in variety of information sources and infrequent updating due to a lack of incentives to produce. The strict standard of harm offered by the Coalition would increase the price of database information, its data derivatives and complimentary services, since data owners are "penalized" by the possibility of free duplication. Consequently, we can expect increasing prices for information-related services, as downstream suppliers (providing derivatives of processed information based on crude databases) will raise price levels in order to maintain their profit margins. As a result, entry costs to the market will rise as well, creating a tendency for niche markets monopolized by single information providers. Thus the Coalition's proposal, originally aimed at assuring free flow of information, if implemented, may have very different effects in the long run.

The current IPR regime in the US, which is based on a single substantial ruling of Court (*Feist*, from 1991), grants narrow protection to database producers as factual contents were excluded from copyright protection in the US by this ruling. On this ground, we can expect that during the next years a transition in US legislation will take place towards a new regime for protection of database contents, as legislators will strive to preserve an essential balance between the interests of the industry, guaranteeing incentives for innovation and production of new data

sets, and the requirements of commercial and non-profit organizations to obtain free flows of information. Although it is possible that US legislation will continue to be constructed on the basis of the current regime and on the juridical rulings since the beginning of the 1990s, technological advances will call for advanced modifications in protection of the content during the next years. Moreover, the need to maintain an ongoing dominance of the US information industry in the global markets would possibly enforce US regulators to consider further changes in the legal structure of the US regime.

	IPR After *Feist*	**HR 354**	**Coalition Proposal**	**Senate Discussion Draft**
Standard of Harm	Extraction of one database out of the other with a minimal degree of creativity (duplication or derivation).	Actual or potential markets may be harmed by extraction of database.	Duplication and extraction are prohibited *only* when a competition with the original database may appear.	Actual markets may be harmed by extraction of database. Potential markets are not included in the standard of harm.
Scope of Protection	Collections of copyrighted works are included if creative effort was involved in their selection and arrangement.	Collections of copyrighted works are included.	Authorship works, which are already protected by copyrights, are excluded. Thus, anthologies, collections and journal databases are not protected by themselves.	Collections of copyrighted works are included.
Term of Protection	Copyrighted contents – author's lifetime + 70 years. Uncopyrightable contents are not protected.	15 years for uncopyrightable contents, renewed only for newly-added contents.	Unlimited term of protection for uncopyrightable contents (i.e. unlimited term of protection for databases).	15 years for uncopyrightable contents, renewed only for newly-added contents.
Exemptions for Non-Profit Research and Education	Database extraction is permitted by Fair Use Law. Equal access fees for commercial and non-profit users.	Database extraction is permitted if actual markets are not harmed. New developments on the basis of current databases are allowed.	Database extraction is permitted by Fair Use Law. Lower access fees are granted by law to non-profit organizations.	Database extraction is permitted if actual markets are not harmed. New developments on the basis of current databases are allowed.

Table 3.2: Comparison between the current database IPR and proposed regimes.
Based on: National Research Council (1999).

3.5.2. The EU Database Directive – Did Europe Adopt an Over-Protective Regime?

Rationale

Information production is perceived as a labour-intensive activity, employing various levels of human skills in surveys, in collection and aggregation of crude data, in typing into a database structure and in skillful analyses. Generation of a new database "from scratch" or creation of derivatives from existing databases often requires immense investments in information technology, in surveys and data procurement and in human capital.

Unlike the large investments necessary to formulate and to produce a database, the costs of copying, extracting and using databases in unauthorized manners are only minor. Moreover, as information is publicly disclosed to authorized users, possibilities for reproduction of accessible records and for creation of a new commercialized variant of information on the basis of an existing database can be achieved at small costs compared to the initial costs of the original database producer.[56]

Since contents that do not carry an innovative or a creative step would not qualify for copyright protection, European producers and database publishers became concerned about the vulnerability of data sets to free-riding by users and rivals, and by the possibility of unauthorized use of their (mostly factual) databases, simply because of a lack of legislation. As stated in the introductory part of the Directive:

> *"Whereas the making of databases requires the investment of considerable human, technical and financial resources while such databases can be copied or accessed at a fraction of the cost needed to design them independently… Whereas the unauthorized extraction and/or re-utilization of the contents of a database constitute acts which can have serious economic and technical consequences… Whereas such an investment in modern information storage and processing systems will not take place within the Community unless a stable and uniform legal protection regime is introduced for the protection of the rights of makers of databases".*

Background and Structure

The background work on the EU Directive for the Legal Protection of Databases formally started in the early 1990s, as a result of the EEC's IMPACT research program recommendations. Its original aims included legislation of a statutory policy for uncopyrightable contents of databases, as well as formulation of guidelines to harmonize the legislation of database IPRs in Member States. The Directive follows a legal model adopted from the Danish Copyright Act, which grants a term of ten years for protection of contents in printed and electronically stored databases. Unlike the Danish Act, the Directive included in its initial scope only information elements that are electronically stored (Rosler, 1995).

The first draft was submitted in 1992 (in: COM (92)24-FINAL-SYN393) and then underwent vast changes in response to the comments and present interests of European

[56] In order to avoid unauthorized and illegitimate use of databases, technical means to restrict accessibility to the contents and advanced methods of data encryption are employed in CD-ROM and online databases. The Digital Millennium Copyright Act, accepted in the US in 1998, supports anti-circumvention regulations that prohibit copyright infringements of technically-protected information by hacking techniques (Samuelson, 1999). In spite of the possibilities of protecting databases by technical means, legislation plays a major role in protection of the content.

information industrialists, scholars in Science and Technology and advocates of free information flow.[57] The final version of the EU Directive was approved in March 1996 (DIRECTIVE 96/6/EC).

One of the major issues in the discussion of the Directive's implementation was that several of its underlying principles stand in contradiction of the Berne Convention. The Berne Convention defines the following artefacts to be copyrightable: literary works, musical works, maps and technical drawings, photographic works, motion pictures and computer programs (WIPO, 1998). These types of creative works, stored in a database or a collection of digital media, continue to receive a similar coverage of legal protection in their digitized form. However, a collection of works *as a collection* differs fundamentally from the individual artistic artefacts which are collected. So the collection is an uncopyrightable entity in and of itself. Collected data sets are similarly treated by the Convention, which excludes facts and news items from its scope of protection (WIPO, 1998).

Notwithstanding the scholarly opinions objecting on *inter alia* the grounds of this contradiction (see for example: Reichman and Samuelson, 1997; Reichman and Uhlir, 1999), the EU Directive has adopted in its final version a *sui-generis* approach, to provide protection to database contents that are not copyrightable by the terms of the Berne Convention. To emphasize the issue of a *sui-generis* law, the EU Member States that fully accepted and signed the Berne Convention agreed to the establishment of a harmonized regime, which may not substantially differ from other legal regimes in **copyright legislation**. When the Directive was accepted, stating compulsory guidelines for legislation in the EU, a peculiar regime (different than the uniformity that the Berne Convention aspired to achieve) expanded the scope of protection for databases **in the EU**, in comparison to regimes in other member states of the Convention.

The Public Debate

The announcement of the new Directive initiated a public debate between academia and the business community in which several issues were expansively discussed: whether a new Directive was necessary; its potential influence on wide areas of information-dependent activities including scientific research; the pace of innovation in the information industry; the emerging phenomena of database extraction; and information piracy. Since EU and US regimes differ substantially, aspects of international information trade between the EU and the US were also part of the debate.

The Berne convention specifies a minimum term of the author's lifetime plus 50 years for copyright. Databases are granted fifteen years of protection under the Directive. Although the economics literature contains several models to measure the optimal duration (Palmer, 1986; Towse, 1997), the fifteen year term was haphazardly accepted, to some extent as a compromise between policy makers and the representatives of the European information industry. The evidence indicates that the average life span of commercial databases is three years. In this period, most of the returns on investment are received (Williams, 1997). Therefore, the following twelve years of protection that the Directive grants carry only a minor share of economic incentives for database producers. This implies that a monopoly is granted for a period much longer than is necessary to provide appropriate incentives to innovate. Even so, if "substantial" changes and investments are made in the database, a *new* term of protection of fifteen years will

[57] As Britain's market share in the electronic data processing market is 28.5% of the total share of EU Member States, British database producers held a dominant voice relative to representatives from other Member States in the initial discussions of the Directive and in further hearings. To compare: Germany's share of the market is 15.7%; Ireland's share is 14.7%; Netherlands holds only 6.4% of the market (OECD, 2000).

start. Thus, the EU Directive seems likely to be a highly over-protective regime, when considering the average life cycle of stored data.

The EU Directive grants legal protection only in countries that apply a similar *sui-generis* regime and thus US databases are excluded from the scope of protection in European markets. This provision raises significant issues that are strongly attached to the trade between the US and the EU. The EU Directive was accepted in contradiction of WIPO's aim of harmonizing national and regional IPR regimes and avoiding international legislation variations.[58] Furthermore, as EU information industries are underdeveloped in comparison to the US, a strong IPR regime would not necessarily serve the required purpose of development of information industries in the Inner Market.[59] Other institutional schemes, such as subsidies and tax incentives, would probably foster industrial evolution, whereas a protective EU regime might hinder this trend, as possibilities for mergers and co-operation with American affiliates have become more restricted due to differences in legislation (NRC, 1999).

The International Treadmill

While the EU has applied a more encompassing approach to the protection of databases by including uncopyrightable contents, the US has narrowed its scope of protection as a result of the *Feist* precedent in 1991 (Reichman and Samuelson, op. cit.). Since then the US industry has been pushing policy makers towards a re-examination of the regime, trying to create new legislation similar in scope to that of the EU Directive.

To a large extent, suggestions for a new legislative framework, submitted to the US Congress, have been influenced by the approval of the EU Database Directive by the European Parliament. Not only has the Directive presented a more restrictive approach by protecting uncopyrightable database contents by similar provisions to which original works entertain, but the Directive has also limited these to databases originating in countries with a similar *sui-generis* regime, thus excluding the US databases from coverage. As a result, US database producers are driving to establish a parallel law to protect their contents, as the present situation leaves part of the databases that were produced in the US with no protection, both in the US and the EU.

The legislative structures in the US and in the EU seem influenced by a mutual "ratchet effect", pushing legislation in each regime towards a more protective framework, because of more restrictive guidelines have been passed by the other jurisdiction. In this regard, the verdict in *Feist* was exceptional, as it lowered the standard of protection in the US law, creating imbalance with EU provisions (the EU Directive widens WIPO's scope of protection, which covers copyrighted contents alone). However, WIPO's aspiration for uniformity of national systems may foster the adoption principles of the EU Directive in the US regime, rather than appealing to the European Parliament to narrow the standard of protection of its Directive.

3.5.3. Towards Implementation of the Directive: The Dutch Case

The case of *Koninklijke Vermande B.V. vs. Bojkovski* (1998) may serve as a nice example to elaborate the consequences of the implementation of the EU Directive on the Member States, and in particular on the Netherlands.

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[58] Notice that it creates more rights, and that to get rid of them will now be quite difficult, given the ratchet effect referred to earlier.

[59] The strong database industry in the US was developed in the absence of such strong IPRs.

Since 1985 the *Vermande* Company has published collections of Dutch legislation in an edited format which includes summaries, footnotes and additional information, incorporated into the original texts. The legal manuscripts are collected from official, *public* sources, which are published by the Dutch government and by the European Community. A digital version of Vermande's publications appeared on a CD-ROM (the "VNW-CD") and was bundled with the hard copies under terms of a "shrink-wrap" license, by which "*unauthorized downloading or other kinds of copying [are] prohibited"*, at no additional purchasing costs.

Pavle Bojkovski, a student of law, copied from the CD-ROM sixty laws and regulations in their complete form (that is, including Vermande's annotations) and uploaded them to his Internet website. In January 1998, after Vermande's forewarning to remove both law contents and editorial commentaries from the website, Bojkovski deleted the Vermande annotations from the texts in his website, so that only original legislative manuscripts remained online.

In a lawsuit submitted to the District Court in den Hague in March 1998, Vermande claimed that its copyrights had been infringed by unauthorized copying of contents from the VNW-CD, and reproduction of *"unpersonal writings"* and editorial information uploaded to the Internet. According to Vermande, Bojkovski's duplication of contents as originally appeared in the VNW-CD were prohibited in light of the EU Directive, which was accepted in March 1996, and by terms of distribution that were attached to the CD-ROM. Moreover, Vermande claimed that even if its editorial commentaries had been removed, thus leaving only the original manuscripts in the website, Bojkovski's acts remained wrongful according to the guidelines of the new Directive that enjoin the duplication of digitally-stored content from its database.

The Dutch Court mentions in its verdict the necessity to adapt Dutch legislation to the guidelines presented in the EU Database Directive, as required since January 1998. However, as legislation had not yet been modified, Court's rulings had to be made on the basis of national laws and interpreted by Court in light of the instructions of the new Directive, if possible. The Court also recognized that efforts and investments involved in collection, editing and publication of legal texts from various sources of information justify a suitable protection from access to their database, even though its contents have been derived from the public domain.

However, pursuant to Article 11 of the Dutch Copyright Act, legal protection is not afforded to collections without a personal character (as in this case – laws). Such provisions to protect legal databases would have become possible, with respect to the definitions of the Directive, if its implementation had been settled prior to the lawsuit. Hence, Vermande's claims were denied by Court.

The Vermande ruling is crucial in two ways. First, it determined that national law takes precedence over the directive. The Court's rulings since January 1998 should follow the Directive's guidelines to the extent possible and with no contradiction to Dutch Law, until legal modifications in the national regime are approved by legislators. Second, and more important in a precedent-setting way was the fact that the Court provided an interpretation of the Directive. The mere activity of collecting public domain material, if costly, is sufficient to warrant protection for the product under the Directive.[60]

Indeed, the Vermande case implies an empowered protection for the content vis-à-vis the ongoing implementation of the Database Directive in the Member States. Following the principles of the Directive, the Dutch Court expressed a belief that appropriate protection should be guaranteed to non-original database contents that have incurred costs, in contrast to precedents established in the US Court (*in re Feist*).

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[60] Clearly more statutory means will have to be established, since on one interpretation of this ruling a newspaper counts as protectable under the Directive. This constitutes a severe departure from historical views of newspapers as intellectual property.

3.5.4. The Impact of the US legislation and the EU Directive on Science, Technology and Public Research

Scientific research relies heavily on data processing in order to test new relations between system variables and to generate new hypotheses on the basis of accumulated knowledge. It is indeed the heaviest user of databases (see Figure 3.9). New contributions are built on derivatives of data sets collected over time (see for example the growth of the *Genbank* database in Figure 3.10). Databases are therefore an extremely useful source, enabling researchers to enrich their activities by analysis of collected records from historical perspective and an empirical point of view. Meteorological data, as a common example, is freely accessible to earth scientists via the Internet. This permits them to use the large quantities of data needed to examine the complex theoretical framework used to understand the puzzles of the atmospheric system.

The establishment of the EU Database Directive was driven by interests of content producers and the database industry, attempting to guarantee protection for the fruits of their investments in data collection and production. Notwithstanding the original intentions, the implementation of the Directive may achieve the opposite result in the long run if it restricts scientific access to data, and thereby slows the production of scientific knowledge.

In addition to the new protective *modus operandi* offered to database producers, the principle of the "first buyer" should be reviewed. According to this principle, copyright protection allows reproduction of works originally purchased by public libraries and institutes ("*first buyers"*), by the public ("*second buyers"*) under the restrictions of Fair Use. Among the conditions are quotations in a scientific review, book lending in libraries and article photocopying for educational purposes. Currently, as publishers digitize contents of scientific and technical articles, libraries and research institutes prefer procurement of *database access* to the purchase of hardcopies. Hence, publishers may improve their profitability and legal protection by converting collections of works that are not covered by the Copyright Act into databases which are legally covered by the Directive and thus not subject to Fair Use exemptions. The common act of photocopying the bound copy of an article becomes impossible since that act was legal only under Fair Use exemptions. While acquiring scientific know-how only online (since the libraries and institutes no longer acquire the works but only access to them) the "first buyer" principle no longer applies, and a lack of accessibility to "database contents" which is now what articles will be, may nip in the bud research (and educational) activities.

As libraries shift to online access through publisher databases scientific journals become available only on line, removing distribution agencies from their traditional role. Because these databases now have strong IPR protection, alternative sources disappear. We will see an increasing dependence of research institutes and libraries on direct access from the publisher which creates for each journal a monopoly on the supply side. This problem is exacerbated by the fact that the Directive contains more restrictive Fair Use provisions, which makes it more difficult for researchers to access recent work.

Several problems in the Directive appear to have affected scientific and technological progress. First, a *sui-generis* approach, as has been implemented in the Directive, differs from traditional copyright regimes by including non-original artefacts in its scope of protection, thus excluding them from the public domain. The Directive has formulated a new IPR regime that grants rights for a long duration even if copyrighted works are merely collected and digitized.

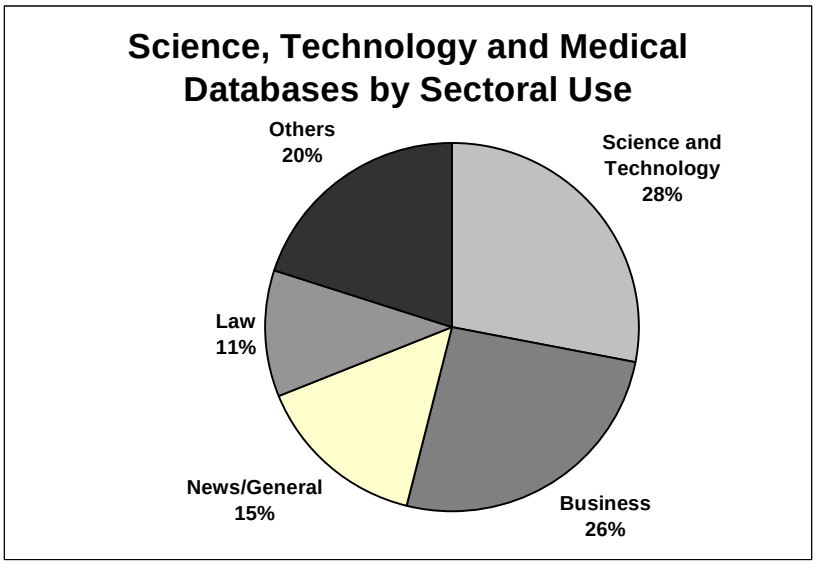

Figure 3.9: Shares in use of databases in categories of science, technology, health and engineering.
Source: Williams (1997).

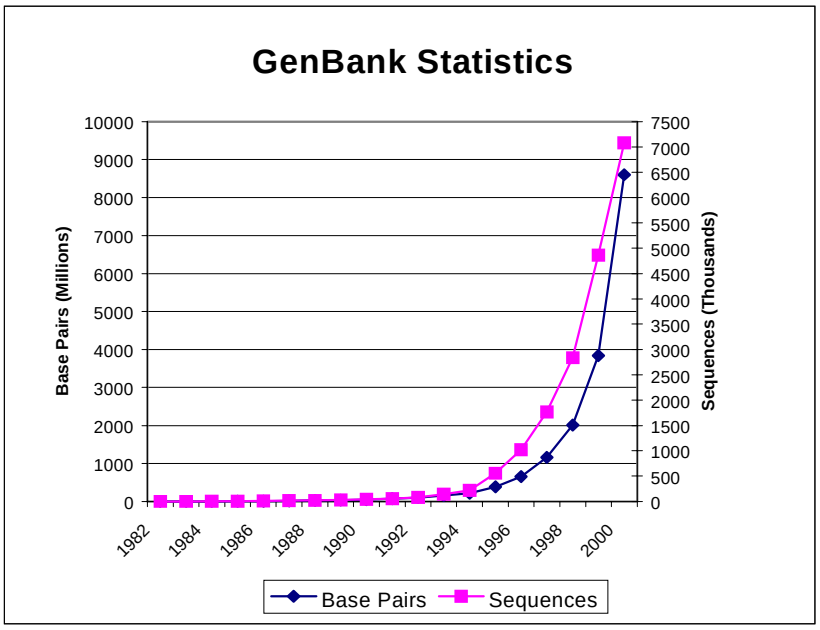

Figure 3.10: The Development of the GenBank Database, 1982-2000.
Source: GenBank – US National Center for Biotechnology (2000).

Second, the Directive narrows the distinction between original contents and material that is already in the public domain. The EU Directive grants ownership to collections of freely-distributed contents if database owners prove that investments and efforts have been involved to generate the final database. Moreover, if "substantial" investments are made in existing databases by the owners the term of protection would be extended by an additional fifteen years, implying an ongoing ownership of rights over information.

Third, as the integration of the content into external databases (e.g. scientific data sets) becomes restricted and dependent on licensing agreements, accessibility of information and its compilation become limited for long periods. Furthermore, exclusive rights enable unrestricted licensing of databases and do not create allowances for compulsory licensing for research and educational purposes. Hence, special databases, despite being regenerated from existing sources, form unregulated *niche-monopolies* over knowledge (Reichman and Uhlir, op. cit.). Previously, the academic community involved in basic, public research was able to access information through provisions like Fair Use exemptions for research activities and compulsory licensing. Although the EU Directive includes *sui-generis* exception for research and teaching activities, these provisions do not completely support free use of factual databases, potentially a detriment to basic research (NRC, 1997; David, 2000).

Most concerns of the academic and research community, as reviewed above, relate to the influence of the new Directive on the accessibility of databases, particularly as larger shares of the information market are digitally stored and become available only with online authorization. Moreover, as retrieval technologies enable the storage of new information forms (video, audio and electronic books), researchers in the EU and the US are equally threatened by recent legislation. However, to avoid vulnerability of scientific research and the "tragedy of knowledge commons" as a result of over-priced access fees for rent seeking and "over-fencing" of protective legal regimes, David (2000) suggests broad "Fair Use" exemptions in database use, or, alternatively, compulsory licensing for academic users at reduced costs. Despite being presented in the early stages of hearings in the Directive's legislation process, neither proposal was accepted by policy makers. It is time for European legislators to reconsider intellectual property rights and to design a regime which will assure continuous information flow throughout the economy among users, producers and owners of information, and prevent us from travelling the road to a monopoly over *the bits.*

4. Conclusions

IPRs constitute a long-existing and traditional doctrine, whose principles have been put under intensive examination since the beginning of the 1980s. Policy makers and legislators attempt to evaluate the appropriateness of regimes, in particular patents and copyrights, to guarantee both protection to the emerging technologies and proper innovative progress. In addition, industrialized countries aspire to coordinate their IPR regimes by international legislation (e.g. the Berne Convention, the TRIPs agreement) to achieve uniformity in methods and definitions of intellectual property, and to assure equal terms for competition in international trade.

These developments have led policy makers to open the *Pandora's-box* of patent and copyright legislation and attempt to adapt both regimes to the new *technological dynamics.* Attempts have further been made more urgent by the emergence of knowledge-based technologies and commercialization of information goods. Information goods and knowledge-based products, also known as the *New Economy* or the *Weightless Economy*, have articulated a new economic reality in which goods are produced at zero marginal costs and distributed to millions of users with no additional overhead.

Confronted by new technological paradigms, presented by intangible goods, IPR regimes (which originally meant to protect artistic endeavors and physical inventions) have failed to become legislative design that could both preserve incentives to innovate and restrict monopolies over infant technologies. Instead, guidelines for registration of patents and copyrights were expanded to protect the evolving technologies, and legislation was altered to meet only parts of

their needs. However, modifications in present regimes have been implemented only since the beginning of the 1980s, lagging behind legal and technological issues by a decade.

As a result, the new regimes created an overlap between copyrights and patents, granting inventors extended monopolistic dominance in wide fields of developing technologies. The alternative approach of *sui-generis* laws, which attempt to narrow legal gaps between definitions and methods (for example, the case of the EU Database Directive), articulate a more restrictive regime. As a consequence, accessibility of sources of scientific and technological information by public and non-profit institutes has become more limited and expensive. In most technologies, however, protective regimes of IPR have not managed to reduce scales of piracy and unauthorized use.

Inefficiencies have been exposed in the inability of current IPR regimes to apprehend adequately the new technological paradigms, and by a long duration between the introduction of technologies and policy changes. As a result, a series of new inefficiencies have appeared since the implementation of the new, inappropriate regimes. Further, as WIPO and the WTO have fostered the implication of harmonized outlines as a minimal standard for global-scale regimes, we see evidence of a "ratchet effect" in the adaptation of IPR to new technologies. The EU, lagging in implementation of legal means to protect emerging technologies after the US, has preferred to coordinate its policies by implementing the US guidelines and to strengthen its doctrine according to requirements of the Inner Market and the European industries. However, as US legislation is mostly based on previous paradigms, created for the development of traditional industries, the EU still has not approved any alternatives to the present legislation, but was maintained US policies in a rather restrictive manner. As a result, in the long run an over-protective regime may emerge leading to a monopolistic dominance of sole producers over a wide range of technological applications and niche technologies. We expect a formation of barriers to entry to stand in the way of new inventors and entrepreneurs, thus reducing the pace of innovation, in this market structure.

Nevertheless, policies of IPR have benefited from several sources over the years.

First, the ongoing debate about adaptability of IPR to emerging technologies for over two decades has formulated a wide body of economic, social and legal research. Thus, literature and academic works may assist policy-makers, in refining the current regimes to current, and recently-emerging technologies.

Second, lessons from the brief history of IPR and knowledge-based technologies make clear the necessity to monitor technological trends and diffusion of future technologies to the market. Appropriation of present regimes should therefore be assessed in conformity with the technological environment and the predicted trajectories of development. Indeed, experience has shown that, compared with the 1960s and the 1970s, time lags between the diffusion of new technologies and the adaptation of IPR have shortened.

Third, since the 1960s, we have witnessed how "**technology affects the concept**" of knowledge transfer, innovation and the protection of intellectual property. In many cases, IPR regime is determined by jurisdiction and not by well-organized processes of legislation. Judges do not have technological skills, and sometimes have to analogize state-of-the-art technology advances to outdated definitions of the law. Hence, involvement of technology experts in recent stages of adaptation of existing legislation, or formulation of *sui-generis* laws to address the problematic aspects in protecting certain technologies, will prevent reliance on single verdicts to regulate IPR in a wide variety of technologies.

Fourth, applied developments and inventions are generated in recently developed technologies mainly due to basic research and academic works. However, research activities also draw from related scientific sources and access to databases and data sets. Thus, determinants of

scientific and technological research are extremely vulnerable, and can easily be affected by changes in IPR policy. Hence, IPR policies should be examined in light of their influence on technical research and the academic milieu.

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