3

Globalization and the Economics of Intellectual Property Rights: Dancing the Dual Distortion

Human thought is astonishingly creative in finding solutions to applied technical and scientific problems, in communicating the existence and quality of products and persuading consumers to buy them, and in expressing images and ideas. These intellectual efforts create new technologies, products, and services, describe new ways of doing things, and expand the cultural richness of society. They result in intellectual assets, pieces of information that may have economic value if put into use in the marketplace. To the extent that their ownership is recognized, such assets are called intellectual property. The economic returns on them depend on the costs of their creation, their desirability to potential users, the structure of markets in which they are sold, and the legal rights that permit their owners to control their use. The legal devices that provide such control are called intellectual property rights.

Three distinct philosophies about the nature of intellectual property and its protection may be discerned from history:

- The *natural rights* view, stemming from some European traditions, assigns ownership of mental creations to their inventors under the precept that failure to do so constitutes theft of the fruits of their effort and inspiration. Moreover, creators should have the right to control any reworking of their ideas and expressions. This moral view of IPRs exists independently of any thoughts about the incentive effects or economic costs and benefits of regulation. This approach is evidenced today in strong protection for artists' moral rights in European law.
- In contrast, under what might be called the *public rights* view, it is inappropriate to assign private property rights in intellectual creations.

Information belongs in the public domain because free access to information is central to social cohesion and learning. This approach found its strongest application in socialist systems, which did not recognize the notion of private ownership of intellectual assets. The task of generating knowledge fell to the state; the fruits of its invention were provided widely to potential users (at least in principle). This precept still underlies conceptions of the nature of information in some developing countries.

- There is much room between these extreme positions for recognizing that IPRs may be assigned and regulated for purposes of social and economic policy. Most legal systems adopt a *utilitarian* view, in which IPRs strike a balance between needs for invention and creation, on the one hand, and needs for diffusion and access, on the other. Private property rights in information bear both benefits and costs, suggesting that they may be designed with incentives and trade-offs in mind. This is the point of departure taken by economic analysis of IPRs.

Economics of Intellectual Property Rights

Designing an effective and appropriate system of IPRs is complex for any country. The mechanisms by which IPRs operate vary across functional areas (patents, trademarks, copyrights, *sui generis* forms of protection, and rules against disclosure of trade secrets) and their importance differs across sectors. Indeed, as discussed below, the nature and purposes of these mechanisms are distinctive, although they share certain fundamental characteristics that bring them under the IPRs umbrella. The strength of IPRs depends on demand characteristics, market structure, and other forms of business and competition regulation. However, the essential economic processes may be described simply.

Static and Dynamic Failures in Markets for Information

Because intellectual property is based on information, it bears traits of a public good in two separate but important ways. First, it is *nonrivalrous*: one person's use of it does not diminish another's use. Consider a new means of production, a musical composition, a brand name, or a computer program. All may be used or enjoyed by multiple individuals. In this context, it is optimal in a static sense to permit wide access to intellectual property. Indeed, the public interest is extreme in that the marginal cost of providing another blueprint, diskette, or videotape to an additional user may be low or zero. Unlike the case of physical property, a multiplicity of users does not raise congestion costs in the exploitation of intellectual property.

The second characteristic is that intellectual property may be *non-excludable* through private means: it may not be possible to prevent others from using the information without authorization. If an intellectual effort is potentially valuable but easily copied or used by others, there will be free riding by second comers. In turn, there may be no incentive to incur the costs of creating intellectual property. Society has a dynamic interest in avoiding this outcome by providing defined property rights in information. In some cases private mechanisms, such as market lead times, difficulty in copying or imitating particular technologies, and marketing strategies, provide natural incentives to create and exploit information. Accordingly, the strength of this dynamic argument for protection depends on circumstances of market structure and technological complexity.

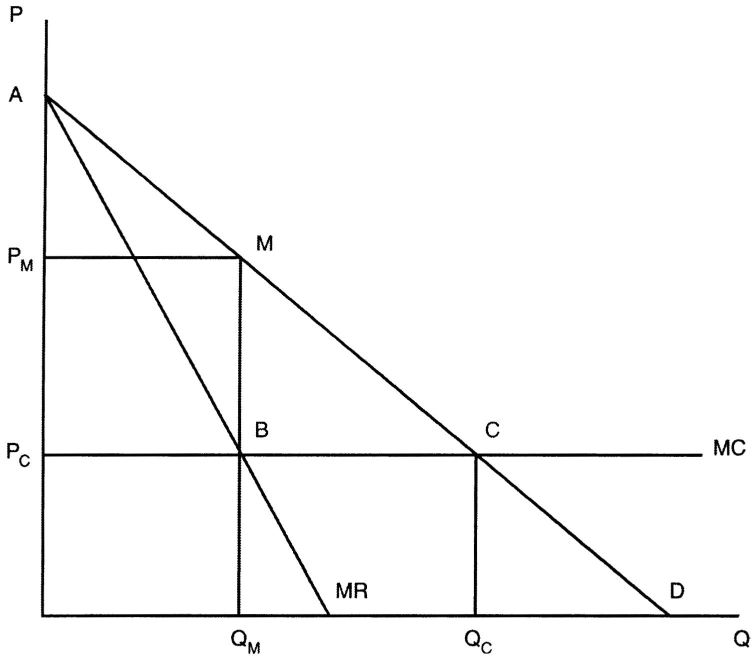
The fundamental trade-off in setting IPRs is inescapable. On the one hand, static efficiency requires wide access to users at marginal social cost, which may be quite low. On the other hand, dynamic efficiency requires incentives to invest in new information for which social value exceeds development costs. These are both legitimate public goals, yet there is a clear conflict between them.

Economists often state this problem by noting that IPRs operate on the mixture of these two market distortions. Excessively weak property rights satisfy the static goal but suffer the dynamic distortion of insufficient incentives to create intellectual property. There the economy suffers slower growth, more limited culture, and lower product quality. Excessively strong IPRs favor the dynamic goal but generate the static distortion of insufficient access. The economy suffers from inadequate dissemination of new information. A common alternative expression of this trade-off is that IPRs generate monopoly positions that reduce current consumer welfare in return for providing adequate payoffs to innovation, which then raises future consumer welfare.[1]

The basic trade-off is illustrated in figure 3.1, which demonstrates a linear demand and marginal revenue for a product that has been invented and may be supplied to the market at constant marginal cost. Once the product is available, ex-post optimality requires that it sell for marginal cost at point C, generating consumer benefits in the area AP_CC. However, the solution at C, which would emerge in a competitive market in which all firms could costlessly imitate the product and sell a close substitute, generates no rents with which to cover the costs of the

1. This description is most apt for patents, which support exclusivity over the use of an idea. Patents are the subject of the overwhelming majority of theoretical studies by economists. It is somewhat less apt for copyrights, which generate ownership of a particular expression, and trademarks, which protect the use of a distinctive mark or symbol.

Figure 3.1 Basic access innovation trade-off in IPRs



original research and development program. Therefore, there would be no such investment, the product would go undeveloped, and the entire consumer benefit area would disappear.

An alternative solution is to create a monopoly in the good through an intellectual property right, such as a patent. In this case the firm would offer the product at point M, earning monopoly rents of area P_MP_CBM. These rents, which represent a transfer from consumers to inventors, are the return on the original investment in product development. The economy suffers a deadweight loss of area MBC in comparison with the competitive (but unattainable) solution at point C. Compared to having no innovation, however, society achieves a net gain of the remaining consumer surplus plus monopoly profits, less associated R&D costs.

This simple theory shows the need for public intervention to stimulate invention in cases where ex-post competition would reduce market price to the competitive level and deter the ex-ante costly investment. In principle, society would provide support that is just sufficient to induce the introduction of all innovations for which optimal ex-post consumer surplus exceeds R&D costs. Because IPRs are incapable of operating so precisely, they are second-best remedies for the underlying market distortions. Protection might be too weak, resulting in forgone innovation, or too strong, generating surplus transfers to inventors and sacrificing available benefits from consumer access. Note also that a poorly struck bargain could slow economic growth to the extent that access to protected technologies is required to induce incremental innovations and artistic creation, which is how the bulk of innovation occurs.

Within this fundamental problem of dual distortions lie numerous economic issues of considerable concern. First, rights to own information impose other costs on society. For example, rent seeking for IPRs may be a serious problem because the property is being invented or discovered anew. There is no ownership until the right is created. Thus, a strong IPRs system may cause wasteful duplication of investment in R&D (that is, patent races) plus costly effort to assert ownership rights. Further, technical and judicial actions to enforce rights through excluding free riders may be costly. Finally, the costs of transferring rights to information can be high if there is uncertainty about the value of the information, about monitoring its use by those who buy or license it, or about other contracting costs. This problem leads to serious issues of antitrust policy in determining "fair" or "efficient" means of transferring intellectual property rights. These costs should be taken into account in assessing IPRs systems.

So also should external benefits that emerge from invention. The social value of information may be greater than the private market revenues it generates, because there may be market failures in creation of intellectual property. For example, the social value of an invention would exceed private revenues if there were positive consumption externalities, such as network effects from computer systems, software standards, or inoculations. Similarly, there is surplus social value whenever cost reductions spill over to other uses without market compensation. Examples here might include accounting systems and weather satellites. Note the implication that if such spillovers were easier under weak patents, an economy optimally could choose to provide limited protection. Risk aversion in undertaking high-cost R&D programs also could result in deficient private incentives to create the socially optimal amount of innovation, while such deficiencies would also sacrifice potential scale economies in research activities.

The main goal of an intellectual property system should be to create economic incentives that maximize the discounted present value of the difference between the social benefits and the social costs of information creation, including the costs of administering the system. The net effects of IPRs on social values versus private values are unclear. Much depends on demand parameters, the cost-reducing effects of process innovations, and market structures. The evidence suggests that there are large spillover gains from major inventions, while IPRs on smaller inventions generally do not create significant monopoly rents. Thus, there is likely a presumption in favor of strong IPRs in most societies on the grounds that private markets are inadequate to induce socially optimal information creation.

Setting an optimal policy for promoting invention and innovation requires accounting for numerous market characteristics in each product or artistic area. These characteristics include prospective demand and growth in demand, potential spillovers, the costs of R&D and duplicative races, potential impacts on market structure, and competitive aspects in the economy. Because many of these characteristics are highly uncertain at the time decisions on providing IPRs are made, finely tuned policies are probably unworkable. If it were possible to do so precisely, an economy could create a system of IPRs that would vary in the scope and length of protection with each potential new invention or creation. Further, there would be limits on protection due to the costs of providing and enforcing IPRs. But this task is not only impossible due to uncertainty, it is itself subject to severe government failure associated with poor choices and rent seeking.

An alternative policy regime would call for the government to retain a monopoly over technology and product creation, funding all development itself. It could then provide wide dissemination at low cost. As economists note, however, it is unlikely that governments would react efficiently to changing market preferences and technical information. Monopolized research in the former Soviet Union and China, for example, largely failed to produce technologies and products that could be moved into commercial streams.

Between these extremes countries might pursue systems that mix incentives for private information creation through IPRs with various public supports. In the United States, for example, research in the defense and aerospace industries is largely undertaken in or funded by public agencies. Large public research subventions are made to university researchers working on applied solutions that could find their way into private markets. Governments also subsidize artistic creation, libraries, and museums.

While the issue is complex, it is fair to say that provision of new goods and technologies through government procurement and nationalized research programs has not proven effective in stimulating and disseminating knowledge. Market-based approaches, in which governments set rules for protecting the fruits of invention but ensure competition in the creative stages, seem to be more flexible. IPRs are an obvious solution to this problem.

In setting rules governing IPRs, societies must strike a balance between the needs of inventors to control exploitation of their new information and the needs of users, including consumers and potential competitors working on follow-on inventions and innovations. Stated another way, the system should find an appropriate balance between creating and disseminating intellectual property. A system that creates innovations that are not put widely into use may be less beneficial than a regime that places less emphasis on creation but ensures broad dissemination of new ideas and creative works.[2] For instance, where many patents are never placed into commercial use because their holders do not see them as commercially viable, commercialization incentives are as important as incentives for creation.

In this context, the system should (1) allow market-based incentives for creation, (2) try to minimize the costs of innovative activity, and (3) provide for timely disclosure of innovation or creation and reasonable fair use with economic and social goals in mind. Moreover, it is important that IPRs interact coherently with other regulatory or economic systems, including antitrust policy, trade and FDI policies affecting the values of IPRs, and general technology development strategies. These last, which include industrial policies such as R&D subsidies, R&D joint ventures, and public grants to universities and agencies for basic R&D, are influenced by how IPRs are granted and protected.

Intellectual Property Rights in an Open Economy

The preceding captures the essence of the argument for intellectual property rights in a closed economy. The situation is more complicated in a world of many countries linked by trade and investment. The first difference is evident from figure 3.1. For a country that imports or produces an imitative product or technology at the competitive price, a decision to award protection transfers monopoly rents to foreign firms; the country thereby suffers a static loss of area $P_M P_C CM$ from the worsened terms of trade. It also reduces output by local firms that the rights holder has not authorized. If the country is too small for such a transfer to induce foreign firms to spend more on R&D of products that meet local demands, there is a straightforward loss in welfare. This simple observation underlies much of the resistance to stronger IPRs in many developing countries.

Technology-importing countries may prefer weak IPRs as a form of strategic trade policy. In addition to the discipline on monopoly pricing indicated in figure 3.1, weak patents, trade secrets, trademarks, and copyrights allow uncompensated imitation and copying of foreign products and technologies. Thus, limiting IPRs may provide inexpensive technology transfer, to the extent that imitative and adaptive capabilities are effective. International technology spillovers through uncompensated imitation have long been an important justification for refusing to grant patents (Vaitsos 1972).

Thus, countries that import goods and technologies that may be subject to IPRs coverage count several costs of protection, including higher prices for imports, potential competitive abuses in the exploitation of

2. Again, this is essentially a utilitarian statement. Different societies may value creation and novelty per se differently than they do social use and commonality.

IPRs, employment losses in imitative and copying industries, and restricted access to international technologies.

However, greater IPRs protection in developing countries does generate domestic benefits. One gain would be more domestic innovation, which would be better suited to local needs than foreign innovation. The prospects for such innovation depend, among other things, on local market size and domestic technological capacities. Benefits from trademarks seem particularly important, because product development reacts elastically to such protection in developing countries (Maskus 1997b). Further benefits stem from the fact that stronger IPRs expand incentives for trade and inward FDI and reduce the costs of writing and monitoring contracts for technology licenses.[3]

IPRs are national in scope, permitting considerable differences across nations in their protection regimes. International variations in IPRs have been the subject of trade conflict for a long time. For example, the US Copyright Act adopted by the first American Congress actively sought to encourage the development of the publishing industry by awarding rights to print, reprint, publish, and sell literary works only to domestic citizens and residents (Post 1998). Foreigners were not allowed to obtain copyrights and the law explicitly permitted parallel importation of works copyrighted abroad. In consequence, American publishers were able to publish and sell foreign literary creations cheaply; this attracted sharp criticism, especially from British authors.

Throughout several revisions of the law in the 19th century, discrimination against foreign authors and publishers remained central to US copyright law, as it did in many other major countries. Only with the passage of the International Copyright Act of 1891 did the US government recognize equal treatment for foreigners, and then only for countries offering reciprocal treatment to American authors. The change was made because of both pressures from foreign governments and, more importantly, growing interests on the part of US authors and publishers to receive protection abroad. Even so, the new law, which imposed discriminatory requirements on foreigners, remained explicitly protectionist.[4] Only with American accession to the Berne Convention in 1989 did all vestiges of discrimination in the publishing industry disappear.

The history of US copyright law demonstrates convincingly that countries that are substantial net importers of products and technologies that

3. These issues are discussed at length in chapter 4.

4. This law still imposed difficult formalities, such as requirements for copyright notice, registration, and deposit of works, with which foreign publishers found it difficult to comply. Moreover, it added the so-called "manufacturing clause," which mandated that, in order to receive copyright protection, any book or journal in the English language had to be printed from type set in the United States or Canada, and be printed and bound in the United States or Canada. The manufacturing clause, which was the subject of an adverse GATT ruling, remained a part of US law until 1986.

potentially are subject to IPRs protection consider weak protection to be a form of infant-industry support. To the extent that the losing interests from weak protection are foreign, they command little weight in the policy framework. The creation of indigenous firms that develop and produce items that require security from piracy has been the traditional spur toward stronger IPRs.

It is interesting to note one substantive potential difference between infant-industry trade protection and IPRs, however. Trade protection tends to create inefficient industries that block trade liberalization. Thus, to the degree that weak IPRs induce the development of innovative firms, they generate a future constituency for systemic reform.[5] Whether weak protection of intellectual property in fact has such an impact remains open for debate, as will be discussed later.

The copyright story also demonstrates that weak IPRs can be viewed as a means for achieving noneconomic objectives, such as the growth or maintenance of domestic cultural industries. The most prevalent of such objectives in the global economy is the preservation of public health through limiting the costs of procuring medicines simply by not patenting them. Thus, many developed nations, including Italy and Japan, did not provide patents for pharmaceutical products until the late 1970s; Canada only removed compulsory licensing of patented drugs in 1993.

Indeed, significant controversies persist over differences in IPRs among developed countries. For example, the United States remained dissatisfied with aspects of the Japanese patent system until its recent reform, claiming that it encouraged excessive filing of narrow patent claims and discouraged patenting by foreign firms. The US and the EU have moved toward patenting software with demonstrated industrial utility, but they differ considerably in their rules on acceptable decompilation of computer programs for purposes of reverse engineering. Negotiations continue over the scope of protection for geographic indications, with the US preferring less protective standards than the EU. Developed countries also differ markedly in their treatment of copyrights. In the world economy today, however, the largest differences in intellectual property protection occur along North-South lines. Information developers in the innovative countries of the North see several primary shortcomings in the regimes of many developing countries:

- Inadequate enforcement of copyrights and trademarks allows extensive copying of entertainment and software products and unauthorized use or misrepresentation of well-known trademarks.
- Pharmaceutical and chemical products have generally been excluded from patent protection.

5. I am grateful to Catherine Mann for this insight.

- The absence of patent protection for biotechnological inventions and patents or *sui generis* rights for plant varieties has been controversial.
- There is concern about the practice, albeit rare, of issuing compulsory licenses with inadequate compensation to firms that are perceived to be exercising their patent insufficiently to achieve desired consumer benefits or technology transfer.
- Also problematic is the often weak or poorly defined system of rules protecting trade secrets.

Structures and Objectives of IPRs

Despite the terminology related to figure 3.1, it is inaccurate to think of IPRs as mechanisms for creating monopolies. Intellectual property rights define the extent to which their owners may exclude others from activities that infringe or damage the property. Thus, IPRs set out and protect the boundaries of legal means of competition among firms seeking to exploit the value of creative assets. In principle, efforts to extend the rights beyond these boundaries are denied. In this context, it is more fruitful to conceive of IPRs as rules regulating the terms of static and dynamic competition, rather than mechanisms for creating legal monopolies. While IPRs do create market power, the impact on competition varies as widely across products, technologies, and countries as it does across the form of rights granted and the scope of protection. Indeed, the strength of the protection depends not only on the scope of the rights granted, but also on the ability of competitors to create non-infringing products and technologies and the ability of consumers to substitute among supply sources.

This section describes the general structure of various forms of IPRs, noting the different objectives they try to fulfill and the limitations placed on them to ensure their proper functioning.[6] While the focus is on the economics rather than the legal characteristics of IPRs, it is useful to introduce certain legal terms that come up throughout the volume. Table 3.1 lists each area of intellectual property and its main forms of protection.

Patents

A patent gives its owner the right to exclude all others from making, selling, importing, or using the product or process named in the patent without authorization for a fixed period of time. In principle, it is the

6. An excellent source on this material is Besen and Raskind (1991).

Table 3.1 Instruments and agreements for protecting IPRs

Types of intellectual property	Instruments of protection	Protected subject matter	Primary fields of application	International agreements
Industrial property	Patents and utility models	New, nonobvious inventions with industrial utility	Manufacturing, agriculture	Paris Convention Patent Cooperation Treaty Budapest Treaty Strasbourg Agreement TRIPs
	Industrial designs	Ornamental designs of products	Automobiles, apparel, construction tiles, others	Hague Agreement Locarno Agreement TRIPs
	Trademarks	Identifying signs and symbols	All industries	Madrid Agreement Nice Agreement Vienna Agreement
	Geographical indications	Identifying place names	Wines, spirits	Lisbon Agreement TRIPs
Artistic and literary property	Copyrights and neighboring rights	Original expressions of authorship	Publishing, electronic entertainment, software, broadcasting	Berne Convention Rome Convention Geneva Convention Brussels Convention WIPO Copyright Treaty WIPO Performances and Phonograms Treaty Universal Copyright Convention TRIPs

(*table continued next page*)

Table 3.1 Instruments and agreements for protecting IPRs (*continued*)

Types of intellectual property	Instruments of protection	Protected subject matter	Primary fields of application	International agreements
Sui generis protection	Integrated circuits	Original designs	Computer chip industry	Washington Treaty TRIPs
	Database protection	Databases	Information processing	EC Directive 96/9/EC
	Plant breeders' rights	New, stable, distinct varieties	Agriculture, food	UPOV TRIPs
Trade secrets	Laws against unfair competition	Business information held in secret	All industries	TRIPs

Source: Adapted from Primo Braga, Fink, and Sepulveda (2000).

most powerful instrument in the IPRs system because it provides exclusive rights to the physical representation—in the forms of goods, blueprints, formulas, and designs—of ideas with industrial applicability. Because they protect technologies and products to which follower countries wish to have access, patents are also among the most controversial forms of IPRs.[7] This is particularly true in sectors where the public interest may call for wide dissemination at moderate prices.

Legal and Economic Principles

Patents may be awarded in any area of technology to any new and useful process, product, composition of matter, or, in the United States, ornamental design of a product. However, some subject matter may be excluded from patentability in order to preserve morality, national security, or public health. In most systems patents also are not awarded for fundamental scientific discoveries flowing from the basic physical laws of nature, including mathematical algorithms. Under the nearly universal "first-to-file" rule, patents are granted to the applicants who first submit the appropriate documents. The United States is an exception, awarding patents to inventors who can document that they were the first to invent the product or technology (a "first-to-invent" rule).

To be patentable, an invention must meet three criteria: (1) it must be novel (that is, previously unknown), (2) it must contain an inventive step (that is, a step that is nonobvious to one skilled in the area of technology it represents), and (3) it must be useful or have industrial applicability. Novelty and nonobviousness are important, for they set the technical bar that patent examiners must certify has been met before protection can be awarded.

In general, an inventor may apply for one of three types of patents, though not all countries recognize all three forms:

1. *Invention patents* (or simply patents) require significant nonobviousness, meaning that they embody discrete advances in technology. They receive the longest term of protection, with the global standard under the TRIPs agreement being 20 years.
2. *Utility models* are awarded to mechanical inventions with less stringent nonobviousness standards. These inventions, which tend to be incremental improvements in existing products and technologies, embody less technological progress and receive shorter protection.
3. *Industrial designs* protect the aesthetic or ornamental aspects, such as shape, pattern, or color, of a useful commercial article. The design

7. Others are copyrights for software and electronic databases.

must be associated with the industrial article itself. TRIPs requires that designs be protected from unauthorized copying or imitation for a minimum period of 10 years.

Inventors make claims about the protectable novelty of their inventions but examiners may narrow the claim or reject it. Patent *breadth* refers to the precise claims that make up the protected subject matter. It is a technical matter; examiners do not try to consider economic efficiency in patent grants. Patent *scope* refers to the effective coverage awarded by the patent and associated instruments. For example, coverage may be complemented by a legal "doctrine of equivalents." This doctrine permits patent owners to litigate against competing products and technologies shown to rely on techniques that are essentially equivalent to those in the patent grant. The power of the doctrine may depend on national legislation.

In economic terms, whether a patent should cover narrow claims over a long life or broad claims for a short time depends on expected market competition and the likelihood of spillover effects (Klemperer 1990). These considerations argue for structuring patents to meet the specific conditions of each application, which is impractical. Some economists mention also the height of patent protection, which refers to the power of a particular grant to permit its recipient to limit or control development of follow-on technologies.

Four arguments may be put forward to justify the award of market power through patent grants:[8]

First, patents provide an incentive to take on the research effort and the costs of inventing new technologies and products and bringing them to market. Thus, patents are a primary solution to the problem of ensuring that inventors may appropriate the returns to R&D in the area of industrial invention and innovation. Note that the incentives must be sufficient not only to induce invention but also to encourage commercialization. A patent that is not "worked" through production or sales, even if it were commercially viable to do so, locks up an area of technology with little gain to consumers. In consequence, some countries include working requirements, within particular time periods, for patent grants to be sustained.[9] An important variant of the commercialization-inducement theory of patents is that patents may reduce the transaction costs of licensing, resulting in broader sharing of new information.

A second argument is that patents serve to expand the public stock of technical knowledge. It has long been recognized that in return for

8. Mazzoleni and Nelson (1998) provide a trenchant analysis.

9. Note that domestic production requirements may be effectively equivalent to a trade restraint or an investment mandate, pointing out the intricate interplay between IPRs and commercial policy.

cre-ating market exclusivity through a patent, society requires compensation. For this reason, patents bear a disclosure requirement, in which the technical aspects of patents are made known and others are free to incorporate the information into new inventions that do not violate the patent claim. Note that the narrower the claim, the easier it is to invent around the patent. Similarly, the sooner the patent application is laid open for inspection by the public, the more rapidly the technical information it contains becomes known. In this sense, patents may be dynamically procompetitive even if they are statically anticompetitive. Indeed, advocates of strong patent rights believe that they create significant competition, with long-run consumer benefits.

A third justification is that the awarding of market power through patent grants may facilitate the establishment of markets for developing and disseminating knowledge.[10] Absent exclusive rights to new information, these markets themselves might fail to develop—an observation that is consistent with the practical situation in some developing countries, as I discuss later.

A final argument is that well-recognized patent claims encourage orderly follow-on innovation, much as do prospecting claims for mineral deposits.[11] In this view, ownership of a broad patent on an invention supports fruitful development of related innovation by the owner or its licensees. Without such rights, there may be wasteful duplication of R&D targeted to applications of the controlling technology. This justification for awarding monopoly rights on a technology that permits control of subsequent exploratory research is controversial, even within leading technological nations such as the United States.

Clearly, the market power associated with patents may impose social costs even as it encourages invention and commercialization. Accordingly, societies limit the power of patent grants. Not only are patents limited in duration and breadth, they also carry disclosure requirements and, in many nations, must be worked if protection is to be sustained. These limitations vary across countries and, as will be discussed in later chapters, may be selected to affect the competitive conditions associated with the patent regime. Moreover, the potential for abusing the market power inherent in patent grants is recognized in national competition policies. Attempts to extend protection beyond the patent grant are considered anticompetitive. They may be subject to antimonopoly remedies, including orders to cease the practice, compulsory licenses to competing firms of key products or technologies, and even patent revocation. Some examples of abuses include the horizontal restraints on trade associated with patent licensing, tied sales that extend the patent to an unpatented

10. See David (1993).

11. The "prospect theory" of patents is associated with Kitch (1977).

product, exclusive grant-back conditions in technology contracts, and conditions preventing challenges to patent validity. These are taken up further in chapter 7.

The Effectiveness of Patents

Many observers question whether strong patent systems are needed to achieve their stated goals. An obvious question is whether patents are necessary to stimulate investment in invention and commercialization. Competitive rivalry in technology development may spur invention naturally. Further, market and technical barriers to imitation may allow inventive firms to charge a price above current production costs long enough for them to recover investment costs and compensate for risks taken. Scherer (1980) notes some conditions under which this situation might prevail, including imitation lags due to secrecy, imperfect information transfer, and the complexity of successful imitation. Being first to market a new product may also confer an advantage by establishing a company's reputation for quality.

Thus, the ability of firms to appropriate the economic returns to invention and innovation depends on several characteristics, among them the degree of market imperfection, the technical ease of imitation, the pace of information diffusion and firms' abilities to control it, and market demand parameters. In cases where innovation and development would happen naturally, patent protection is redundant and potentially costly. In practice, however, it is difficult to identify such cases, since inventors generally do file for patents. It may not be possible to determine whether the promise of a patent was the stimulus to invention or whether registration is a means of establishing claims to an invention that would have emerged anyway.

There is suggestive evidence on some of these questions. In the United States, information about new products and processes becomes available to a firm's competitors (including foreign competitors) fairly rapidly, generally within one to two years (Mansfield 1985). The information is transferred through shifts of personnel, technical meetings, communication with suppliers and customers, reverse engineering, and the study of patent applications. Thus, the ability of firms to retain technological advantages in-house without protection is limited.

However, there is a big step from learning the information to imitating the new product or process. Imitation takes time and requires investment in R&D, marketing, production facilities, and start-up costs—and, if necessary, the need to invent around the original patent. In the United States, these costs can be substantial in many industries. In a sample of firms in four industries, average imitation costs totaled some 65 percent of innovation costs and imitation time equaled about 70 percent of innovation time (Mansfield, Schwartz, and Wagner 1981). These costs depended significantly on market structure. Further, except in the pharmaceuticals industry, patents had small impacts on imitation costs and patented innovations were relatively easily imitated, generally within four years of introduction.

Mansfield (1986) sampled 100 firms in 12 US manufacturing industries on their views of whether patents are important to their decisions about investment in innovation. His results suggested that only in the pharmaceutical and chemical industries were patents considered essential; here more than 30 percent of the inventions would not have been developed without potential protection. In these sectors, fixed costs of R&D are high and imitation is fairly easy. In three industries (petroleum, machinery, and fabricated metal products), patents were seen as important in the development of 10 to 20 percent of inventions; in the other seven industries, patents were viewed as unimportant or only marginally significant in inducing R&D. These results are consistent with those reported in Levin et al. (1987).[12]

That patents may not be considered important incentives for invention in US industry does not mean that firms decline to patent. In Mansfield's sample, a high percentage of patentable inventions were patented, ranging from 50 percent in the primary metals sector to 86 percent in the petroleum and machinery industries. The remaining inventions were protected, to the extent possible, with trade secrets and private actions. Thus the benefits of patent protection were seen as worth incurring its costs.

This evidence suggests that the elasticity of invention with respect to patents is rather small, except in certain industries. However, these surveys are rather dated. Newer technologies such as biotechnology and plant genetics find patent protection important. Moreover, inventor attitudes toward the importance of patents are surely endogenous to the strength of the system. At the international level, the general weakness of the global patent system and the ease of technological spillovers may have contributed to the view of patents as unimportant (Mansfield 1988). If so, stronger protection could alter this view and potentially increase inventive activity and economic growth. Further, any dynamic linkages or spillovers between product generations would be enhanced by stronger patent regimes, causing firms to view patents as more significant over time.

A second question is whether patents are the least-cost means of stimulating invention. Patents may be a crude means of compensating inventors, resulting in inadequate returns if protection is weak or excessive returns if protection is so strong as to transfer to inventors revenues above their investment. This latter outcome often happens, at times spectacularly (Scherer 1980). It is evident that the fixed-term patent structure is ill designed to effect optimal dynamic resource allocation. Cheung (1986) suggests that it is possible in principle to design lump-sum transfers from

12. Taylor and Silbertson (1973) present similar evidence for the United Kingdom.

consumers to inventors that could stimulate the same investments in innovation without suffering the price distortions of patent grants.

This argument is a variant of the case for using tax-cum-subsidy schemes rather than tariffs and quotas to promote certain social objectives—and from a practical standpoint it has the same shortcomings, chiefly the difficulty of making such transfers efficiently and political resistance to cash transfers. Further, it would be practically impossible to compute the required surplus transfer ex ante, given the uncertain nature of technology development. The third alternative of government provision of R&D is, as noted earlier, also unwieldy and ineffective. Thus, for all its imperfections the patent system is probably the most efficient system for promoting inventive efforts, though this hypothesis cannot be tested.

There is little systematic evidence that patent disclosure enhances the dissemination of technical information, though Mansfield mentions the importance of this requirement in his 1986 survey. The more significant factor is that the patent system may provide the necessary incentive for firms to undertake the risky, long-term R&D that leads to major technological breakthroughs, such as copying technologies, computers, and semiconductors (Scherer 1980). Around these inventions grow whole industries that use their technologies, improve on them, or develop residual applications. The social gains to large technological advances can far exceed private returns because their associated spillover benefits have a substantial positive impact on growth, a point on which there is virtually no doubt (Bresnahan 1986). While there is little empirical evidence on the role of patents in this process, largely due to the difficulty of constructing counterfactual cases to study, practitioners suggest that patent protection plays an important role.

Copyrights

Copyrights protect the rights of creators of literary and artistic works to communicate, display, or perform those works in some medium, plus the rights to make and sell copies. Copyright laws protect the expression of an idea—its arrangement and presentation in words, musical notes, dance steps, colors, and so on—rather than the idea itself. By tradition, literary and artistic ideas are without industrial applicability, which renders them different from patentable inventions, though this distinction has been blurred by recent technological developments, as will be discussed later. Thus, the idea to render a painting of a mountain cannot be protected from others who also wish to paint it. But the particular rendition by one artist is protected from being copied, either literally or so closely as to constitute "slavish copying."

To receive a copyright, the item must be a demonstrably original work, but there is no need for novelty in the underlying idea. The particular expression must be fixed in a medium, such as a book, recording, electronic broadcast, software, or even electronic mail. It is generally not necessary to undergo registration formalities to receive a copyright because any original expression is protectable upon creation regardless of its inherent quality. Rather, it is sufficient to establish the date on which the work was created. Formal registration, however, may be of material assistance in defending the copyright.

Copyrighted works are protected from unauthorized copying for long periods, typically the lifetime of the creator plus 50 to 70 years (50 years for corporate copyrights). The longer period compensates for the lower monopoly power of copyrights compared to patents. Copyrights cannot be renewed. When they expire, the works enter the public domain for free use.

A copyright confers the rights to prevent unauthorized duplication, performance, recording, broadcast, translation, or adaptation of a work. Further, the Berne Convention requires member countries to provide "moral rights" or "authors' rights," by which the creator may prevent any prejudicial modification of her work even after she has sold its economic rights. Further, most countries provide "neighboring rights," which protect the rights of those who disseminate an author's work, such as performers, phonogram producers, and broadcasters, to prevent unauthorized duplication of their efforts. Copyright laws also typically extend rights to authors to control the development and use of derivative products, such as the affixation of literary characters on clothing.

The main exceptions to copyright protection come under the "fair-use doctrine," the terms of which vary from country to country. Under this doctrine, countries define activities that can make use of protected works in the interests of educational, scientific, and technical advance. Thus, limited uncompensated quotation of a work is allowed, subject to appropriate citation, as is the making of a limited number of copies for educational and research purposes.

More controversial is the treatment of decompilation of computer programs for purposes of developing competing applications. In the United States, for example, many software developers consider this form of reverse engineering to be free riding that injures their investment in program development.

The fundamental objectives of copyrights in literary and artistic property are like those in patents for industrial property: creative works provide social, cultural, and economic benefits that society wishes to secure. These works involve investment costs, including training, time, materials, technology acquisition, and the like. Moreover, marketing copyrighted products requires costly investment that is more readily recouped given the greater certainty provided by protection. If other members of society were allowed to free ride on works without compensating their creators, the incentives to create would be severely dampened. Static economic efficiency might be achieved, but at the cost of lower growth in cultural identity and reduced investment in "industrially useful" expressions such as software. At the same time, providing exclusive rights limits the dissemination of literary works and raises the static costs of education, research, and entertainment. The copyright system reflects a compromise between these difficulties, attempting to balance the needs of creators with society's interests in wide access to their creations.

There may be natural market mechanisms that would provide adequate remuneration to creators in the absence of copyrights. Examples include subject matter that is relatively inaccessible, the advantages of being first to market the creation, embedded devices that defeat copying of electronic products, and demand characteristics. However, most cultural creations are not naturally protected because second comers may appropriate their value through low-cost duplication and distribution, with little or no investment in mastering the underlying creative effort. Indeed, free-riding competitors would focus their efforts on those creations that had proved successful in the marketplace, relieving them of any uncertainty costs and allowing them to take advantage of the marketing efforts of creators. The returns to original developers would be significantly reduced.

The rapid and dramatic improvements in copying technologies that have emerged in recent decades underlie growing demands for stronger global protection, as well as extension of protection to subject areas such as software, internet transmissions, and broadcasts. These issues are complex and subtle. For example, the technologies required to receive a satellite broadcast have become sufficiently inexpensive that it is costly for the broadcaster to practice exclusion. Some who receive the broadcast without authorization may then benefit commercially by displaying it to paying patrons or by retransmitting it over local cable systems. Such actions reduce the value of both the copyright owned by the program's producer and the neighboring right owned by its broadcaster, resulting in lower appropriability.

The private solution, in which broadcasters scramble their signals to make them unintelligible to all but authorized receptors, may be socially inefficient. It achieves exclusion at the sacrifice of consumer benefits, but the cost to the broadcaster (or its consumers) may approximate the original loss in copyright value, leaving a net potential loss. The United States has effected a compromise solution, in which broadcasters get limited copyright protection plus remuneration from cable operators at a price set by the government, effectively giving cable operators a compulsory license to carry the broadcast. This solution may also be suboptimal, because compulsory licenses imply involuntary transactions by the broadcaster that may stifle further program development.

Related questions surface with respect to electronic transmission of databases and other proprietary information among computers. Again, exclusion, though feasible, is costly, particularly when transmission is over networks with multiple users. To encourage their development and sale, databases may be copyrighted in some nations, while laws covering trade secrets may help protect proprietary information. However, when such information is transmitted, the difficulty of excluding unauthorized users raises policy concerns like those in broadcasts. There is a substantive international component to this issue: such transmissions are often transborder and countries assert the right to regulate the amount and type of information flows crossing their borders.

Information technologies are particularly vulnerable to low-cost and massive copying, raising thorny issues about copyright and fair use, as I will discuss later. These are critical issues on the global IPRs agenda.

Trademarks and Geographic Indications

Trademarks and *service marks* protect rights to use a particular distinctive mark or name to identify a product, service, or company. Such marks are of material value in distributing goods and services. Because the pool of potential trademarks is limitless, they typically require only registration formalities, with an opportunity for others to protest the award of a trademark if it can be shown to infringe a prior mark. Trademarks typically may be renewed indefinitely.

Related rights include *geographic indications*, which certify that a consumer product (wines, spirits, and foodstuffs) was made in a particular place and that it embodies physical characteristics of that location, such as soil conditions and climate, or that it meets quality conditions implicit in the reputation of a location. Though there is variation in how these mechanisms operate and how they affect economic incentives, they all have the same basic purposes: to lower consumers' search costs, protect consumers from fraud regarding the origin of a product, and safeguard commercial reputations for quality.

Like patents and copyrights, trademarks carry legal authority to enforce the exclusive use of an asset created by human thought. In this case the asset is a symbol or other identifier that conveys information to the consumer about the product. If consumers view the mark as a reliable indicator of desirable product characteristics, they would be willing to pay a premium for the good. This premium compensates the firm for the cost of developing and advertising the trademark. If competitors were allowed to duplicate the mark or use a confusingly similar mark these costs might not be recoverable.

It is important that trademarks be distinctive, because protecting nondistinctive marks could impose confusion and litigation costs on society without lowering consumer search costs. Similarly, generic names like "car" or "microwave oven" are not eligible for protection.

In most countries other than the United States, trademarks are awarded to the first person to register them. Though this system provides legal certainty about ownership and helps avoid inadvertent duplication of trademarks, it may encourage excessive investment as firms attempt to register all potentially interesting or descriptive names and symbols in a prospective product line.[13] In other countries it is simply first commercial use that procures a trademark; registration serves to buttress claims to first use. The advantage of this system is that trademarks provide little social benefit except when they are actually used to identify a good being sold. Its main difficulties are ambiguity about where the trademark may have been used first and the geographic extent of protection, along with an inability to avoid inadvertent duplication.

Unlike patents and copyrights, trademarks do not protect the creation of additional knowledge; rather, they identify the origin of a product. Critics claim that this substantive difference renders trademarks less socially valuable, in that they sustain market power without providing dynamic incentives to create new products.

A balanced view recognizes that trademarks have positive impacts that offset the market power they might generate.[14] Because trademarks indicate the inherent quality or other distinguishing features of identified products, the consumer's costs of searching for preferred quality characteristics are lowered. This gives firms an incentive to maintain or improve quality over time in order not to erode the value of their marks. Thus, trademark protection may be expected both to raise the average quality of products on the market and to generate further product differentiation. Moreover, trademarks offer an inducement for new firms with distinctive products to enter markets, a process that can be of considerable importance for growth and market deepening in developing economies.[15] Trademark protection establishes incentives for orderly distribution, which can be important in securing economies of scale. Finally, trademarks provide an outlet for consumers who desire exclusivity in their consumption. The need to protect high-end consumer trademarks, such as Chanel and Calvin Klein, is evident, since otherwise free riders would duplicate the marks and attach them to goods of lower quality and lower cost. Indeed, such well-known trademarks are the targets of most product counterfeiting in international markets.

Potential monopoly costs and consumer damages from trademarks are limited for several reasons:

13. Landes and Posner (1987) suggest that this has been a problem in Japan, and stories about speculative or fraudulent registration are common in many countries. A modern variant is the practice of registering domain names on the internet that are quite similar to the names or trademarks of familiar enterprises.

14. See Landes and Posner (1987) and Besen and Raskind (1991) for discussion.

15. Maskus (1997b) discusses the importance of this process in Lebanon, while Maskus, Dougherty, and Mertha (1998) describe its operation in China.

- The market power associated with a particular trademark is likely to be small because the potential supply of competing trademarks is virtually unlimited (the exceptions occur where a highly successful brand in a sector with substantial fixed investment costs serves to augment entry barriers).
- Legal structures covering unfair competition generally prevent fraudulent passing off of goods and services and false and misleading advertising.
- Consumers are capable of assigning quality variations to goods. If the claimed quality is consistently not forthcoming, consumers will discount the trademark. Because firms have strong incentives to safeguard their reputations, misleading activity should be minimal in well-functioning markets that are complemented by adequate legal systems.

Unauthorized duplication of a mark or use of a confusingly similar name or mark constitutes trademark infringement. The primary international area of contention is the production, sale, and importation of counterfeit goods that are represented as legitimate goods. While counterfeiting may enhance consumer welfare by providing lower-cost alternatives, it also reduces welfare by increasing confusion, raising search costs, diminishing the value of trademarks, and lowering incentives to maintain product quality and develop new products. Worse, the fraudulent sale of low-quality food items and medicines could endanger human safety. Rights are usually enforced through private litigation; it is up to the courts to determine the likelihood of confusion, whether infringement was deliberate, and what damages to assess.

Trade Secrets

Trade secrets are proprietary information about production processes, including such mundane but commercially valuable items as customer lists and organizational methods. A trade secret is protected by standard liability laws against unauthorized disclosure through commercially unfair means. Because these laws define torts, not IPRs in the classic sense, they do not fit well into the standard intellectual property framework. In particular, there is no exclusive right to use the information if in leaking out fairly it enters the public domain. Trade secrets cannot be protected against learning by fair means, such as independent creation, reverse engineering, or reading public documents. Thus, while a trade secret has no statutory time limit, it can run out in the regular course of competition.

Traditionally, economists doubted that trade secrets could provide net economic benefits. If no disclosure is required but market power is created, by protecting trade secrets society must lose.

This view has changed with the growing recognition that protecting trade secrets may efficiently fill gaps created by the patent system and also provide important incentives for innovation (Reichman 1994). There are three such gaps: (1) An inventor might judge his creation to be unpatentable in legal terms but hard to imitate. (2) A firm could prefer not to disclose its process, as a patent requires, because disclosure could reduce expected profits. (3) A firm might wish to avoid the costs of patent filing.

Society could achieve economic gains from protecting trade secrets in comparison with patents: trade secrets laws could generate innovation, especially of the smaller, incremental kind that would have value for a limited time. Trade secrets could reduce incentives for R&D races because no patent might be awarded or sought. Learning trade secrets by reverse engineering would be more common than under patent protection since the follower firm may use its findings without liability. Indeed, this could be a cheaper route for competitors to learn new technologies than reading patent applications and inventing around patent grants.

There is an interesting reason, in principle, that there is no liability for lawful copying in trade secrets law. Firms are at some times likely to be creators and at other times copiers of trade secrets. All have a joint interest in being able to reverse engineer each other's products in order to learn the underlying processes. Legal protection against reverse engineering would impose costs on the system that, in expected value terms, could be higher for every firm than the expected costs of imposing limited trade secrets protection.[16]

Trade secrets law is dichotomous. There is full liability when the attempt to learn a proprietary process is illegal but no liability when the attempt is legal. This structure acts as an incentive to firms to engage in legitimate learning activities, which in turn could stimulate greater dynamic competition. The task for policymakers in each country is to define the boundaries of legal attempts to learn a rival firm's trade secrets.

Hybrid Forms of Intellectual Property Protection

Recent advances in technology have strained the classical categories of intellectual property because new forms of creative activity do not easily fit into them.[17] For example, computer software embodies elements of both literary expression, in the form of its binary code, and industrial utility, to the extent that programs are integral to production processes. In the former case, protection via copyrights is indicated, which is largely

16. This claim was articulated most forcefully by Reichman (1994, 1998). See also Besen and Raskind (1991) and Landes and Posner (1987).

17. Some of these issues are explored further in the next section.

the global standard. However, programs of industrial utility that meet novelty and nonobviousness requirements are patentable in many systems, including the United States, the EU, and Japan. There are also questions about the extent to which decompilation of programs should be permitted in order to facilitate competing applications and maintain software interoperability.[18]

Similar comments apply to aspects of semiconductor topography (chip design). Such designs do not seem to be literary expressions, yet it is relatively easy to copy them. At the same time, patent protection of layout designs seems excessive because the designs themselves may not meet novelty requirements. Accordingly, chip topographies have attracted their own form of sui generis protection that requires originality (as in copyrights) but provides only 10 years of exclusive rights in production, sales, and imports.

An additional form of protection is plant breeders' rights (PBRs), which permit developers of new plant varieties to control their marketing and use. These rights operate much like patents, being provided for fixed terms. However, rather than PBRs requiring that new plants be nonobvious and have industrial utility, plants need only be distinctive from earlier varieties and genetically stable. PBRs are controversial in developing economies with significant farming sectors but little capacity in the private sector for innovation in agriculture and horticulture.

Finally, questions persist about whether copyright protection is adequate to encourage electronic transmission of broadcasts, internet materials, and databases (Reichman and Samuelson 1997). While copyrights have emerged as the global standard in these areas, additional mechanisms may be required to discipline unauthorized copying and commercial use of materials transmitted electronically. This point is discussed further below.

Sectoral Reliance on IPRs

Just as IPRs vary considerably on functional grounds, their importance differs greatly among economic sectors. In order to understand the sources of pressure for change in global protection it is useful to discuss the dependence of critical sectors on various forms of IPRs. This discussion should not obscure the fact that all sectors make extensive use of IPRs. Patents are important in machinery, equipment, and motor vehicles, for example, and virtually all goods and services are marketed with trademarks. Copyrights protect publishers of magazines, industrial manuals,

18. Samuelson et al. (1994) advocate sui generis protection for software, but their proposal has not yet been adopted in any national legislation.

and blueprints. Moreover, various IPRs can interact in a portfolio of protection. Characters developed by the Walt Disney company may be copyrighted in films, books, and derivative products, but they are equally protected by the Disney trademarks.

The "Patents Complex": Pharmaceuticals, Biotechnology, and Plant Varieties

Patents in all fields of technology are sought by innovative firms in all industrial sectors. However, patent protection is seen as particularly critical for capturing returns to basic invention in pharmaceuticals, agricultural and industrial chemicals, and biotechnology. These industries have high R&D costs but face considerable appropriability problems. It is not difficult for competitors to determine the molecular composition of pharmaceutical compounds or the genetic makeup of biotechnological inventions, and to develop imitative products. Such inventions wear secrets "on their face," in the terminology of Reichman (1994). Accordingly, drug manufacturers and biotechnology firms in the United States and Europe are in the forefront of programs to strengthen global patent protection. The situation is similar for new plant varieties, which typically entail substantial innovation costs that may not be recoverable if exclusionary limits are not placed on the ability to duplicate and resell seeds.

At the same time, IPRs related to drugs, genetic inventions, and seed varieties are precisely the technologies that attract the greatest controversy. There is widespread concern in developing countries over the potential for monopoly pricing and limited distribution of new technologies and products in response to stronger patents. I address these concerns in a later chapter. At this point it is useful to discuss briefly the economics of each of these sectors in order to demonstrate the importance of patents. Note that these three lines of business are closely related. Research and production activities are often conducted in all of them by firms that are ordinarily classified as chemical, pharmaceutical, or agribusiness companies. Biotechnological inventions are themselves sources of new medicines, industrial processes, and food products.

Pharmaceuticals

The global pharmaceutical industry is both hierarchical and intensely competitive. At the top lie a relatively small number of large multinational enterprises, headquartered in the United States, Switzerland, Germany, the United Kingdom, and Japan, that undertake virtually all the basic pharmaceutical research done by private entities. A wave of mergers in the 1990s has increased concentration at this level of the industry.

These enterprises are truly global in scope. For example, the American pharmaceutical industry has far more foreign production and distribution facilities per parent enterprise than any other US manufacturing sector (Maskus 1998b). In large part this internationalization reflects cost savings from transporting bulk ingredients, with assembly into dosages and distribution undertaken locally. It also reflects the significant price advantages that trademark recognition affords in the industry, even in countries with weak patent laws, such as India (Lanjouw 1997).

Patented pharmaceutical products face competition from a variety of sources. Depending on patent scope, substitute products within each therapeutic group may be widely available. Upon expiry of a patent, all firms are free to market versions of the product. And because patents may not be sought or recognized in various markets, there are numerous imitations for nearly all therapeutic treatments—a situation that presumably will change considerably after TRIPs is fully implemented. The vast majority of pharmaceutical firms in the world produce generics, other substitutes under their own brand names, or imitative varieties of patented goods. Thus, beneath the top level of major pharmaceutical companies the thousands of medicine producers in the world make the industry highly competitive in most markets.

In the countries where innovative research in pharmaceuticals is undertaken, the industry is the most research intensive of all sectors. Approximately 18 percent of pharmaceutical sales is spent on R&D by American drug companies (US Congressional Budget Office 1994). The after-tax R&D cost per new chemical entity (NCE) that is placed on the market has been estimated recently at between $194 million ($359 million before tax credits) and $241 million (US Office of Technology Assessment 1993; DiMasi, Grabowski, and Lasagna 1991). The Pharmaceutical Research and Manufacturers' Association (1999a) currently estimates that it requires an average of $500 million to introduce a new marketed medicine. These costs per marketed product have risen considerably in real terms in the last decade.

An important reason for these high R&D costs is that many failed compounds are investigated for each product that is shown to be safe, effective, and patentable. Another is that it takes a long time, on average 12 to 15 years in the United States, for a product to make it from preclinical research through clinical testing and regulatory marketing approval to product launch. This imposes a heavy capital cost in forgone interest on funds tied up in R&D. Given the high research costs and the low probability of product success, it is easy to see why appropriability problems in this sector are extreme. Follower firms need only target those successful product launches with proven market demands, rather than undertake a comprehensive exploratory research program.

Distribution in the pharmaceutical sector is heavily regulated in most nations (Danzon 1997) in order to control prices to consumers (hospitals and patients) and to limit budgetary costs of public health facilities. Prices may be regulated directly based on costs, wholesale and retail markups, inflation adjustments, and reference prices set through negotiations or by inspection of foreign prices. In some regulatory systems specific manufacturers and physicians are subject to revenue limits in an attempt to control prices or prescription practices. In others, firms are regulated by limits on returns to capital invested. Patient co-payments and managed care systems also limit pharmaceutical prices and company revenues.

The effectiveness of various systems in controlling prices and procurement costs is debatable because of the many distortions these systems impose (Danzon 1997). Among OECD countries, pharmaceutical price indices tend to be lower in countries with extensive price regulation, although in these countries fewer generics and over-the-counter drugs are available. However, real expenditures for drugs are not necessarily restricted by extensive regulation. Innovative pharmaceutical research seems to be encouraged in countries, such as the United States and the United Kingdom, where firms are relatively free to set prices, while imitative research is encouraged in nations, such as France and Italy, where price and revenue regulations are extensive.

It is not surprising that before TRIPs many developing countries failed to use patents to protect pharmaceutical products, viewing the absence of patents as a form of limiting public health costs. Though a number of developing nations have extended their patent laws to pharmaceutical compounds in recent years, many still have not. Indeed, as noted earlier, even in some industrial countries recognition of patents has come only in recent decades. In part, this situation reflects the political power of local pharmaceutical firms that have grown up behind weak patent systems that allow them to produce and sell imitative products. Such firms will come under considerable competitive pressure as their governments enact patent protection for pharmaceutical products as required by TRIPs.

Biotechnology

The biotechnology industry remains dynamic, with most firms being created to develop and sell a single new genetic technological process or product. Thus, research in this field is performed largely by small firms, though the major pharmaceutical, chemical, and agribusiness firms do undertake research, as do university scientists. Biotechnological inventions consist of genetic research tools, pharmaceutical products, transgenic strains of plants and animals, and biological industrial processes. It has been estimated that roughly half the "important" drugs on the market and under development are based on biotechnological inventions (Rathmann 1993).

R&D costs are also significant in this industry. Estimates of the costs of launching a biotechnological medicine are comparable to those for pharmaceuticals more generally, while it is thought that costs for successful food products and genetic plant improvements are perhaps even higher (Rathmann 1993). However, learning a biotechnological formula through reverse engineering is typically straightforward and inexpensive, again making it hard for original inventors to recoup investment costs where there is no protection.

Early forms of biotechnology products came from cloning proteins found in nature in order to produce commercially viable quantities. Because this research involves discovering genetic sequences rather than inventing them, there is considerable uncertainty about the patentability of its outcomes (Barton 1993). Moreover, though knowledge of gene sequences (such as those being mapped in the Human Genome Project) is of potentially great value, the gene sequences themselves may not have industrial utility, rendering questionable the idea of patentability. Courts also find it difficult to identify a specific point of invention (isolation versus sequencing, which might be achieved by different claimants) for purposes of enforcing rights.

For these reasons and because of ethical and environmental concerns, there is a natural tension over the patentability of products involving living organisms. The United States Supreme Court first addressed the issue in 1980, when it upheld the patent claim for an organism that would attack oil spills.[19] Although this organism was never commercialized, the recognition of organism patentability was a critical inducement to the US biotechnology industry. Within two years, more than 100 companies had been formed and today annual global sales exceed $20 billion (Rathmann 1993). Since that time, the American courts and the US Patent and Trademark Office have moved sharply in the direction of strong and broad patent protection in biotechnology. Patents have been upheld covering all potential products from the genetic engineering of a particular plant or a critical research tool, such as a genetic sequence developed for one drug but that could be required in developing numerous pharmaceutical products, all of which would be subject to the initial patent (Barton 1995).[20] Moreover, such patents encourage filing for protection of all potential genetic combinations, potentially limiting follow-on competition. Thus, critics characterize the American system as overprotective. Indeed, recent statements from the Clinton administration encouraging the developers of maps of genetic sequences to make these maps of the human genome available widely to scientists, rather than to limit access through patents, points to rising concern about the effects of protection in core technologies.

The EU generally has taken a more cautious view, though recently it has strengthened patent rights for microorganisms. Nonetheless, concerns

19. *Diamond vs. Chakrabarty*, 444 US 1028 (1980).

20. See US Patent 5,195,135, 7 December 1994, Agracetus cotton patent covering genetic engineering of cotton plants and lines; and US Patent 5,328,987, 12 July 1994, Maliszewski (Immunex) IgA FC receptors.

over unknown health risks and the potential environmental impacts of engineered genetic materials merging with natural materials have caused numerous European nations to restrict their use in plants and animals used for food.[21] Such concerns appear to be spreading to the United States, where numerous farmers have chosen to forgo further sowing of genetically modified plants.

Many developing nations do not permit patenting of biotechnological inventions. This situation does not seem to reflect protection for local biotechnology firms, because few developing economies have successfully established a presence in the industry. Rather, it indicates concern over potential impacts of patents on the costs of biologically activated pharmaceuticals, food products, and agricultural inputs, plus complex questions about regulating the exploitation of domestic genetic resources. Under TRIPs, the obligation of countries to provide biotechnology patents remains ambiguous, although the definition of excludable subject matter clearly is broader than that practiced in the United States (Maskus 1998a; Watal 2000).

Plant Varieties

The development of new plant varieties that may be higher yielding or more disease resistant than prevailing varieties is accomplished by both biotechnological research and genetic mixing. In the industrialized countries such research is performed in private chemical and agribusiness firms, university research laboratories, and public research institutes, including extension services. In developing economies such work is largely undertaken by public universities and research institutes, which make seeds available to farmers at low cost. Publicly funded international research institutes also provide new strains to agricultural ministries for dissemination to farmers. The best-known example is the International Rice Research Institute, which is commonly credited with perfecting higher-yielding and more robust rice strains that were widely planted in some developing countries.

As these comments suggest, agricultural research has long been considered something of a public good, because food supplies depend on widespread dissemination of new seeds. Limited intellectual property protection for new varieties reflected a policy tilt toward dissemination, requiring public research procurement. However, this view has changed fundamentally in recent years, with more countries recognizing the advantages of shifting research into private facilities, supported by exclusive rights to research results. Indeed, under considerable pressure to reduce budgets or become self-financing, a number of public research

21. Pollin (1998) provides an entertaining and cogent summary of these concerns.

institutes in developing countries have shifted sharply toward a more commercial orientation in order to remain competitive with a growing number of private breeders (UNCTAD 1996). Limited evidence suggests that such institutes support IPRs in plant strains because they also wish to protect their own research results.

As with drugs and biotechnology, appropriability problems are significant in seed varieties. Plant varieties are protected by systems of plant breeders' rights, which combine patent-like protection with limitations on the scope of rights. Thus, inventors are given exclusive rights to produce, sell, and import seed varieties. One key exception is the farmer's privilege, which allows farmers, after initial purchase of protected seeds, to retain for their own use sufficient quantities of seeds to plant the following year's crops. Another is the breeder's exemption, which allows competing breeders to use varieties freely in developing new strains. Such exceptions to the exclusive use of seed varieties are not allowed under the US system of patent protection, so the choice between patents and this form of *sui generis* protection is important in determining the competitive nature of PBRs in each country.

TRIPs obliges nations to provide either patents for new plant varieties or less restrictive protection of the kind just discussed. The privatization of rights to the outcomes of agricultural research is among the most controversial areas of IPRs. Concerns arise on behalf of farmers in poor countries who might not be able to afford new agricultural inputs priced under IPRs protection, inducing them to use older technologies that would be less competitive. It is also argued that extensive recognition of PBRs could eventually reduce genetic diversity, with unforeseen consequences for plant diseases and public health.

The "Copyrights Complex": Recorded Entertainment, Software, and Internet Transmissions

Copyrights protect original artistic and literary expression in numerous media, including print publishing, audio and video recording, live performances fixed in some medium, derivative products and services, broadcasts, software, video games, electronic databases, integrated networks, and electronic transmissions over the internet. Classical copyright doctrine envisioned only the first of these activities. Thus, it is not surprising that strains on the copyright system have emerged as its purview has extended to newer technologies and products. I illustrate these issues through a brief discussion of three critical areas that are at the forefront of the international policy debate in copyrights. Although recorded entertainment, software, and electronic commerce are commonly considered distinctive economic sectors, they are interrelated through their extensive reliance on information technologies.

Recorded Entertainment

Among the more dynamic industries in the United States is film and music production. Global sales of such products have expanded dramatically in recent years, as has American employment in film and music production. The industry depends critically on advanced technology to achieve special effects and sound quality. It also invests considerable amounts in talent. Thus, there are substantial investment costs at the creative end. Moreover, marketing is costly as firms attempt to establish quality reputations for differentiated acts and products. Thus, industry profits are protected both by copyrights and trademarks.

Unauthorized copying of recorded films and music lies at the center of international disputes over IPRs. Incentives for pirating (copying and selling such goods without authorization) are easy to understand. It is cheap to acquire machinery for duplicating videotapes, digital video disks, and compact disks, and this machinery can produce many copies with minimal diminution in quality. Copies are sold, with minimal distribution costs, at prices near marginal costs because pirating industries are generally fluid and competitive.

Piracy is the classic example of free riding in the copyright area. Pirating firms absorb no research costs and free ride on the creativity of performers and producers, allowing the firms to sell duplicates of original movies and records at a fraction of the price that would be supported by copyrights. The International Intellectual Property Association (IIPA) annually estimates the revenue losses American firms suffer from limited copyright enforcement around the world. It claims that in 1995 such losses amounted to $2.3 billion in motion pictures and $1.3 billion in records and music. Estimated "piracy rates" ranged from 20 percent in Western Europe to 99 percent in Africa in films and from 5 percent in Western Europe to 70 percent in Eastern Europe in music.[22]

The United States has expended considerable diplomatic energy convincing developing countries to enact and enforce copyright laws that would reduce piracy. Numerous countries have done so, both because of this external pressure and because emerging creative interests in those countries favor stronger copyrights. Moreover, TRIPs requires antipiracy efforts through adequate enforcement. Accordingly, copyright protection in recorded entertainment should soon improve markedly, which is a signal victory for US entertainment firms. However, effective enforcement of copyrights in developing economies will be delayed because of administrative costs and economic interests in pirating that will be difficult to overcome.

22. These estimates are likely exaggerated because they assume that current sales levels would not fall if prices rose as a result of eliminating piracy. See IIPA (1998a).

At the international level, software developers face problems similar to those in recorded entertainment, again because the high margins between protected software prices and costs of unauthorized duplication create large markets for pirated programs. The IIPA estimates that piracy losses to US software firms in 1995 amounted to $7.2 billion in business applications software (including platforms) and $3.1 billion in computer games. Piracy rates tend to be higher in business software than in any other form of recorded media. Illegitimate copies of programs such as Microsoft's Windows 98 and Office 97 are sold over the counter (with copies sometimes made while the customer waits) and loaded onto hardware systems. This activity constitutes literal copying of software code, meaning that copyright protection should be sufficient to reduce the problem. Hence, the global standard in software, as written into the TRIPs agreement, is for countries to recognize computer programs as copyrightable expression. Again, this is a significant improvement from the standpoint of software developers, though adequate enforcement is years away.

While American software firms are pleased that there is a global commitment to protect their products with copyrights, it is a minimum standard. In the United States protection is considerably stronger, thanks to a combination of copyrights and patents, along with maintenance of trade secrets (Samuelson et al. 1994). The need for additional protection arises from the fact that literal application of traditional copyright precepts to computer programs may be too weak to provide incentives for innovation. Classical doctrine would make illegal only "slavish copying" of computer code, rendering it easy for competitors to produce rival programs by simply rewriting code in imitative ways. Thus, through judicial interpretation copyrights have been extended considerably to protect programs. For example, the Third Circuit Court upheld the claim that the "structure, sequence, and organization" of programs are copyrightable, extending protection to interfaces and structural features of programs.[23] In another case the "look and feel" of programs through its computer interfaces was protected from being mimicked by competitors.[24] Critics think such extensions do not fit comfortably with copyright doctrine; they equate protectable expression with functional aspects of programs. Because copyright provides very long protection (copyrights last for author's life plus 50 years) to functional areas without corresponding novelty requirements, it may be overprotective.

23. *Whelan Associates, Inc. vs. Jaslow Dental Laboratories, Inc.* 797 F. 2d 1222 (3d Circuit, 1986).

24. *Lotus Development Corporation vs. Paperback Software International*, 740 F. Supp. 37 (D. Mass. 1990).

Similarly, American policy precludes reverse engineering of programs by allowing software firms to license their products subject to a no-decompilation clause. This structure is unusual in the copyrights area, where other forms of expression, such as books and published music, may be studied by definition. Computer programs prevented from decompilation bear no automatic disclosure. This policy is restrictive, for decompilation is an important source of follow-on innovation and permits interoperability of programs in an open environment. For this reason, the EU follows a compromise solution by allowing decompilation to the extent needed to obtain information to create an interoperable program.

Computer programs and algorithms are patentable in the United States and Japan subject to novelty and utility demonstrations. Such patents recognize the functional aspects of software, such as programs that effectuate an industrial process. Software patents are criticized on two grounds. First, some critics complain that algorithms as discovered "truths of nature" are not patentable under classic doctrine. Second, patents provide strong rights to exclude others from using the idea underlying a particular functional program design, potentially according considerable market power to software firms that could be exercised in user industries and through computer networks.

This description points out that technology can render classical IPRs concepts difficult to sustain. The essence of the problem is that computer programs are "industrial literature" that embodies elements of both functional utility and literary expression. Some experts call for a hybrid form of protection that would combine shorter patent terms for functional aspects and copyrights for the textual expression (Reichman 1994). This view has not affected policy to date; the United States continues to provide full copyright and patent protection on various programs. It is not clear what the competitive implications of this system are but many observers, particularly within the software industry, consider it to be excessively protectionist.

Internet Transmissions

Electronic transmissions over the Internet pose complex questions for copyright (World Trade Organization 1998; Shapiro and Varian 1999). TRIPs applies standard copyright principles to such transmissions. Therefore, the copyright owner holds duplication and distribution rights. However, enforcing these rights is difficult in digital products, which may be easily downloaded with no deterioration in quality. Indeed, users may compile their own music disks or videos without paying royalties to any of the original rights holders. Technology for such activity continues to improve, leading to calls for technical means to deter unauthorized downloading and distribution.

The Copyright and the Performances and Phonograms treaties (concluded at the World Intellectual Property Organization in December 1996) allow countries to bar the use of technical means to circumvent electronic measures to control copying. They also facilitate collective management of copyrighted materials on the internet by permitting identifying markers, the unauthorized removal of which is illegal. The treaties further clarify the rights of performers and music producers to authorize electronic trans-mission of their works.

The United States and the EU have adopted these treaties and amended their copyright laws in light of the concerns of content providers that their materials were not well protected. For example, under the Digital Millennium Copyright Act, enacted in the US in 1998, it is illegal to circumvent antipiracy measures built into commercial software and to manufacture or distribute devices that defeat encryption codes, unless this is done to conduct encryption research or to assess program interoperability. Limited exceptions for the anticircumvention rules are provided to nonprofit libraries and educational institutions. Internet service providers are excused from infringement liability for transmitting materials submitted by content providers, but are expected to remove clearly infringing material from users' Web sites. Fair-use exceptions are provided to faculty members and students who wish to download a single copy of protected material for research or study, but the exceptions are subject to rigorous conditions. The law also requires Webcasters to pay licensing fees to record companies. Finally, it clarifies that it is illegal to distribute, in any form, electronically downloaded or uploaded materials without the authorization of the copyright holder.

Such laws in effect not only extend copyright protection to internet transmissions but also extend copyright scope to regulations intended to defeat electronic piracy. Stronger copyrights should expand the supply of electronic materials and contribute to the growth of electronic commerce. There should be significant additional gains associated with network externalities, which may markedly reduce transaction costs in international trade and introduce new electronic products and services to wide areas of the globe.[25]

However, some users, such as university libraries and researchers, worry about the effects of this additional protection on their access to, and ability to duplicate, research materials. Again, the issue is essentially the same as it is generally with IPRs: stronger rights increase returns to creative activity but raise the costs of enjoying that activity. Finding a balance between these two objectives is never easy.

The tension is illustrated well by the ongoing controversy over legislative attempts to extend copyright protection to databases. The European Union has done so through its Directive on the Legal Protection of

25. See Mann and Knight (1999) and Organization for Economic Cooperation and Development (1999) for discussions of the market-expansion impacts of electronic commerce.

Databases.[26] The United States has legislation pending in the form of the Collections of Information Antipiracy Act.[27] Both strive to protect the investments of firms and researchers in the creative assembly of data compilations from copying for commercial use by second comers—a laudable goal in principle. However, they go too far—their conditions could throw significant and costly barriers in the path of scientific researchers and educational institutions (Reichman and Samuelson 1997; Reichman and Franklin 1999).

For example, as written, their provisions would extend copyright protection to data compilations that require nothing more than arranging publicly available data into a particular order, thereby protecting materials that, under standard interpretation, should not be copyrightable. Researchers seeking to use scientific data so protected would be obligated to seek approval through a licensing arrangement, which could extensively raise research costs, particularly if the scientists needed to combine several databases from disparate sources. More chillingly, the owners of scientific databases could choose not to license them, tending to reduce the pace of technical change and scientific progress.

Licensing would be technically and legally feasible, given the ability of providers to attach binding licensing contracts (e.g., shrink-wrap licenses and standard-form contracts) to electronic data downloads. A researcher who obtained a license could be prevented from sharing the data with other researchers, because exhaustion of rights at first sale does not extend to licensing contracts. The 15-year protection could be indefinitely extended if the database were improved. In principle, this provision would award to databases—a creation of limited inventive activity—protection that exceeds even the patent grant.

In response to significant protest from the research communities, libraries, and universities, a number of amendments to the US legislation have been proposed. The objective is to extend standard concepts of fair use to database protection. Thus, researchers would be permitted to make and use single copies of data to the extent that their use and discoveries did not harm the commercial interests of the developer—a standard that is vague as currently written. Libraries would be allowed to make (at least) single copies for archival purposes and universities would have limited liability if the law were infringed by faculty and students.

The strongly protective EU directive and proposed US legislation essentially reflect the accelerating view of data as a commodity. In part, this reflects the growing private use of data for marketing products and services. There is merit in providing copyright protection to expensively accumulated customer lists, for example. However, it also further blurs

26. Directive 96/9/EC, March 1996.

27. H.R. 354, 106th Congress; H.R. 2652, 105th Congress.

the distinction between public research and its private uses. On current trends an increasing amount of research data will become private property, either because they were generated with funding by private grants or because the researcher, working from public grants and data, sees commercial value in exploiting them.

The "Trademark Complex": Status Goods and Quality Inputs

Trademark infringement is common in many developing countries. Rising incomes in the rapidly growing economies of Asia and Latin America account for a shift in demand toward status goods like high-quality apparel, cosmetics, jewelry, and accessories. The substantial gap between the market prices of legitimate products and the costs of producing knockoff goods creates a thriving market for counterfeit merchandise sold without authorization under marks that are identical or confusingly similar to registered trademarks. It is the classic free-rider problem. Creation of recognizable trademarks and reputations for quality requires significant investment in design, marketing, and quality control. Once this investment is made it is difficult to prevent expropriation or dilution of the trademark by second comers.

The problem plagues both well-known international brands and local enterprises that invest successfully in trademark development. Indeed, while stories of illegitimate use of foreign marks are well known, the unauthorized exploitation of local brand names may be even more prevalent, both because they may be more familiar to consumers and because their owners may be less capable of enforcing their rights. Inadequate enforcement of trademark regulations and unfair competition laws are a drag on business development and economic growth.

Trademark infringement is far more common than is often recognized. Beyond the obvious attempts to pass off counterfeit goods under names like Gucci, Chanel, and Rolex, marks and brand names are falsified in, among other sectors, prepared foods and beverages, medicines, transport equipment, industrial machinery, electronic equipment, personal computers, and software. Thus, unauthorized versions of Compaq computers and Microsoft programs have a market at least as much because of their reputations for quality as for their functional characteristics. Well-known manufacturers of industrial machinery, such as transformers, heating equipment, and construction cranes, also experience problems with local competitors selling like products with a false representation of trademark, licensing rights, or technology.

Because trademark infringement is ubiquitous and cross-sectoral, many firms harmed by it have widely varying interests in their operations in developing countries and are not easily organized into an effective lobbying campaign. In contrast, the concentrated patent (pharmaceuticals) and copyright (software and recorded entertainment) interests exert more influence on global policies through their national trade authorities (Ryan 1998). Nonetheless, multinational firms are pursuing their rights more aggressively in key markets, such as China, while pushing for regulatory reform and additional enforcement. Moreover, TRIPs calls for countries to recognize well-known trademarks, to remove onerous registration and use requirements, and to improve administrative and judicial enforcement.

Geographical Indications

When food products, wines, and spirits bear a reputation for quality that is essentially attributable to their geographical origin, there is a special category of protection. Otherwise, competitors may pass off their products even if made in other locations, thus diminishing the value of investments in improving the original locations and marketing products. TRIPs envisions two levels of protection. First, there is a requirement for countries to provide legal means to prevent false or misleading claims of geographical origin, applicable to any products. Second, there is special protection for wines and spirits that precludes the use of geographical terms with products that do not originate in the indicated area, even if accompanied by expressions such as “imitation” or “kind.” The agreement further calls for negotiation of an international system of registration for wines and spirits in order to implement the higher level of protection.

Protecting geographical indications has long concerned French vintners and Scottish whiskey distillers. The recent explosion in global demand for distinctive wines, spirits, and food products lends further urgency, with high-quality winemakers in the United States, Australia, Chile, and elsewhere recognizing the potential value of such protection. At present the issue is largely contested among food and wine producers in developed countries and such key developing countries as Chile, Argentina, and South Africa. Many firms undertake global advertising campaigns based on production *location*. However, increasing numbers of firms in developing economies are exploiting the value of distinctive place *names*.

Trade Secrets

There is no identifiable “complex” of industries that rely on trade secrets for competitive advantage. The term “trade secrets” covers any form of industrial or commercial know-how that (a) supports efficient production and (b) is maintained within the enterprise and its licensees as proprietary information. Such secrets could be chemical formulas underlying production of foods, medicines, and industrial chemicals, methods for heat transfer, construction techniques, bookkeeping or management systems, customer lists, and so on. Trade secrets are transferred internationally through FDI and technology licensing contracts.

Laws governing trade secrets define as illegal any attempts to learn and disclose proprietary information or to use it without authorization to develop competing production. Such laws vary widely across countries and even across states within the United States. The main source of contention, however, is inadequate laws and weak enforcement in developing economies. For example, it is alleged that public agencies, in reviewing proposed FDI or technology licensing agreements, leak confidential information to domestic competitors. It may be difficult to prosecute competitors that pay employees to divulge proprietary know-how. And there may be few restraints on the ability of managers and technical employees to leave a company and start a competing firm based on their acquired knowledge of trade secrets.

While TRIPs accords considerable discretion in the protection of undisclosed commercial information, it requires that countries develop systems for safeguarding such information from unfair competition, consonant with specified minimum definitions of illegal conduct. Further, undisclosed test data submitted for regulatory approval of agricultural chemicals and pharmaceutical products must be protected against unfair commercial use and any disclosure that is not necessary to protect the public. Legal and administrative enforcement of trade secrets must be improved as well.

The Evolving US System: Protectionism Unchained?

The remainder of this book focuses primarily on the implications of weak IPRs systems in developing nations. However, this policy overview would be incomplete without noting that in important respects the American regime has become overly protectionist by almost any utilitarian standard. For example, the United States recognizes virtually no exceptions to patentable subject matter. Claimants need only to document that the invention is nonobvious, bears an inventive step, and has industrial utility, without reference to the area of technology. These standards raise only minimal bars under American practice. These weak requirements could be offset in principle by certifying only narrow patent claims. Yet US patent examiners often award patents with broad coverage to inventions with limited inventiveness. This problem was mentioned earlier in the biotechnology area, where patents are granted on both genetic combinations and research tools. Patents on the functional aspects of computer programs are also common.

Most recently, American patent examiners extended protection to basic business methods on the Internet. The most visible examples are the patent awarded to Amazon.com, Inc.'s "one-click" ordering process and

Priceline.com, Inc.'s patent on its process for permitting shoppers to propose transaction prices.[28] These patents cover broad methods of facilitating electronic distribution, yet cannot reasonably be considered novel. The idea that consumers could propose a price at which they would be willing to purchase a product dates back thousands of years; there can be little public benefit to protecting exclusive rights to it. The "one-click" patent rewards an idea that has similar antecedents in regular commerce and is excessively broad in any case. Pending litigation between Amazon.com, Inc. and BarnesandNoble.com could sort out these issues. In recognition of these problems, some observers call for shorter duration, say 5 rather than 20 years, for business-methods patents on the Internet.

The United States also has increased dramatically the scope of copyright protection. Problems surrounding copyrights on electronic transmissions and databases were discussed earlier. Regarding copyrights generally, in October 1998 Congress passed Senate Bill 505, the "Sonny Bono Copyright Term Extension Act," which extended the term of protection by an additional 20 years. It is possible to argue that the additional protection could induce greater creative activity in the future. However, this act also covers works already in existence, serving only to increase their economic value while delaying their entry into the public domain. There can be no justification for this inclusion in the economic conception of copyrights; it was passed only to transfer more profits to past creators.

Each of these issues is the subject of intense debate in the United States. Thus, it is inaccurate to suggest that the highly protective regime encounters no opposition or that the community of intellectual property experts speaks with one voice. Nevertheless, the legislative and judicial "balance" struck in the United States in recent years heavily favors intellectual property developers. Perhaps this wave of excessive protection ultimately will reverse itself. At a minimum, it seems unwise to advocate the exportation of such protection to developing nations.

Globalization and the Technology Content of Trade

The preceding discussion set out the essential trade-offs and complexities in IPRs protection, including sectoral interests and international variations in protection. Differential standards among countries are consequential because intellectual property accounts for a substantial and growing share of international trade and investment. Inventors and creators market their products and technologies globally, a fact that collides

28. See "U.S. Will Give Web Patents More Scrutiny," *Wall Street Journal*, 29 March 2000. Part of the problem seems to be that patent examiners have insufficient resources to conduct adequate searches for prior art and are therefore incapable of detecting what is actually novel within the broad claims.

with weak and variable protection. Indeed, in recent years perhaps no other area of international commercial policy has come under greater pressure to expand the global reach of standards that have traditionally been set in developed countries. This section discusses the extent of international exchange of intellectual property.

The Use of Intellectual Property Rights

It is difficult to accurately measure the outputs of intellectual creation. Such outputs range from major inventions to minor product innovations, all of which may be patented though they have vastly different economic and social values. They include slogans, logos, and brand names that may be trademarked but not necessarily put into use. Research activities may generate trade secrets, which by definition are not published. Finally, copyright registrations do not cover the vast amounts of creative materials for which registration is not sought; nor do they reflect the underlying value of particular literary and artistic expressions. Thus, the contributions of intellectual work to economic activity, growth, and wealth creation are not easily measured.

Nonetheless, such contributions are important and growing in many countries, as judged by standard counts of intellectual property applications. For example, table 3.2 lists the number of patent applications in several countries or regions for the years 1990 and 1996. The 12 countries first comprising the European Union (through the accession of Spain and Portugal) saw no increase in applications (row N) through their own patent offices, which handle perhaps 104,000 per year in total. The main reason for this is the diversion of applications to the European Patent Office (EPO), either directly or through the Patent Cooperation Treaty (PCT). The treaty allows centralized EPO patent applications to be designated as valid in all EPO member nations.[29] For example, the PCT permits an applicant to seek patent protection in multiple designated countries by filing one international patent application, thereby economizing on application fees.

It is evident that the EPO provides considerable economies to both resident and nonresident applicants. In 1996 there were 86,614 EPO applications, a rise of 88 percent over 1990. When extended to national coverage within the EU, these applications supported over 800,000 filings, suggesting that each EPO filing requested extension to nine countries on average. Nonresidents are particularly likely to use the EPO to achieve coverage throughout the region.

In the United States, annual patent applications rose by 27 percent in the early 1990s, from 176,100 to 223,419. The mix between domestic and

29. The EU12 countries comprise most of the members of the EPO.

Table 3.2 Patent applications in selected countries

	1990			1996		
Country	Resident	Nonresident	Total	Resident	Nonresident	Total
EU12	94,614	443,284	537,898	112,115	805,362	917,477
N	69,900	34,007	103,907	81,500	22,492	103,992
Percent PCT/ EPO	26	92	81	27	97	89
EPO	23,505	22,549	46,054	38,546	48,068	86,614
USA	91,410	84,690	176,100	111,883	111,536	223,419
PCT	1	13	7	4	21	13
Japan	333,373	43,419	376,792	340,861	60,390	401,251
PCT	0	36	4	1	65	10
Canada	2,782	35,135	37,917	3,316	45,938	49,254
PCT	8	31	29	22	75	71
Australia	6,948	19,559	26,507	9,196	34,125	43,321
PCT	11	47	37	12	84	69
Mexico	750	4,539	5,289	389	30,305	30,694
PCT	n.a.	n.a.	n.a.	1	87	86
Brazil	2,430	10,004	12,434	2,655	29,451	32,106
PCT	0	59	47	1	89	81
China	4,780	4,872	9,652	11,698	41,016	52,714
PCT	0	0	0	1	74	57
South Korea	9,083	22,304	31,387	68,446	45,548	113,994
PCT	0	37	26	0	69	27
MIT	299	8,100	8,399	408	12,424	12,832
PCT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
India	1,147	2,673	3,820	1,660	6,632	8,292
PCT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

EU12 = the first 12 members of the European Union.
N = national patent office.
EPO = European Patent Office.
PCT = Patent Cooperation Treaty.
MIT = combined figures for Malaysia, Indonesia, and Thailand.
Note: Figures for PCT are percentages of applications.

Source: World Intellectual Property Organization, *Industrial Statistics Yearbook*, various years.

foreign applicants remained roughly consistent, indicating a mature and open system. Nonresident applicants rapidly increased their filings through the PCT.

The rising numbers of patent applications in the EU and the United States in the 1990s are significant because they seem to reverse the widely discussed "patenting slowdown" in those countries in the 1970s and 1980s

(Evenson 1984; Segerstrom 1998). American resident patent applications in the United States fell from approximately 72,000 in 1970 to a low of around 59,000 in 1983, returning to 1970 levels only in 1988; the trends in Europe were similar. These facts occasioned concerns about the declining productivity of R&D programs, because over the same period real R&D spending and the number of scientists and engineers employed in R&D rose sharply. It thus appears that after some lag these increasing investments are now resulting in growing patent applications.

Japan has long had a system that encourages large numbers of applications filed to cover narrow claims (Ordover 1991). Moreover, specific features of the Japanese patent system, including utility models and pregrant disclosure, favor frequent filings by domestic residents for small claims over infrequent filings by foreign residents over somewhat larger claims (Maskus and McDaniel 1999). These characteristics are reflected in the patent data: 85 percent of all applications in 1996 were filed by residents. This is a far higher percentage than anywhere else. However, the growth of foreign applications was larger than that of domestic applications, reflecting an expanding interest in protection in Japan. Overall applications rose by about 6 percent.

Canada and Australia represent developed economies in which nonresident applications are far larger than resident applications, though both types are rising rapidly. In both countries use of the PCT by foreign applicants rose dramatically over the period. Total applications rose by 29 percent in Canada and by 59 percent in Australia.

The first four developing nations listed in table 3.2—Mexico, Brazil, China, and Korea—exhibited explosive growth in patent applications in the 1990s:

- Filings rose by a factor of five in Mexico and by 158 percent in Brazil. However, this was due entirely to nonresident applications, particularly through the PCT.
- In contrast, Korea's near trebling of total applications featured a massive increase in domestic applications.
- China registered substantial increases in both resident and nonresident applications.

Thus, both domestic residents and foreign firms are increasingly registering for protection in South Korea and China, reflecting the importance of those markets, the ability of domestic enterprises to develop patentable technologies and products, and improving technology protection. The PCT is an attractive route to registration in both nations.

The Southeast Asian economies of Malaysia, Indonesia, and Thailand also saw total applications rise dramatically, dominated by increased foreign filings. Thus, in the 1990s these markets, characterized by high growth

Table 3.3 Trademark applications in selected countries

	1990			1996		
Country	Resident	Nonresident	Total	Resident	Nonresident	Total
EU12	219,854	116,630	336,484	235,524	130,294	365,818
MP		38	13		51	18
USA	106,693	20,653	127,346	183,925	28,585	212,510
Japan	151,935	19,791	171,726	163,518	24,642	188,160
Canada	13,948	11,733	25,681	17,895	15,446	33,341
Australia	12,826	9,189	22,015	21,777	15,569	37,346
Mexico	15,863	9,579	25,442	19,562	12,774	32,336
Brazil	57,769	6,111	63,880	56,481	12,910	69,391
China	50,853	6,419	57,272	122,057	28,017	150,074
MP		32	4		19	4
MIT	25,897	14,459	40,356	33,368	28,527	61,895
South Korea	33,564	13,262	46,826	60,852	14,846	75,698
India	18,713	1,968	20,681	35,799	6,924	42,723

EU12 = the first 12 members of the European Union.
MP = Madrid Protocol.
MIT = combined figures for Malaysia, Indonesia, and Thailand.
Note: Figures for MP are percentages of applications.

Source: World Intellectual Property Organization, *Industrial Statistics Yearbook*, various years.

rates, successive rounds of economic liberalization, and some attempts to strengthen IPR regimes, became more attractive locations in which to protect intellectual property.

Table 3.3 lists the number of applications for trademarks and service marks in the same years. In all countries the number of resident exceeds the number of nonresident applications, but especially in Brazil, China, South Korea, and India. This attests to the fact that emerging economies tend to experience significant entry of new domestic enterprises that find it advantageous to protect brand names for purposes of investing in product recognition. Except for Brazil, there was dramatic growth in annual trademark registrations over the period, with the number in China rising by 163 percent. The United States, Canada, Australia, and Mexico also registered significant expansion in trademark use. Within the EU there was a nearly 10 percent rise in trademark filings, with nonresidents making growing use of the registration procedures available under the Madrid Protocol (MP). Foreign enterprises also extensively employ the MP in China.

The figures in table 3.4 are for applications to register new plant varieties in various countries in 1992 and 1996. In the EU, resident applications

Table 3.4 Applications for registrations of plant varieties in selected countries

	1992			1996		
Country	Resident	Nonresident	Total	Resident	Nonresident	Total
EU12	2,812	2,211	5,023	2,016	669	2,685
CPVO	n.a.	n.a.	n.a.	1,209	169	1,378
USA	463	178	641	677	374	1,051
Japan	620	97	717	736	203	939
Canada	14	149	163	99	162	261
Australia	65	123	188	137	154	291
Argentina	80	23	103	69	76	145
Chile	11	27	38	16	13	29
South Korea	0	1	1	3	36	39

EU12 = the first 12 members of the European Union.
CPVO = Community Plant Variety Office.
n.a. = not available.

Source: World Intellectual Property Organization, *Industrial Statistics Yearbook*, various years.

through national intellectual property offices, combined with applications through the Community Plant Variety Office (CPVO), rose from 2,812 to 3,225 over this period. Nonresident applications were heavily supplanted by applications through the CPVO. The United States saw a substantial increase in applications from both residents and nonresidents, while in Japan nonresidents chose to increase their protection for plant varieties rapidly. Both Canada and Australia experienced rapidly rising registrations from domestic firms.

Argentina and Chile are listed as representative developing economies. It is only in South America that protective systems for plant varieties were commonly implemented in developing nations in this decade, though Brazil (among others) had not established such a system by 1996. Argentina saw a substantial rise in applications, dominated by nonresident filings, though applications in Chile fell off somewhat over the period. Since South Korea established an application system for plant varieties in 1992, it has registered a marked rise in nonresident applications. Thus, although this form of protection is relatively new in developing nations, interest in it seems to be rising rapidly.

There are no centralized data for copyright registrations in different countries; even if there were, because in general copyrights need not be registered to be valid, such data would reflect only a small part of the materials being created. One indirect way of representing the importance of copyrights is to consider that publication and other production of

Table 3.5 Indicators of demand for copyright products in selected countries

	Book titles		TV receivers per 1,000 population		PCs per 1,000 population	Internet hosts per 10,000 population
	1991	1996	1990	1995	1996	1996
EU12	315,736	354,303	453[e]	532[e]	176[e]	92.4[e]
USA	48,146	68,175	799	805	362	442.1
Japan	35,496	56,221	611	684	128	75.8
Canada	22,208[a]	19,900	612	714	193	228.1
Australia	n.a.	10,835	486	554	311	382.4
Mexico	n.a.	6,180	148	270	29	3.7
Brazil	27,557[b]	21,574[c]	208	223	18	4.2
China	92,972[a]	110,283	267	319	3	0.2
South Korea	29,432	35,864[d]	210	337	132	28.8
MIT	13,198	18,003	91[e]	132[e]	17[e]	2.1[e]
India	14,438	11,903	32	61	2	0.1

EU12 = the first 12 members of the European Union.
MIT = combined figures for Malaysia, Indonesia, and Thailand.
n.a. = not available.
a. 1993.
b. 1992.
c. 1994.
d. 1995.
e. Weighted by GDP levels.

Sources: United Nations Educational, Scientific, and Cultural Organization, *Statistical Yearbook*, various years; World Bank, *World Development Report*, various years; and World Bank, *World Development Indicators 1998*.

creative activities reflect demand for copyright protection. Thus, table 3.5 presents information on book titles produced, television receivers and personal computers per 1,000 members of the population, and internet hosts per 10,000 people in selected nations.

Because annual figures on book production are subject to considerable cyclical pressures, they must be treated with caution. Nonetheless, between 1991 and 1996 most countries reported notable increases in the output of titles, the exceptions being Canada, Brazil, and India. EU members collectively published over 350,000 titles in 1996, with nearly a third of this sum accounted for by the United Kingdom, which is the world's largest publisher of books by title. The number of books published in the United States rose by 42 percent over the five years. China, South Korea, and the Southeast Asian economies also became significant centers of publishing in the 1990s.

Televisions receive copyrighted programming and display copyrighted videos. The developed economies saw relatively small increases in the penetration of TV receivers into households (see table 3.5), reflecting near saturation of that medium by the early 1990s. However, substantial increases were registered in Mexico, China, South Korea, the Southeast Asian economies, and India. Clearly, as incomes rise the demand for televised services and entertainment expands, suggesting a rising need for copyright protection.

Finally, the penetration of personal computers and internet services into households and businesses provides a measure of demand for computer software. While the figures in table 3.5 are for a single year and therefore do not indicate growth rates, it is evident that software usage is growing rapidly in many countries (Mowery 1996). Developing nations lag far behind in personal computers and internet connections, suggesting substantial room for growth as these economies expand.[30] In turn, copyright protection will prove vital for growth in the use of legitimate software and for the international spread of internet commerce.

International Trade in IPR-Sensitive Goods

As I have noted elsewhere (Maskus 1993), goods that rely extensively on IPRs protection tend to be among the fastest-growing items in international trade and also are distinctive in terms of international comparative advantage. This is not surprising in light of underlying product characteristics, including advanced technological content, rapidly evolving dynamics in technology, and marked quality differentiation.

Strong support for these statements is provided in table 3.6, which shows trade growth and a simple measure of revealed comparative advantage (RCA) for a selection of product categories in 1990 and 1996. The first set of columns lists both nominal gross trade (exports plus imports) in billions of US dollars for total merchandise and percentage growth in nominal trade. Clearly, this growth rate depends not only on volume increases but also on inflation and exchange rate variations. However, my interest here is in demonstrating the relatively rapid expansion of sectoral trade. Thus, a comparison of trade growth by sector with aggregate trade growth should be largely free of inflation and exchange rate effects. Finally, for each product group I list an RCA index, which is the ratio of group exports to group imports, divided by the ratio of total merchandise exports to total merchandise imports. Thus, RCA measures the extent to which the sectoral trade pattern differs from each country's overall trade pattern. An index well in excess of unity suggests an under-

30. The data on personal computers surely underestimate the number of PCs in place in developing economies, because there is often a thriving underground business in the PC and software sectors (Maskus 1997b).

Table 3.6 Trade in IPR-sensitive goods for selected countries

		Total merchandise			Pharmaceuticals			Polymerization products		
Country	Year	Total	Percent of change	RCA	Total	Percent of change	RCA	Total	Percent of change	RCA
		($b)*			($m)			($m)		
EU12	1990	2,784		1.00	41,694		1.30	58,536		1.10
	1996	3,718	34	1.00	78,970	89	1.21	66,656	14	1.14
USA	1990	911		1.00	6,717		2.16	7,952		2.83
	1996	1,447	59	1.00	14,480	116	1.35	13,806	74	2.42
Japan	1990	523		1.00	3,714		0.25	3,461		2.79
	1996	760	45	1.00	6,391	72	0.36	5,719	65	3.52
Canada	1990	251		1.00	1,117		0.29	2,443		0.89
	1996	377	50	1.00	2,708	142	0.29	5,111	109	0.91
Australia	1990	82		1.00	927		0.33	478		0.27
	1996	126	54	1.00	2,254	143	0.53	864	81	0.33
Mexico	1990	58		1.00	359		0.38	779		0.59
	1996	117	99	1.00	1,346	274	0.72	2,308	196	0.27
Brazil	1990	54		1.00	445		0.15	545		1.68
	1996	105	94	1.00	1,226	176	0.22	1,253	130	0.69
China	1990	115		1.00	1,060		1.32	1,292		0.16
	1996	290	151	1.00	1,867	76	3.97	7,079	448	0.05
South Korea	1990	135		1.00	396		0.44	1,295		0.99
	1996	281	108	1.00	1,044	164	0.42	4,038	212	3.80
MIT	1990	162		1.00	598		0.17	2,106		0.12
	1996	377	132	1.00	1,334	123	0.25	3,838	82	0.45
India	1990	42		1.00	711		2.30	553		0.04
	1996	70	69	1.00	826	16	0.86	863	56	0.16

Country	Year	Special industry machines: Total	Percent of change	RCA	Metalworking machines: Total	Percent of change	RCA	Data processing equipment: Total	Percent of change	RCA
		($m)*			($m)			($m)		
EU12	1990	36,669		1.58	29,941		1.25	63,598		0.66
	1996	39,601	8	2.05	26,571	–11	1.47	103,362	63	0.77
USA	1990	8,474		1.55	6,426		0.96	31,439		1.31
	1996	17,236	103	1.95	12,061	88	1.00	65,155	107	0.83
Japan	1990	5,731		3.40	6,054		4.58	15,122		3.38
	1996	13,167	130	4.16	10,578	75	6.84	28,254	87	1.09
Canada	1990	1,870		0.45	1,218		0.36	4,190		0.29
	1996	2,980	59	0.58	1,940	59	0.42	7,687	83	0.24
Australia	1990	693		0.27	323		0.19	1,696		0.10
	1996	1,314	90	0.50	584	81	0.28	3,093	82	0.12
Mexico	1990	662		0.08	466		0.09	807		0.88
	1996	1,589	140	0.24	1,191	156	0.17	4,025	399	2.10
Brazil	1990	297		0.13	370		0.14	242		0.20
	1996	1,232	314	0.14	986	167	0.27	1,143	372	0.25
China	1990	4,865		0.26	1,053		0.28	462		0.23
	1996	8,608	77	0.05	4,048	284	0.10	4,655	907	3.52
South Korea	1990	2,067		0.15	1,431		0.14	2,992		2.07
	1996	6,725	225	0.28	3,724	160	0.23	7,233	142	2.15
MIT	1990	2,446		0.04	1,267		0.05	888		0.84
	1996	6,600	170	0.07	3,114	146	0.08	9,143	930	4.34
India	1990	313		0.37	334		0.28	119		1.30
	1996	1,152	268	0.05	496	49	0.15	272	128	1.06

(*table continued next page*)

Table 3.6 Trade in IPR-sensitive goods for selected countries (*continued*)

		Electromedical machines			Electronic microcircuits			Measuring, control instruments		
Country	**Year**	**Total**	**Percent of change**	**RCA**	**Total**	**Percent of change**	**RCA**	**Total**	**Percent of change**	**RCA**
		($m)*			($m)			($m)		
EU12	1990	6,764		1.44	20,166		0.76	37,428		1.04
	1996	9,799	45	1.49	53,162	164	0.81	42,208	13	1.12
USA	1990	3,671		1.49	22,142		1.41	13,235		2.82
	1996	5,961	62	2.32	64,900	193	1.27	22,570	71	2.44
Japan	1990	1,837		3.25	10,286		2.41	6,112		1.36
	1996	2,737	49	1.58	34,010	231	1.61	11,606	90	1.59
Canada	1990	327		0.14	3,166		0.53	2,501		0.37
	1996	375	15	0.25	8,413	166	0.43	3,945	58	0.38
Australia	1990	147		0.09	187		0.02	813		0.22
	1996	290	97	0.25	799	326	0.02	1,281	58	0.29
Mexico	1990	76		0.05	99		0.12	508		0.20
	1996	212	179	0.60	2,903	2,822	0.27	2,051	303	0.52
Brazil	1990	111		0.01	348		0.08	422		0.12
	1996	208	87	0.06	781	125	0.06	809	92	0.12
China	1990	210		0.08	23		0.52	850		0.16
	1996	380	81	0.14	3,145	13,498	0.19	2,267	167	0.20
South Korea	1990	159		0.15	6,831		1.99	1,796		0.18
	1996	432	171	0.25	22,368	227	2.87	4,149	131	0.09
MIT	1990	84		0.06	5,075		2.58	1,015		0.11
	1996	213	153	0.05	20,759	309	1.48	2,451	141	0.19
India	1990	74		0.10	115		0.03	388		0.09
	1996	196	166	0.13	219	90	0.02	755	94	0.10

Country	Year	Alcoholic beverages: Total	Alcoholic beverages: Percent of change	Alcoholic beverages: RCA	Perfume, cosmetics: Total	Perfume, cosmetics: Percent of change	Perfume, cosmetics: RCA	Printed matter, sound recordings: Total	Printed matter, sound recordings: Percent of change	Printed matter, sound recordings: RCA
		($m)*			($m)			($m)		
EU12	1990	25,889		1.73	11,894		1.56	36,550		1.05
	1996	33,457	29	1.67	20,794	75	1.68	45,396	24	1.20
USA	1990	4,410		0.19	1,727		1.43	10,582		2.55
	1996	6,280	42	0.28	3,775	119	2.00	16,777	59	2.40
Japan	1990	1,773		0.03	540		0.42	3,881		1.98
	1996	1,878	6	0.06	1,213	125	0.34	6,041	56	1.11
Canada	1990	1,093		0.99	365		0.38	2,941		0.20
	1996	1,262	15	0.82	1,051	188	0.45	4,390	49	0.29
Australia	1990	401		0.85	199		0.25	1,121		0.16
	1996	755	88	2.08	407	105	0.49	1,539	37	0.26
Mexico	1990	355		2.68	80		0.08	556		0.70
	1996	706	99	4.43	360	350	0.46	1,937	248	0.63
Brazil	1990	93		0.64	25		0.76	130		0.14
	1996	322	246	0.55	143	461	0.68	385	196	0.09
China	1990	62		5.43	158		14.72	457		0.65
	1996	125	99	5.75	152	–3	8.01	1,455	218	0.82
South Korea	1990	58		0.35	65		0.41	1,225		4.04
	1996	307	431	0.41	413	532	0.20	2,159	76	1.74
MIT	1990	248		0.20	220		0.88	402		0.16
	1996	417	68	0.50	446	103	0.66	2,139	432	0.65
India	1990	12		1.59	127		9.93	131		0.50
	1996	19	60	2.57	46	-63	8.43	492	277	0.69

EU12 = the first 12 members of the European Union.
MIT = combined figures for Malaysia, Indonesia and Thailand.
*All figures are in US dollars.

Source: United Nations, *International Trade Statistics Yearbook,* various issues.

lying comparative advantage; an index below unity suggests a comparative disadvantage.[31]

The product groups chosen cover sectors that figure prominently in international debates over IPRs: patents in pharmaceuticals, chemicals, machinery, and instruments; chip topography protection in microcircuits; trademarks in alcoholic beverages and perfume and cosmetics; and copyrights in printed matter and sound recordings. Clearly these sectors do not exhaust all categories in which IPRs loom large. Moreover, they are broad aggregates covering a large mix of products of varying ages and technological contents, so they do not necessarily correspond closely to product-specific demands for IPRs. Nonetheless, they seem to tell a consistent story.

As might be expected, in the 1990s aggregate merchandise trade rose most rapidly for the developing economies in the sample, especially South Korea, China, and Southeast Asia (MIT). Among the developed economies, US trade rose most rapidly in nominal terms, though overall the EU12 nations saw a 34 percent rise. (The aggregation of European economies clearly masks considerable national variation in trade performance, a fact that carries over into, and clouds, the sectoral analysis.)

There is much to digest in table 3.6 and I simply highlight interesting cases. The pharmaceuticals and medicines group saw relatively rapid trade growth in all countries except China, MIT, and India. The United States maintained a substantial, though declining, RCA in pharmaceuticals as its gross trade more than doubled. Japan demonstrated a comparative disadvantage in the sector, in considerable contrast to the other high-technology industries in the table. China's RCA indices were well above unity, mainly reflecting a near absence of imports in drugs and medicines but a substantial export trade. These ratios are likely to moderate as China improves its patent protection for imported drugs and liberalizes import restrictions. India saw a marked deterioration in its RCA for pharmaceuticals in the 1990s. India's export strength in this sector has been based on competitive imitation and production of products that were not patentable in India and its export markets (Watal 1996; Marino 1998). Recently India, after rapid growth in imports of medicines, is again a net importer.

Nearly all countries experienced relatively fast trade growth in special industry machinery, machine tools, electromedical machinery, measuring and controlling instruments, and computers.[32] Save for the last category,

31. RCA indices should be treated with caution, as they depend also on sectoral trade protection, subsidies, and other factors. However, ratios quite different from unity are surely meaningful, as are comparisons over time within a country. Moreover, because these indices are computed solely on trade flows they do not reflect production advantages associated with FDI for local markets.

32. The EU12 is a frequent exception, reflecting cross-currents in trade data that emerge through the aggregation of disparate countries.

these high-technology machinery sectors are not only areas of revealed comparative advantage for the United States, the EU, and Japan but also areas in which patents are common. Thus, these countries clearly are net exporters of the technology embodied in such machinery, which helps explain their keen interest in stronger global patent rights. At the same time, these machinery categories revealed significant comparative disadvantages in nearly all other countries, especially developing countries. Mexico and South Korea are noteworthy in registering marked increases in their RCA indices in high-technology machinery, providing a crude explanation for their rising interest in implementing stronger patents during this period. Canada and Australia remain net importers of these machinery categories.[33]

Perfume and cosmetics represent highly differentiated consumer goods that are sold under familiar trademarks and that are subject to considerable infringement. Trade growth has been especially rapid in this group, except in China and India, whose unusually low import levels account for their high RCA indices. Mexico, Brazil, and South Korea are rapidly expanding markets for such goods. Again, these are decided net export commodities for the EU and the United States, consistent with their strong push to crack down on trademark piracy. Trade growth has been less rapid in alcoholic beverages, an area of strong comparative advantage for the EU, Australia, and Mexico. As noted earlier, the EU has been the strongest advocate of a global system of registration and protection for geographical indications in wines and spirits.

Finally, trade growth in printed matter and sound recordings has been especially great in the developing economies. The United States, Japan, and the EU (especially the United Kingdom) retain net export positions in publishing at this aggregate level.[34] Canada and Australia are significant net importers of published materials, a fact that helps explain Canada's support for its cultural industries and Australia's recent decisions to permit parallel importation of books and music compact disks. In any event, these figures suggest that effective copyright protection in developing countries is of rising interest to publishers in the developed world.

Licensing and Foreign Direct Investment

Table 3.7 provides perspective on trade trends in services that are sensitive to IPRs protection. Indicators include net trade in computer and information services (IT) and royalties and license fees (RLF). The latter

33. Again, these categories are aggregates of detailed machinery subgroups. At more disaggregated levels Canada and Australia would undoubtedly register RCA indices above one in many subgroups.

34. Unfortunately, software is not broken out separately in the international trade data.

Table 3.7 Trade in IPR–sensitive services and royalties and license fees

		1990 ($billions)			**1996** ($billions)		
Country	**Service**	**Receipts**	**Payments**	**Balance**	**Receipts**	**Payments**	**Balance**
EU12	IT	0.6	1.4	–0.8	6.6	6.7	–0.1
	RLF	8.8	13.6	–4.8	13.9	20.4	–6.5
USA	IT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	RLF	16.6	3.1	13.5	27.3	6.7	20.6
Japan	IT	n.a.	n.a.	n.a.	1.1	2.2	–1.1
	RLF	2.9[b]	6.1[b]	–3.2[b]	6.1	9.0	–2.9
Canada[a,d]	IT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	RLF	854	855	–1	1266	993	273
Australia[a]	IT	n.a.	n.a.	n.a.	151	179	–28
	RLF	162	827	–665	229	992	–763
Mexico[a]	IT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	RLF	73	380	–307	111	328	–217
Brazil[a]	IT	n.a.	n.a.	n.a.	39	229	–190
	RLF	12	70	–58	29	482	–453
South Korea[a]	IT	3	50	–47	5	69	–64
	RLF	37	136	–99	168	2214	–2046
MIT[a]	IT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	RLF	0	170	–170	23	653	–630
India[a]	IT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	RLF	1	72	–71	1[c]	82[c]	–81[c]

EU12 = the first 12 members of the European Union.
MIT = combined figures for Malaysia, Indonesia, and Thailand.
IT = computer and information services.
RLF = royalties and license fees.
n.a. = not available.
a. Millions of dollars.
b. 1991.
c. 1995.
d. Data for technology balance of payments. Data for 1996 are deflated by US wholesale price index (1990 = 100).

Sources: International Monetary Fund, *Balance of Payments Statistics Yearbook 1997* and *International Financial Statistics*, various issues; and Organization for Economic Cooperation and Development, *Basic Science and Technology Statistics 1997*.

variable is what the OECD refers to as the "technology balance of payments." It comprises "money paid or received for the use of patents, licenses, trademarks, designs, inventions, know-how, and closely related technical services" (OECD 1998). Because not all countries report each of these flows, there are some gaps in the coverage. All data are reported in US dollars at prevailing exchange rates. Accordingly, the 1996 figures are deflated by the US wholesale price index to achieve a crude measure of changes in trade volumes.

There are several reasons why published data on RLF may not capture adequately the amount of technology being traded. Licensing fees are determined through complex contracting procedures, which attempt to price the implicit value of information. Information is unlike standard commodities in that its ultimate economic value may be unknown at the time a contract is struck. Further, the fees paid may be influenced by tax laws, accounting rules, and management decisions regarding the extent and form of income repatriation. Finally, joint ventures, business alliances, and cross-licensing agreements may encompass different volumes of licensing than would be suggested by straightforward licensing fees. Thus, these figures should be treated with caution.

Data on credits and debits for the EU countries are sums of gross flows and therefore do not net out intra-EU trade. However, in principle two-way flows within the EU should cancel in computing trade balances, which therefore do indicate extra-EU net trade. With this caveat, note that gross receipts from and payments for computer and information services amounted to around $6.6 billion in 1996, a substantial rise from 1990 levels. Both receipts from and payments for royalties and license fees rose by over 50 percent within the EU over the period, indicating a substantial increase in international licensing of technologies and trademarks. The EU12 nations remain net payers of RLF, reflecting the existence of substantial net importers of intellectual property (including France, Germany, Ireland, and Spain) in that region.

The United States also experienced significant increases in receipts from and payments for RLF, with payments more than doubling. However, the near-doubling of RLF receipts earnings from abroad generated a large rise in net receipts for intellectual property. Indeed, the United States remains by far the largest global net supplier of technology, trade secrets, and IPRs for which royalties are paid. Japan as a net importer of both computer services and intellectual property has also seen a marked rise in transactions requiring license fees.

That rapid growth is associated with rising technology imports seems clear from looking at the remarkable increases in the volume of RLF payments by Brazil, the Southeast Asian economies, and especially South Korea from 1990 to 1996. South Korea's outward payments rose fifteenfold in this six-year period, resulting in net outward payments for RLF of over $2 billion by 1996. In contrast, India's gross RLF payments grew only marginally; Mexico's payments actually fell, probably as a result of the macro-economic crisis in the middle of the decade.

A final way to trade intellectual property is to transfer information to subsidiaries through foreign direct investment. Table 3.8 presents basic indicators on trends in the stocks of inward and outward FDI between

Table 3.8 Inward and outward stocks of foreign direct investment

	1990				1996			
Country	**Inward** ($b)	**GDP** (percent)	**Outward** ($b)	**GDP** (percent)	**Inward** ($b)	**GDP** (percent)	**Outward** ($b)	**GDP** (percent)
EU12	691	10.9	724	12.0	1,026	13.0	1,309	16.8
USA	395	6.9	435	7.6	630	8.3	793	10.4
Japan	10	0.3	201	6.8	30	0.7	259	5.6
Canada	113	19.7	85	14.8	129	22.0	125	21.3
Australia	74	25.2	31	10.3	117	29.7	46	11.7
Mexico	33	13.2	0.6	0.2	75	22.3	2.2	0.7
Brazil	37	8.5	2.4	0.5	110	14.2	7.2	0.9
China	19	4.8	2.5	0.6	172	24.7	18	2.6
South Korea	5.7	2.3	2.3	0.9	15	2.6	14	2.8
MIT	61	32.2	2.7	4.6	130	31.0	18	11.0

$b = billions of dollars.
EU12 = the first 12 members of the European Union.
MIT = combined figures for Malaysia, Indonesia, and Thailand.
Note: For both EU12 and MIT percentages of GDP are weighted by national investment stocks.

Source: United Nations Conference on Trade and Development, *World Investment Report 1998: Trends and Determinants*.

1990 and 1996. That FDI has risen in recent years more rapidly than output in most areas of the world is clear from the figures on investment stocks as a percentage of GDP. With few exceptions these ratios rose sharply during the early 1990s. The European Union, the United States, and Japan remained large net suppliers of FDI, while Canada and Australia had larger inward investment. The inward rise was especially large in Mexico, Brazil, and China, while South Korea has become a significant investor in its own right. To the extent that such investments embody intellectual property, these figures suggest that FDI has also become an important source for trading and exploiting IPRs internationally. These are issues to which I devote considerable attention in the following chapters.

Pressures for Change in the Global IPRs System

The figures just reviewed suggest two broad conclusions: (1) the 1990s have been a period of rapidly expanding international economic activity, particularly with regard to implicit or explicit trade in technology and goods protected by intellectual property rights, and (2) resort to IPRs through patent applications and trademark registrations is strengthening rapidly, particularly in major developing economies.

That the international demand for IPRs is rising stems largely from the fact that in a globalizing economy the creation of knowledge and its adaptation to product designs and production techniques are increasingly essential for commercial success. In this environment firms wish to exploit their technical advantages on an international scale and also to limit expropriation costs from potential rivals. These tasks are made easier by the adoption of stronger and more uniform IPRs in different countries. Thus, globalization of technology trade is itself the key factor in explaining systemic change in intellectual property rights.

Two other factors are also critical. One is that the costs of copying and imitating products from important sectors of technology are falling, making infringement easier and more prevalent. This is evident with electronic media, such as software, computer games, compact disks, and videos, which may be reproduced cheaply and in bulk with little or no quality degradation. Similar problems plague unauthorized duplication of broadcasts and Internet products and services, a fact that has materially retarded the international provision of electronic information. In pharmaceuticals, the costs of original product research and marketing continue to grow rapidly, but imitation costs remain low. Many biotechnological products, in particular, are subject to considerable investment costs but may be copied at a small fraction of the original expense. It is also straightforward to duplicate industrial designs, such as tile patterns or machine configuration. In all of these cases, copying costs are falling relative to original development costs, in large part because of efficiencies from using computer technologies to imitate.

A final strain on the classical IPRs system, as discussed earlier, is that many of these newer technologies do not fit comfortably within standard conceptions of industrial property and artistic property. Computer microcircuits, software programs, biotechnological inventions, and electronic transmissions all strain the limits of classical patent or copyright laws. Thus, even within developed countries intellectual property law remains in considerable flux.

These elements explain the substantial rise in demand from intellectual property owners for stronger and more harmonized global standards of protection. They underlie the massive efforts mounted by authorities in the United States and the European Union to reform the global IPRs system. These efforts have been ubiquitous, encompassing numerous bilateral negotiations with particular developing nations under threat of trade sanctions, comprehensive regional trade agreements that cover IPRs, the multilateral TRIPs agreement, ongoing efforts to unify legal practices within the EU, and international negotiations under the auspices of WIPO over intricate aspects of copyright for electronic transmissions.

Summary

Intellectual property rights are complex phenomena that cannot readily be captured by the phrase itself. They exist in a variety of forms—patents, copyrights, trademarks, trade secrets, and mixed forms of protection—that each operate distinctively. They are aimed at achieving somewhat different goals, which vary by subject matter and economic sector. Ultimately, however, IPRs attempt to strike a balance between (1) providing adequate incentives to develop new technologies, products, and artistic creation, and (2) ensuring effective distribution of those inventions into the economy. As policy tools, IPRs are second-best solutions to the difficult and delicate mix of failures that arise in markets for developing and selling information. Nonetheless, because they are market-based incentives they are generally much more efficient than direct public support for invention.

While all industries make use of a portfolio of IPRs, certain sectors have a need for particular types of intellectual property protection, and these sectors dominate the global policy debate. Patents are especially critical in the pharmaceutical and biotechnology industries, while plant breeders' rights add a complementary form of protection. Each of these areas raises contentious issues about the economic and social implications of protecting exclusive rights to new knowledge. Even within the United States, the bastion of strong protection for intellectual property, debate persists about the wisdom of awarding broad patents to biotechnological tools, genetic sequencing, and life forms. This approach is unlikely to be widely adopted in developing countries for the intermediate future.

Copyright-dependent sectors include software, recorded entertainment, electronic broadcasts, databases, and internet commerce. Because computer software falls uncomfortably between copyright and patent principles, it is subject to varying treatment in different countries. Copyright procedures seem adequate in principle for the protection of internet transactions but may require supplementation with technical solutions to endemic problems of appropriability. The protection of databases remains controversial because it could reward activity that is of limited creativity and yet pose potentially significant difficulties for scientific and educational uses of information.

The use of trademarks is widespread in all forms of business. It generally poses little threat to competition while providing important incentives for product development and quality improvements, thereby benefiting consumers and reducing their search costs. Trade secrets permit firms to protect proprietary information that they do not wish to patent. Often such information consists of small and incremental, subpatentable inventions. Trade secrets protection can promote the development of such inventions and also encourage their diffusion into competition via reverse engineering.

Given these potential impacts of IPRs and the growing need, stemming from globalization of technology, to exploit new information in international markets, the registration of intellectual property is expanding rapidly. Patent and trademark statistics point to rising recourse to protection in virtually all countries. Figures on trade, FDI, and licensing receipts suggest further that the relative IPR-intensity of international economic activity is growing.

Nonetheless, these increases are not shared equally across nations. Patent applications from firms in developed economies continue to dominate global registrations. Developing countries continue to be overwhelmingly net importers of technology and new products. Thus, an inherent tension exists between countries at different levels of economic development in their perceived interests in the global and national systems of protection. This theme is developed at length in chapter 4.