Intellectual Property Rights and the World Trade Organization: Retrospect and Prospects

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Abstract

This paper analyzes the main economic issues of intellectual property rights (IPRs) protection in the context of the World Trade Organization (WTO). A retrospective view on the establishment of the TRIPS (trade-related aspects of intellectual property rights) Agreement, a still controversial accomplishment of the Uruguay Round of trade liberalization, is provided. The paper reviews the economic rationale for the harmonization of IPRs, drawing both on economic theory considerations as well as emerging empirical evidence. The logic of linking IPR protection and trade in the context of the WTO is also re-examined. Some specific attention is devoted to the implications of TRIPS for agricultural and biotechnology innovations. The impact that IPR protection can have in promoting growth and development, and the relation of IPRs with other economic policies, is discussed. The paper concludes with an analysis of the prospects for more (or less) IPRs-related consensus in the current round of WTO negotiations.

Keywords: copyrights, cross-border externalities, intellectual property, international trade, patents, trademarks, TRIPS, WTO.

INTELLECTUAL PROPERTY RIGHTS AND THE WORLD TRADE ORGANIZATION: RETROSPECT AND PROSPECTS

"You invent something, and then someone else comes along and does it pretty."
— Picasso

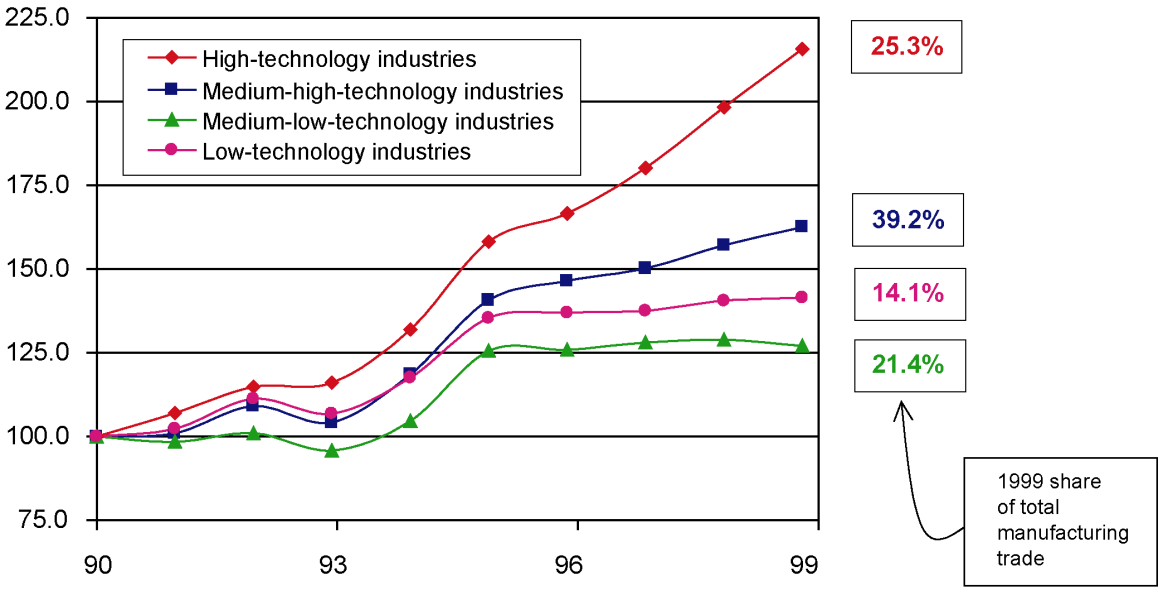
Introduction

The plight of the gifted and rich (and sometimes famous) usually fails to elicit much sympathy. But perhaps what is easily overlooked is that success is hard to win, and often harder to retain. This is very much the case for the products of human inventiveness and creativity—intangible assets that can be quite costly to obtain, that may be extremely valuable to society at large, but that can be copied and/or imitated very easily. Intellectual property rights (IPRs) such as patents, copyrights, and trademarks are quite relevant in that context, allowing the producers of new and/or original work to assert (partial) legal ownership on the outcome of their efforts. The notion of IPRs is a quintessential product of western civilization, rooted in its individualistic view of creativity. Both patents and copyrights appear to have been first used in Renaissance Italy (David 1993), and IPRs in general have evolved into a mainstay of western legal tradition.[1] For most European countries and the United States, a systematic legal framework was first achieved in the nineteenth century. Because IPRs are rooted in the law, they have traditionally been the prerogative of national jurisdictions, although international cooperation in this area, through multilateral treaties and conventions, has a long history. But the internationalization of IPRs got a tremendous boost by the TRIPS (trade-related aspects of intellectual property rights) Agreement, which was incorporated as one of the core agreements constituting the World Trade Organization (WTO) that came into effect on January 1, 1995.

TRIPS is remarkable from both the viewpoint of past trade liberalization efforts undertaken under the aegis of the General Agreement on Tariffs and Trade (GATT), the precursor to the WTO, and from the perspective of international coordination of IPRs as

pursued by numerous previous treaties and agreements in the context of the World Intellectual Property Organization (WIPO). From the perspective of trade institutions and traditions, TRIPS broke from the past by attacking the somewhat arcane issues of IPRs and entirely new subject matter. In so doing, the agreement reaches beyond the border measures that had been, up to that point, the almost exclusive domain of trade liberalization efforts. The need to justify such a less-than-obvious extension of the reach of GATT was very much emphasized by the carefully worded prefix "trade-related" that was used to characterize the new subject matter. From the perspective of previous international efforts at coordinating national IPR rules, TRIPS is remarkable because it bundled together the main provisions of the major (and hitherto separate) international IPR agreements, because it strengthened the requirements of existing agreements in some crucial areas, and because it included the final package as a required element for participation in the WTO (as part of the "single undertaking" process for ratification). Furthermore, enforcement of international IPRs, essentially nonexistent under WIPO, under TRIPS can rely on the WTO dispute settlement mechanism and on the threat of trade sanctions for noncompliance. This expansion of the scope of WTO activities is likely to have important long-run consequences. As one observer put it soon after the conclusion of the Uruguay round, "The farmers and the issues of agricultural subsidies have the limelight. TRIPS, however, will over time play a bigger role in the global economic drama" (Drahos 1995).

A number of sound arguments can be marshaled to explain why IPRs play an increasingly critical role in international economic relations (Maskus 2000). The root of the economic problem is that an increasing share of economic activity worldwide is aimed at the production of goods and services that require considerable R&D investment. Figure 1 provides some indirect evidence in terms of manufacturing trade in OECD (Organization for Economic Cooperation and Development) countries. About two-thirds of such trade is currently accounted for by high and medium-high technology products, and the rate of increase of these products' trade in the 1990s has been much faster than that of other manufacturing products. Furthermore, R&D outputs create the potential for trade in technology *per se*, e.g., transactions involving technology not embedded in intermediate inputs or final products. Table 1, reporting receipts and payments for disembodied



Source: OECD, Science, Technology and Industry Scoreboard 2001.
Notes. Trade is measured as the average value of exports and imports. High-technology industries: Aircraft and spacecraft; Pharmaceuticals; Office, accounting and computing machinery; Radio, television and communication equipment; Medical, precision and optical instruments. Medium-high-technology industries: Electrical machinery and apparatus; Motor vehicles, trailers and semi-trailers; Chemicals excluding pharmaceuticals; Railroad equipment and transport equipment; Machinery and equipment.
Medium-low-technology industries: Coke, refined petroleum products and nuclear fuel; Rubber and plastic products; Other non-metallic mineral products; Building and repairing of ships and boats; Basic metals; Fabricated metal products, except machinery and equipment. Low-technology industries: Manufacturing, and recycling; Pulp, paper, paper products, printing and publishing; Textiles, textile products, leather and footwear; Food products, beverages and tobacco; Wood and products of wood and cork.

FIGURE 1. OECD manufacturing trade by technology intensity (index, 1990=100)

technology transfers, provides some evidence on the current extent of such international exchanges for OECD countries. Quite clearly, the international exchange of high-technology goods and services, and especially of technology itself, relies heavily on the possibility of protecting the underlying R&D investment from expropriation by copying and imitation. Such considerations would seem to establish the need for some international protection of IPRs and the possible scope for joint consideration of IPRs and trade issues. Yet, a number of known international economists have over time expressed skepticisms about the wisdom of including IPRs in the WTO (e.g., Deardorff 1990; Bhagwati 1991; Panagariya 1999; Srinivasan 2002).

TRIPS was controversial before its inception, and it remains so today. The recent debate over access to patented drugs by poor countries, to treat epidemics such as AIDS/HIV, has brought the problem to the attention of the public at large. Additional

TABLE 1. Technology balance of payments, 1999 (millions of U.S. dollars)

	Receipts	Payments	Balance
Canada	1,874	1,152	722
Mexico	64	452	-389
United States	36,467	13,275	23,192
Australia	103	225	-122
Japan	8,435	3,602	4,833
Korea	141	2,387	-2,246
New Zealand	5	9	-4
Austria	2,348	2,553	-205
Belgium-Luxembourg	5,099	4,238	861
Denmark	1,657	1,055	602
Finland	109	63	46
France	2,590	3,124	-534
Germany	12,513	16,218	-3,705
Ireland	528	8,820	-8,292
Italy	3,367	4,236	-868
Norway	917	1,241	-324
Poland	129	668	-539
Portugal	311	809	-498
Spain	191	1,025	-835
Switzerland	2,985	1,338	1,647
United Kingdom	6,081	3,172	2,909
European Union*	41,675	51,787	-10,112
Total OECD*	90,984	73,624	17,360

Source: OECD Science, Technology and Industry Scoreboard, 2001.
Notes: The data comprise unaffiliated and affiliated transfers of disembodied technology including patents (purchases, sales), licenses for patents, un-patented know-how, models and designs, trademarks (including franchising), technical services, and finance of industrial R&D outside national territory. The data do not cover: commercial, financial, managerial and legal assistance; advertising, insurance, transport; films, recordings, material covered by copyright, and software.
* = Includes intra-zone flows.

efforts at understanding the complex issues involved are perhaps warranted. The purpose of this paper is to provide a retrospective view and a tentative assessment of the role of IPRs in the WTO and to venture a few considerations on the prospects for IPRs in the current round of multilateral trade negotiations.

Intellectual Property Rights

IPRs are property rights defined over intangible assets that are the result of human inventiveness and creativity. Patents, copyrights, trademarks, and trade secrets are the most common forms of IPRs, although related but distinct forms of intellectual protection exist to deal explicitly with specific types of innovations (Moschini 2003).

Patents are arguably the strongest form of IPRs. A patent typically is issued by a government agency—in the United States, for example, the Patent and Trademark Office (PTO)—upon successful evaluation of an application. It confers to the inventor the sole right to exclude others from economically exploiting the innovation (by making it, using it, selling it, etc.) for a limited time (20 years from the date of filing, for most countries). To be patentable, an innovation must be novel in the sense of not constituting part of the prior art. The innovation must also involve an inventive step (it must be non-obvious to a person with ordinary skills in the particular field of application), and it must be useful (the innovation must permit the solution of a particular problem in at least one application). A major requirement of a patent application is disclosure: the patent application must describe the invention in sufficient detail to enable those skilled in the particular field to practice it. The foregoing describes so-called "utility patents," the most important and common kind (see Merges 1997 for more details). The subject matter of such patents encompasses machines, industrial processes, composition of matter, and articles of manufacture.[2] Other patents that can be obtained concern "industrial design," which protects visual aspects of a product (as opposed to its technical features), and "utility model" (petty) patents.

Copyrights apply to original works of authorship, such as books, photographs, sound recordings, motion pictures, and other artistic works in general. An explicit condition for such creative expressions to claim protection by copyrights is that they be fixed in a tangible medium (because copyrights protect the form of expression rather than the subject matter). Unlike patents, there is no novelty or usefulness requirement, although there are conditions of originality (the work has not been copied) and authorship. Registration may be possible, but typically property rights under copyright statutes exist independently of such a formality. Protection under copyrights typically extends for the

lifetime of the owner plus 50 years (lifetime of the owner plus 70 years in the United States and the European Union).

A trademark is a sign, word, symbol, or device (which may include or combine letters, numbers, pictures, emblems, etc.) that distinguishes the goods or services of an enterprise from those of others. No novelty or originality is necessary, but the main requirement is distinctiveness (a mark cannot be a generic description). For trademarks to be valid they typically have to be registered (in the United States, for example, with the PTO). Any unauthorized use of a mark identical (or confusingly similar) to a valid trademark is prohibited. Protection of trademarks does not have a time limit, provided the trademarks are used and renewed periodically.

Trade secrets cover any confidential business information—including formulae, devices, methods, techniques, and processes—that may confer an advantage over competitors from the fact that it is not generally known. For trade secret protection to apply, the general requirement is that reasonable efforts be undertaken to maintain secrecy. More specifically, protection is extended against another party's discovery by inappropriate means, but a trade secret offers no protection against independent discovery or reverse engineering.

Specific IPR instruments suited to particular types of innovations (*sui generis* systems) have been developed. Of interest to agriculture is the protection of plant innovations through so-called Plant Breeder's Rights (PBRs). For example, in the United States such rights are defined by the 1970 Plant Variety Protection Act, whereby the U.S. Department of Agriculture (USDA) can issue Plant Variety Protection (PVP) certificates. Varieties claiming a protection certificate must be new and must satisfy requirements of distinctiveness, uniformity, and stability. The protection offered by PVP certificates is similar to that provided by patents (including a standard 20-year term) with two qualifications. First, there is a "research exception," meaning that protected varieties may be used by others for research purposes (e.g., to develop other new varieties). Second, there is a "farmer's privilege," that is, seed of protected varieties can be saved by farmers for their own replanting (but farmers are prohibited from reselling protected seeds). Other important *sui generis* IPRs include Integrated computer circuit rights, which protect the layout design of integrated computer circuits

(chips). Unlike patents, novelty and nonobviousness are not required here (originality suffices). Geographical indications (as applying for example to wine and spirits in TRIPS) are meant to protect reputation about quality that is associated with a particular region of origin. It is similar to a trademark, but it is not privately owned. Database rights are meant to prevent unauthorized use of database compilations (but do not confer exclusive rights to the data themselves). At present such rights are available in the European Union but not in the United States.

Intellectual Property Rights in an International Setting

As noted earlier, although IPR protection is rooted in the law and as such is the prerogative of national jurisdictions, international cooperation in this area, through multilateral treaties and conventions, has a long tradition dating back to the nineteenth century. Prior to TRIPS, virtually all international treaties and conventions dealing with IPRs were administered by WIPO, a United Nations agency with headquarters in Geneva, Switzerland. A cornerstone of this system is the 1883 Paris Convention for the Protection of Industrial Property, the most recent substantive version being the 1967 Stockholm revision (164 countries are currently party to this convention). This convention provides that each country extends to the citizens of other countries the same patent rights available to its own citizens (the principle of "national treatment"). It also allows for a right of priority, such that upon filing in a member nation an inventor can, within one year, seek protection in other countries with the original filing date applying. The 1979 Patent Cooperation Treaty (PCT) is meant to facilitate filing for patent protection for the same invention in member countries by providing centralized filing and standardized application procedures. In connection with patents, WIPO also administers the 1977 Budapest Treaty, which governs the deposit of microorganisms or biotechnology products as required for patent filing.

The 1986 Berne Convention for the Protection of Literary and Artistic Works (its last main revision was in 1971) is the major international treaty that applies to works protected by copyrights. Signatories are required to afford foreign authors the same rights available to their own nationals, including the right of enforcement, and to establish a minimum copyright term (the life of the author plus 50 years). The 1961 Rome Conven-

tion extends copyrights protection to sound recording, performers of music, and radio and television broadcasts. Trademarks are protected by several international treaties, including the aforementioned Paris Convention, which assure national treatment as well as protection of well-known marks worldwide. There are many other conventions and treaties that apply to IPRs; see WIPO (2001) for more details.

International coordination of PBRs is an exception in that it is not the prerogative of WIPO. Instead, PBRs are managed by the International Union for the Protection of New Varieties of Plants (UPOV, after its French acronym), an intergovernmental organization with headquarters in Geneva. UPOV was established in 1961, and later revisions to its convention (1972, 1978, and 1991) tightened the characterization of the rights involved. The latest UPOV convention (1991) allows countries to provide protection for new varieties with both PVP certificates and utility patents, and allows (but does not require) countries to permit farmers to save protected seeds for replanting.

The TRIPS Agreement

In some ways, TRIPS was the outcome of an unprecedented effort initiated by a broad coalition of business interests, mostly from the United States. This fascinating story, as told by Drahos (1995) and Matthews (2002), starts with the poor performance of U.S. corporations in the 1980s and the associated fear of a secular decline in their international competitiveness. It was concluded that, vis-à-vis the competition of Japanese firms for example, the United States was experiencing a massive free rider problem on its ideas and expertise. Stronger IPRs abroad seemed a natural and simple solution. The idea of linking IPRs and trade was pursued vigorously by business representatives from a few industries, especially from pharmaceutical, chemical, and computer-related companies, a line of attack that eventually won over initially reluctant copyright-based industries (such as music and entertainment). This broad-based, single-issue agenda first succeeded in convincing Congress to amend the "Section 301" provisions of the U.S. Trade and Tariff Act in 1984, making failure to protect IPRs by any country actionable with trade sanctions. This tool, and the subsequent "Special 301" of 1988, proved quite useful in the U.S. carrot-and-stick approach to bilateral trade negotiation, and also allowed a closer cooperation between business interests and the office of the U.S. Trade Representative.

With the support of Europe and Japan, IPRs were successfully included in the negotiating agenda for the Uruguay Round. As articulated in the ministerial declaration of Punta del Este in September 1986, the aspirations in this area were somewhat modest, being focused mostly around the issue of trade in counterfeit goods and the role that IPRs and GATT rules ought to play in that context. But what emerged at the end was a much more sweeping and ambitious program, one that made TRIPS probably the most important international agreement on IPRs ever.

A summary of the main elements of TRIPS is reported in the Appendix. It is clear that the scope of TRIPS is quite extensive, as it covers copyright and related rights (i.e., the rights of performers, producers of sound recordings and broadcasting organizations); trademarks, including service marks; geographical indications, including appellations of origin; industrial designs; patents, including the protection of new varieties of plants; the layout designs of integrated circuits; and undisclosed information, including trade secrets and test data. Perhaps more important are the main principles enshrined in TRIPS: national treatment, most-favored-nation, and minimum standards. National treatment requires that the same rights be equally available to nationals and foreigners, and it has been a cardinal element of virtually all the previous efforts at coordinating international IPRs. But the other two principles are new to the international arena concerning IPRs. The most-favored-nation (MFN) clause (equal treatment for nationals of all trading partners in the WTO) is, of course, central to other WTO agreements, and it has the potential to amplify increased IPR protection that may result from bilateral negotiations.[3]

It is in the setting of minimum standards,[4] however, that TRIPS provides perhaps the most ambitious departures from existing international IPR coordination. In particular, the agreement mandates that minimum standards of IPR protection be provided by each member in each of the main areas of intellectual property that it covers. This is achieved by spelling out the subject matter to be protected, the rights to be conferred (and what the permissible exceptions to those rights are), and the minimum duration of protection. The main obligations of the Paris Convention and of the Berne Convention are incorporated by reference and must be complied with.[5] Except for the Berne Convention provisions on moral rights, all the main provisions of these conventions became obligations under the

TRIPS Agreement between WTO member countries because of the "single undertaking" approach of the WTO (there is no opt-out choice).

The TRIPS Agreement also adds a number of additional new obligations not contemplated by previous conventions. Patent protection must be accorded for both products and processes, for at least 20 years, in almost all fields of technology. Plant varieties must be protected, either by patents or by a *sui generis* protection system (such as PBRs). Domestic production of a patented product cannot be required in order to enjoy the rights of a patent holder. With respect to trademarks, the requirement that foreign marks be used in conjunction with local marks is prohibited, and cancellation of a mark on the grounds of nonuse is restricted. TRIPS departs from pre-existing norms by ensuring that computer programs be protected by copyrights under the provisions of the Berne Convention. It also introduces provisions on rental rights (e.g., authors of computer programs and producers of sound recordings have the right to authorize or prohibit the commercial rental of their works). With respect to geographical indications, a higher level of protection is provided for wines and spirits (which are protected even when there is no danger of the public's being misled). With respect to the protection of layout designs of integrated circuits, TRIPS extends the incorporated treaty provisions by requiring a minimum protection period of 10 years, and that the rights must extend to articles incorporating infringing layout designs. Trade secret protection is explicitly imparted by TRIPS. In particular, test data submitted to governments in order to obtain marketing approval for pharmaceutical or agricultural chemicals must be protected against unfair commercial use.

In addition to spelling out the rights on intellectual property to be provided by members, TRIPS also addresses obligations related to the enforcements of those rights. Member governments must provide procedures and remedies under their domestic law to ensure that IPRs can be effectively enforced. The procedures provided must be fair and equitable, should not discriminate against foreigners, and must not be unnecessarily complicated, costly, or subject to unreasonable time delays. Notable enforcement obligations include rules for obtaining evidence (in some cases reversing the burden of proof), and the availability of provisional measures, injunctions, damages, and other penalties. Also, willful trademark counterfeiting or copyright piracy on a commercial scale must be

treated as a criminal offense. Governments must also ensure that the assistance of customs authorities be made available to prevent imports of counterfeit and pirated goods.

A fundamental feature of TRIPS is that, by taking IPR protection under the aegis of the WTO, international enforcement of IPRs can be pursued within the structure available to enforce compliance with trade rules. A Council for TRIPS was established to monitor the operation of the agreement and governments' compliance with it. Perceived failures by member governments can be pursued under the integrated WTO dispute-settlement procedures. In particular, the threat of trade sanctions is expected to considerably strengthen the international enforcement of IPRs.

TRIPS envisioned a differentiated phase-in period for WTO member states' compliance. Specifically, relative to its January 1995 date of birth, TRIPS allowed for a one-year transition period for developed countries to bring their legislation and practices into compliance. Developing countries and (under certain conditions) transition economies were given five years, whereas least-developed countries (LDCs) were allowed an 11-year transition period.[6] Theoretically, therefore, all WTO contracting parties should be in full compliance with TRIPS as of January 2006. But LDCs are allowed, under article 66, to seek postponement of their obligations to implement TRIPS. In addition, in the 2001 Doha Declaration on the TRIPS Agreement and public health, LDCs were given an extension (until January 2016) for implementing their obligations related to pharmaceuticals.

More on Agriculture-Related Intellectual Property Rights

Agriculture-related innovations enjoy a somewhat special and rather complicated set of IPRs, the effects of which have been mostly ignored, until recently, in economic analyses of agricultural innovations (Moschini and Lapan, 1997). Under TRIPS, plant and animal innovations need not be protected by patents, and indeed, they often are not. In the United States, however, the landmark 1980 U.S. Supreme Court decision in *Diamond v. Chakrabarty* opened the door for patent rights for virtually any biologically based invention, if obtained through human intervention. And in its 2001 ruling in *J.E.M. Ag Supply, Inc. v. Pioneer Hi-Bred International, Inc.,* the U.S. Supreme Court held that plant seeds and plants themselves (both traditionally bred or produced by genetic engineering) are patentable under U.S. law (Janis and Kesan, 2002). But plant varieties, for

example, are explicitly not patentable in Europe by the statute of the European Patent Office.[7] PBRs, in the blueprint provided by UPOV, are more commonly used internationally for plant varieties, and in fact they may become the *sui generis* IPR system allowed for by TRIPS in this area. But PBRs are clearly weaker than patents, mostly because they allow for a "research exception" and for the farmer's right to save seed for replanting (the "farmer's privilege"). Trade secrets also can be quite important for plants, at least in developed countries. For example, Pioneer Hi-Bred International successfully used trade secrets to protect its germplasm in at least two high-profile cases (against Holden Foundation Seeds, Inc. in 1991, for a judgment worth an estimated $46.7 million, and against Cargill, Inc. in 2000, for a settlement estimated at $100 million). Other instruments can be brought to bear on private companies' attempts to assert ownership of plant innovations. These include the use of hybrids (provided parent lines can be protected, possibly by trade secrets, patents, or PBRs), genetic use restriction technologies made possible by recent biotechnology innovations (such as the so-called terminator gene), and specific contractual arrangements such as the "bag-label" contracts that are common in the United States (Boettiger et al. 2003).

There are also other conventions, treaties, and initiatives that attempt to shape the ongoing evolution of international IPRs in agriculture, often with reference to development issues and biodiversity. These include the 1992 Convention on Biological Diversity (CBD) and the 2001 International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA) (Dutfield, 2000; Boettiger et al., 2003). One of the aspects of CBD was the assertion of national sovereignty over biological resources, a response to concerns over the perceived "biopiracy" associated with bioprospecting activities by pharmaceutical firms. Current discussions of the role of IPRs in implementing the goals of the CBD center on their effects on access to genetic resources, more equitable sharing of the benefits thereof, as well as protection of the practices of indigenous and local communities (Dutfield, 2003). One of the main objectives of the IT-PGRFA, developed under the auspices of the Food and Agriculture Organization of the United Nations, is to preserve and further the free exchange of germplasm, with the ultimate goal of furthering food security for the world. The IT-PGRFA envisions the establishment of a multilateral system for the sharing of plant materials governed by standardized material transfer

agreements. One of the implicit principles of this vision is to consider existing biodiversity as a "common heritage" of mankind, a view somewhat at odds with the national sovereignty espoused by the CBD. The IT-PGRFA also makes reference to "farmers' rights," a somewhat vague notion asserting rights arising from the past, present, and future contributions of farmers in improving and conserving plant genetic resources. The aim here, similar to some objectives of the CBD, is to include farmers in the sharing of benefits that may arise from subsequent innovations, as carried out by seed companies and possibly protected by patents, for example (Boettiger et al. 2003).

Much of the modern agriculture-related R&D concerns biotechnology innovations. Biotechnology as such is not mentioned in TRIPS, but inventions and activities usually associated with biotechnology are, and it turns out that TRIPS provides quite a bit of flexibility in this area. As noted, plants and animals may be excluded from patentability. Essentially biological processes may also be excluded from patentability, but patents must be provided for microorganisms, and for microbiological processes for producing plants or animals.[8] Also, as noted earlier, TRIPS mandates that plant varieties must be protected, either by patents or by a *sui generis* system such as PBRs.

That the rise of biotechnology has relied crucially on access to patents is illustrated, for the United States, in Table 2. Over the last decade, biotechnology patents have

TABLE 2. U.S. patents and biotechnology patents

Year	All Patents	Molecular Biology and Microbiology	Multicellular Living Organisms	Maize and Soybean Plants
1991	96,513	1,562	29	1
1992	97,444	1,968	48	13
1993	98,343	2,258	38	2
1994	101,676	2,179	99	31
1995	101,419	2,252	91	20
1996	109,646	3,086	253	63
1997	111,984	4,142	281	52
1998	147,521	6,132	497	154
1999	153,493	6,220	670	199
2000	157,497	5,601	630	204
2001	184,172	6,281	665	162
2002	184,531	5,738	554	103

Source: U.S. Patent and Trademark Office.

increased at a much faster rate than overall patenting, and this growth is even higher for multicellular living organisms (the patent class that comprises plants and animal innovations of direct interest to agriculture). The last column of Table 2 also shows that, in the United States, patents are being used fairly extensively to claim plant varieties and inbred lines, something that specifically is not possible in most other jurisdictions. A concern that has arisen recently in biotechnology refers to the fragmentation of IPR ownership. The problem is that producing a complex innovation (such as a transgenic crop) typically requires a number of intermediate inputs that are patented. Insofar as the patented inputs are highly complementary, the patent owners for these inputs essentially hold blocking power, so that the manufacturer of the innovation may become susceptible to hold-up. This is essentially the notion of the "tragedy of the anticommons" discussed by Heller and Eisenberg (1998). Related concerns refer to the "freedom to operate" in a research area in which many necessary tools are patented and there is extreme fragmentation on IPRs, although the constraints here may be less binding in an international context (Binenbaum et al. 2003).

The Economics of Intellectual Property Rights

The crucial feature of IPRs, from the perspective of economics, is that they deal with something valuable that can be easily reproduced. The implications are best illustrated for the case of patents. As discussed earlier, patents (*a*) deal with new knowledge, as embodied in an innovative product or process, and (*b*) confer (limited) exclusive (i.e., monopoly) rights to the inventor. New knowledge that makes possible the production of new products and/or processes is potentially very valuable, but it has features that make it problematic for the market system to handle properly because knowledge is a quintessential "public good" (Arrow 1962). Pure public goods have two distinguishing attributes. First, they are non-rival in consumption, which means that use of the good does not affect the amount of it that is available for others. Second, they are nonexcludable, which means that it is not possible to prevent individuals from using a public good once it is available. Clearly, absent legal means to prevent that, most discoveries and inventions would exhibit public good attributes. The problems that arise in a competitive market system are readily apparent. An inventor may bear all the cost of an innovation, but everyone can

benefit (possibly to varying degrees) from a discovery, and thus everyone has an incentive to "free ride" on the innovative efforts of others. The externalities associated with such public goods give rise to a potentially serious market failure. Absent IPRs, economic agents may lack sufficient incentives to undertake costly innovation activities, and thus a competitive market system would typically provide an inefficiently low level of innovations. Because the nonappropriability of knowledge is what lies at the heart of this market failure, IPRs can be quite useful in that they provide a legal means of affecting the excludability attributes of an otherwise pure public good.

Closed (Integrated) Economy Considerations

Whereas the exclusive privileges offered by IPRs clearly improve on the incentives available to would-be innovators, it is clear that they only represent a second-best solution. In particular, by essentially creating monopolies, IPRs introduce a novel source of distortions into the economic system. *Ex ante,* it may be beneficial to provide incentives in the form of exclusive rights, because that may bring about innovations that would not otherwise take place. But *ex post,* the monopoly position granted by the exclusivity of IPRs is inefficient. Given that an innovation is available, *ex post* efficiency would prescribe that it be used as widely as possible, that is, be made available at marginal production costs. But that is precisely what a profit-maximizing monopolist will not do. This brings to the fore the essential economic trade-off inherent in most IPRs systems: there are dynamic gains because of improved innovation incentives, but there are static losses because of restricted use of the innovation. Earlier economic analysis focused extensively on the inefficiency associated with the artificially created monopoly and questioned the economic desirability of the patent system (see Machlup and Penrose 1950 for an enlightening reconstruction of the nineteenth-century patent debate). But modern economics recognizes the tangible benefits of an IPR system, along the lines anticipated by John Stuart Mills:[9]

> The condemnation of monopolies ought not to extend to patents … [A]n exclusive privilege, of temporary duration is preferable [to a cash reward paid by the state]; because it leaves nothing to anyone's discretion; because the reward conferred by it depends upon the invention being found useful, and the greater the usefulness, the greater the re-

> ward; and because it is paid by the very person to whom the service is rendered, the consumers of the commodity.

To illustrate the main economic rationale for, and features of, IPR protection, consider an economy where there is a continuum of potential inventors, each with a unique possible innovation that is indexed by the parameter $\theta \in (0, \bar{\theta}]$. To represent the fact that each potential innovation has a different social value, we will assume that the willingness to pay is the same for all innovations, but that each innovation entails a different R&D cost. Specifically, the per-period marginal willingness to pay (the aggregate inverse demand function) for each innovation is written as

$$p = \alpha - \beta q .$$

Once developed, each innovation can be produced at a constant unit cost c and yields a flow of benefits (as per the above demand function) forever. For analytical convenience (and without loss of generality), set $c = 0$, such that the potential per-period benefit from each innovation (which would be attained if the innovation were efficiently supplied) is $\alpha^2/(2\beta)$, and thus the potential (gross) value to society of the innovation is $\alpha^2/(2\beta r)$, where r is the discount rate. Let the possible innovations be ordered according to their cost, and for simplicity write the fixed cost $F(\theta)$ of developing the θ innovation as $F(\theta) = \theta^2$. Thus, all innovations for which $\theta \le \theta^*$, where $\theta^* = \sqrt{\alpha^2/(2\beta r)}$, should be undertaken. But if innovations can be copied costlessly, no one has an incentive to innovate in a competitive setting.

Suppose now that a patent of length $T > 0$ is available to innovators, such that they can behave as a monopoly for T periods. Monopolistic pricing yields a per-period profit of $\alpha^2/(4\beta)$ for each innovation undertaken, such that the present value to the innovator (assuming that the same discount rate r applies) is

$$\pi_0 = \int_0^T \frac{\alpha^2}{4\beta} e^{-rt} dt \quad = \frac{\alpha^2}{4\beta r}\left(1 - e^{-rT}\right).$$

With this patent system, all innovations for which $\pi_0 \geq F(\theta)$ are undertaken, that is, all innovations for which $\theta \leq \hat{\theta}$, where

$$\hat{\theta} = \sqrt{\frac{\alpha^2(1-e^{-rT})}{4\beta r}}.$$

RESULT 1. *A patent system improves welfare, relative to a competitive innovation system, but the resulting flow of innovations is still less than socially desirable (i.e.,* $0 < \hat{\theta} < \theta^*$*).*

With patents, the total (gross) surplus from each innovation that is undertaken is

$$S_0 = \int_0^{\infty} \frac{3\alpha^2}{8\beta} e^{-rt} dt + \int_T^{\infty} \frac{\alpha^2}{8\beta} e^{-rt} dt \quad = \frac{\alpha^2}{8\beta r}\left(3 + e^{-rT}\right)$$

where the formulation accounts for the fact that after T periods the innovation will be competitively available at zero cost. To derive an explicit solution for the optimal patent life, assume that θ is uniformly distributed, such that the total R&D cost $R(\hat{\theta})$ of undertaking all innovation projects for which $\theta \leq \hat{\theta}$ is

$$R(\hat{\theta}) = \int_0^{\hat{\theta}} F(\theta) d\theta \quad = \frac{1}{3}\left(\frac{\alpha^2}{4\beta r}\right)^{3/2} \left(1 - e^{-rT}\right)^{3/2}.$$

Hence, the net total welfare from all innovations undertaken with a patent of length T is

$$W \equiv \hat{\theta} S_0 - R(\hat{\theta}) \quad = \frac{1}{6}\left(\frac{\alpha^2}{4\beta r}\right)^{3/2} \left[3\left(3 + e^{-rT}\right)\left(1 - e^{-rT}\right)^{1/2} - 2\left(1 - e^{-rT}\right)^{3/2}\right].$$

The optimal patent length T^* satisfies $\partial W / \partial T = 0$, and thus in this model,

$$T^* = \frac{\ln(5)}{r}.$$

RESULT 2. *The optimal patent life is finite.*

This result displays the often-mentioned trade-off, for a patent system, between dynamic efficiency (more innovations) and static efficiency (larger quantities of any given innovation) (e.g., Nordhaus, 1969). Although setting $T = \infty$ would increase the flow of

innovations, that is not optimal because each innovation is underprovided by the monopolist. With $T < \infty$, fewer innovations are developed, but each one is efficiently supplied after T periods. The market for a typical innovation is illustrated in Figure 2A (for the case $c > 0$), where q^M represents the monopolistically supplied innovation for the duration of patent protection, and q^C represents the efficient level of *ex post* provision of the innovation.

Now suppose that the economy grows, such that the aggregate demand for each innovation expands. This change can be parameterized by increasing α or by decreasing β. The former may be appropriate when a given economy becomes wealthier; the latter may represent an economy that is enlarged by adding more regions to it (cf. Figures 2.A and 2.B). Either way, such growth entails that more innovations are desired by the economy (θ^* increases). But because the optimal patent T^* is independent of α and/or β, it follows that:

RESULT 3. *The optimal patent life is invariant to the size of the economy.*

Thus, ceteris paribus (and abstracting from strategic considerations to be discussed in what follows), small and large economies have equal scope for patent protection in this model. Whereas this result is somewhat special and due to the particular modeling structure, there is a related general point. For any given innovation, a growth in demand

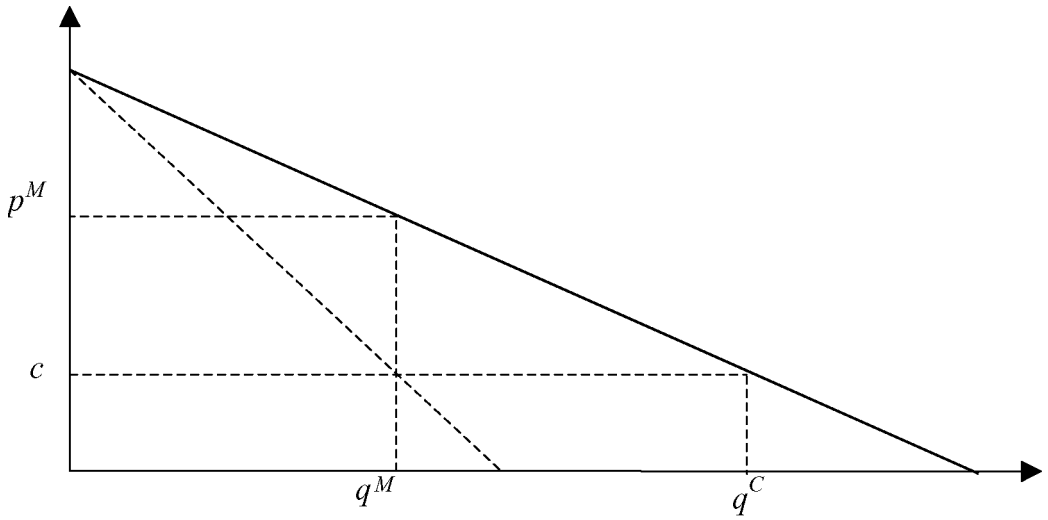


FIGURE 2.A. Patents and the incentive to innovate: integrated economy

allows larger monopoly profit and thus would suggest that a shorter patent length is needed to justify incurring the required fixed R&D cost. But a wealthier economy desires more innovations (i.e., the first-best level of R&D increases with the size of the economy because innovation is a public good, and thus its efficient provision is governed by the Samuelson condition which relates to the "sum" of the marginal willingness to pay). The incentive for private R&D under IPRs, because it derives from the profits that a monopolist can realize, is already directly affected by an expansion of the economy, and thus no strengthening (or weakening) of IPRs may be necessary.[10]

Open Economy Considerations

The model of Figure 2A represents a closed economy, but it may as well represent the integrated world economy. Suppose that the world is made up of two (identical, for the sake of simplicity) countries with independent IPR regimes, as represented in Figure 2B. The international dimension of IPR protection is immediately apparent. If neither country protects IPRs, there are no incentives for private agents to undertake the required R&D to develop the new product. If both countries protect IPRs equally, then the solution is the same as with the integrated economy, and $\pi_1 + \pi_2 = \pi_0$. If only one country, say country 1, provides patent protection, then the per-period profit for the would-be innovator is $\pi_1 < \pi_0$. Two possibilities arise in this context. First, π_1 is large enough, relative to the R&D costs F, so that the innovation is undertaken anyway. Consequently, country 1 has the same price and quantity provision as with the integrated (and IPR protected) economy case, whereas country 2 has access to the innovation at the competitive price $p^C = c$ with efficient quantity provision q^C. Restricting the attention to this one innovation, and conditional on the innovation being undertaken anyway, there would seem to be no dynamic gains from increased IPR protection, and doing away with IPRs in country 2 increases the consumption of the new product and therefore increases welfare. But such potential welfare gains (relative to the integrated and protected economy) are extremely uneven because they all accrue to country 2 (consumers in the IPR-protected country essentially subsidize those in the country without IPRs). The second case, however, is

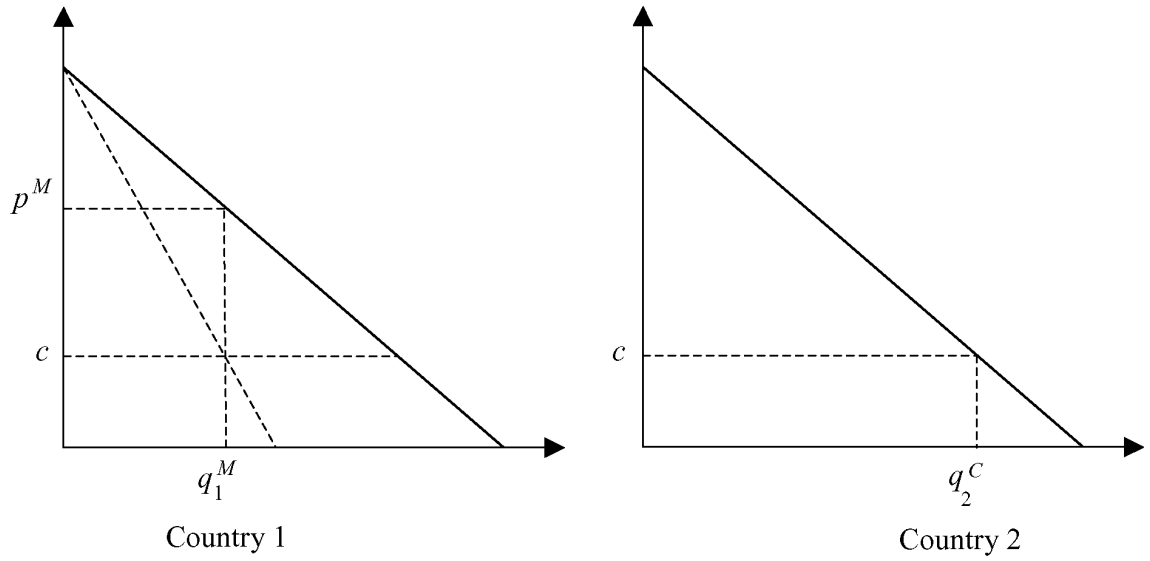


FIGURE 2.B. Patents and the incentive to innovate: two-country model

that π_1 is not large enough (relative to F) to justify investment in R&D, and so no innovation takes place. In such a case both countries lose from the absence of IPRs in one of the countries. More to the point, however, is that IPR protection cannot be tailored to one product, and discussing welfare implication in just one market is misleading. As the analysis of the simple model considered earlier illustrates, weakening IPR protection also means that not enough incentives exist for some products, and the resulting insufficient level of innovation is deleterious to welfare.

Although somewhat simplistic, the framework just discussed brings forth the additional considerations that pertain to the economics of IPRs in an open economy, namely the existence of cross-border externalities, with calls for a coordinated policy response. That such externalities are potentially quite sizeable is illustrated by Table 3, which reports R&D expenditures as a percentage of gross domestic product for a large collection of countries. It is apparent that global R&D efforts are quite unevenly distributed across countries. The few developing countries included in this table display very low R&D expenditures; indeed, for most developing countries R&D is, at present, insignificant. To illustrate some effects of an increase in IPR protection as engineered by TRIPS, suppose that Figure 2B illustrates the *status quo ante*, with country 1 already offering patent protection and country 2 without patent protection, and consider the *ex pos*t situation where the innovation has already taken place. The effect of strengthening IPRs

TABLE 3. R&D as a percentage of gross domestic product

Country	Percent	Country/Region	Percent
Sweden (1997)	3.70	Brazil (1996)	0.91
Japan (1999)	3.01	Spain (1999)	0.89
Finland (1998)	2.89	Slovak Republic (1998)	0.86
Switzerland (1996)	2.73	Cuba (1999)	0.83
United States (1999)	2.63	Poland (1999)	0.75
South Korea (1998)	2.55	China (1998)	0.69
Israel (1997)	2.54	South Africa (1998)	0.69
Germany (1999)	2.38	Hungary (1999)	0.68
France (1999)	2.17	Chile (1997)	0.63
Denmark (1999)	1.99	Portugal (1997)	0.62
Belgium (1999)	1.98	Romania (1998)	0.54
Taiwan (1998)	1.97	Greece (1997)	0.51
Netherlands (1998)	1.95	Turkey (1997)	0.49
Iceland (1999)	1.88	Argentina (1999)	0.47
United Kingdom (1999)	1.87	Colombia (1997)	0.41
Canada (1999)	1.85	Mexico (1997)	0.34
Austria (1999)	1.82	Panama (1998)	0.33
Norway (1999)	1.73	Bolivia (1999)	0.29
Australia (1998)	1.49	Uruguay (1999)	0.26
Singapore (1997)	1.47	Malaysia (1996)	0.22
Slovenia (1997)	1.42	Trinadad and Tobago (1997)	0.14
Ireland (1997)	1.39	Nicaragua (1997)	0.13
Czech Republic (1999)	1.27	Ecuador (1998)	0.08
Costa Rica (1996)	1.13	El Salvador (1998)	0.08
New Zealand (1997)	1.13	Peru (1997)	0.06
Italy (1999)	1.04		
Russian Federation (1999)	1.06	Total OECD (1998)	2.18
		European Union (1998)	1.81

Source: U.S. National Science Foundation, *Science & Engineering Indicators, 2002.*

in country 2, to the standards of country 1, is to reduce consumption and welfare in country 2, and to provide a profit windfall of π_2 to the innovator. And, if the innovator is in country 1, that means new monetary transfer that country 2 must make to country 1. Understandably, countries with lower IPR protection can see immediate negative effects to strengthening IPRs.

More can of course be said about the economics of IPRs in an international context. Deardorff (1992) presents a model where limiting patent protection geographically may be desirable. As discussed earlier, the optimal trade-off between dynamic gains and static losses calls for limiting the monopoly power granted to the innovator, that is, a finite

patent life. The analogy here is that, for a given patent life, extending the set of countries providing IPRs should, from a welfare perspective, proceed only as far as necessary to provide enough innovation incentive, and no more. But, as the invariance in Result 3 discussed earlier illustrates, Deardorff's (1992) result on this point is special to his model.

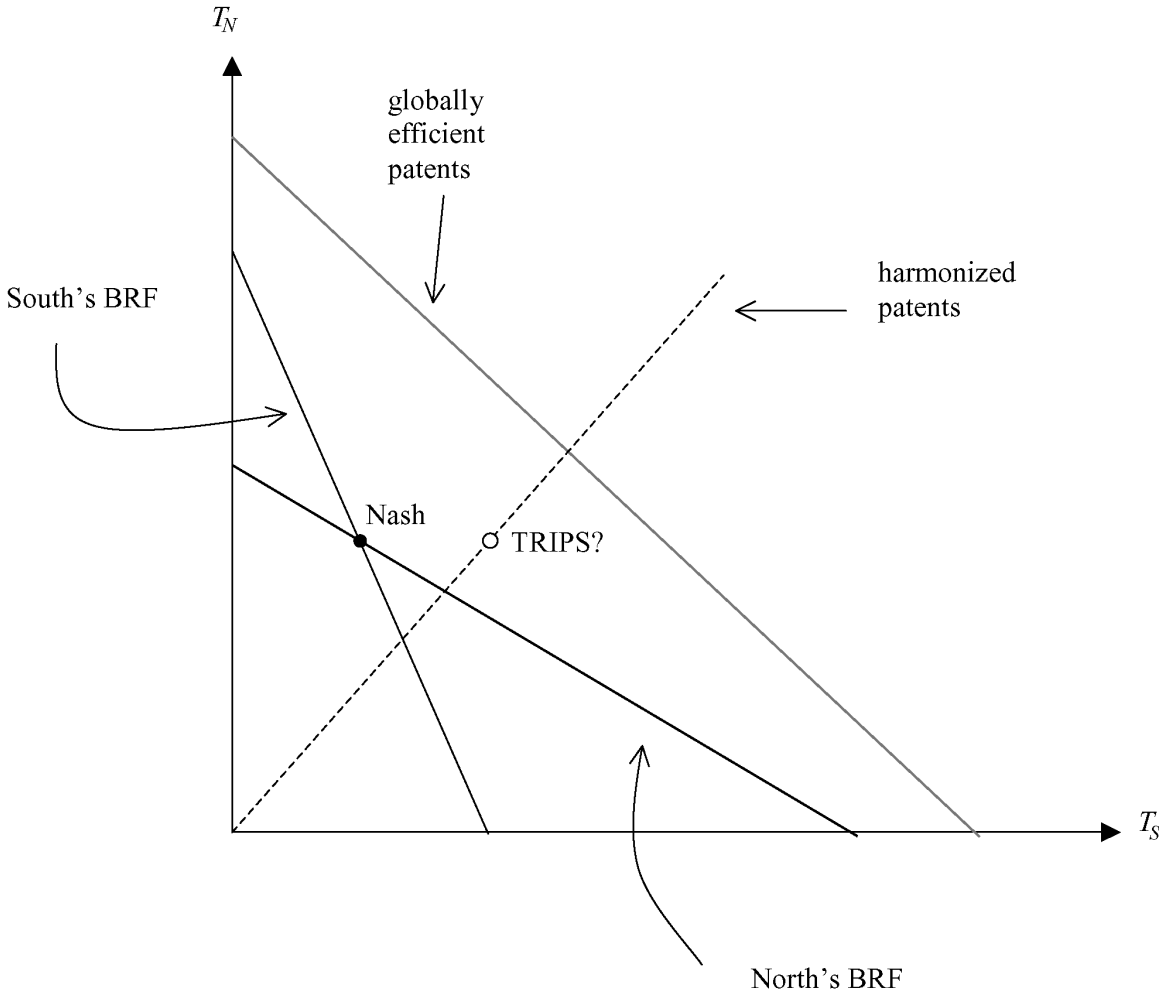
Deardorff (1992) assumes that inventions can take place only in one country, and the question is whether IPR protection should be extended to other countries that only consume the innovation product. A similar approach is taken by Chin and Grossman (1990), who model innovation in an international duopoly with two countries, each with one producer of a homogeneous product, and Cournot competition in the integrated final market. Innovation can take place only in one country (the "North"), where R&D investment can achieve a reduction in the unit cost, but this process innovation can be imitated at no cost by the firm in the "South" if no IPR is provided there. This set-up brings to the fore the typically conflicting interests that countries face in this context. Whereas the North always benefits from IPR protection in the South, the South may lose or may gain from such a policy change. Indeed, global efficiency need not be increased in this model either, and the world may well be worse off by increased protection. In contrast to these models, Helpman (1993) treats innovation as an ongoing process in a North-South dynamic general equilibrium model rooted in the endogenous growth literature. Only the North can innovate, and innovations are diffused to the South through imitation (the rate of which is taken to be a measure of the strength of IPRs in the South). Helpman shows that the South is unlikely to benefit from tighter IPRs. The North may or may not benefit from stronger IPRs in the South (unlike the aforementioned studies, in Helpman's [1993] model there are conditions where no conflict exists between the interests of North and South: with initial low rates of imitation both regions could benefit from relaxing IPRs). Diwan and Rodrik (1991) provide a somewhat different perspective by emphasizing that North and South may have different innovation needs (i.e., different tastes) such that strengthening IPR protection in any region induces a more favorable distribution of innovations suited for that region. Although only the North can innovate in their model, it is not necessarily the case that weaker IPR standards improve the welfare of the South.

An issue quite germane to the economics of international IPRs, when viewed in the context of international harmonization, concerns the properties of an uncoordinated IPR

equilibrium and the scope for negotiated multilateral improvements. The knowledge and information generated by new discoveries can easily move across national borders, and therefore policies that can affects the flow of innovations, such as IPR protection, generate (typically uncompensated) externalities on other countries. When IPR protection is chosen independently by countries, the optimal policy for a country depends on the choices of other countries, and the uncoordinated equilibrium will be affected by the rational attempt by countries to free ride on the policies of others. This problem is lucidly investigated by Grossman and Lai (2002), who consider a world of two countries (North and South) that differ in their market size and ability to innovate. Production yields a homogeneous good and a continuum of differentiated products, the latter produced by private R&D investments that are affected by the length of patent protection. Taking the "national treatment" of patents as given, the authors first investigate the equilibrium patent length when countries act independently. They find that, in the Nash equilibrium of the noncooperative patent-setting game, individual countries set a shorter patent life in an open economy than they would under autarky (an immediate consequence of the countries' individual incentives to free ride). In a world of many countries with some large countries, the free-rider problem is exacerbated and a small country may well choose zero patent protection in a Nash equilibrium. In Grossman and Lai's (2002) model, the structural differences of the two countries (market size and ability to innovate) also explain why patent protection is longer in the North than in the South in the uncooperative equilibrium. Comparative statics analysis shows that an increase in the South's ability to do research (relative to the North) would induce stronger patent protection in the South and weaker patent protection in the North.

The existence of cross-border externalities provides scope for an international IPR agreement. In Grossman and Lai's (2002) model, it turns out that world welfare depends only on an overall patent protection level (a weighted sum of individual protection rates), and an efficient global patent regime can be achieved with many combinations of patent protection (over some domain, protection in the North can substitute for that in the South and vice versa).[11] The latter conclusion means that patent harmonization (equal patent protection in the North and South) is not necessary for global efficiency. But another finding is that an efficient patent policy does require worldwide strengthening of IPR

regimes (i.e., a higher weighted sum of individual patent protection rates). If this tightening of patent protection is to be achieved by a harmonized structure, then typically efficient harmonization entails an increase of patent protection in both regions (relative to the Nash equilibrium of the noncooperative solution). These conclusions are illustrated in Figure 3, where the intersection of the North and South's best response functions (BRFs) determined the noncooperative Nash equilibrium. The locus of efficient patent protection measures (T_N and T_S) is to the northeast of both BRFs, such that efficient IPRs do entail strengthening relative to the Nash equilibrium. Harmonized patents are neither necessary nor sufficient for global efficiency.



Source: Grossman and Lai 2002 and Lai and Qiu 2003.

FIGURE 3. Noncooperative and efficient patent protection

The welfare effects in this setting are important, however, because patent harmonization quite likely hurts the South, although it benefits the North. Lai and Qiu (2003) also find that raising IPR protection in the South above its noncooperative Nash equilibrium solution is globally welfare improving; the South is hurt, but the North gains more than what is lost in the South. Starting from the noncooperative Nash equilibrium, and given adequate compensation from the North to the South, both regions could be better off if the South were to adopt the IPR standards of the North. This observation provides a direct rationale for linking IPR policies with trade policies (which could, in principle, provide the means for compensating the South for the welfare losses that may arise from adopting the North's stronger IPR standards).

TRIPS, Trade, and Economics: A Tentative Assessment

Having provided some detail on institutional developments in the areas of international IPRs, including TRIPS, and taking stock of the cursory review of relevant economic analyses discussed in the foregoing, I will now articulate a tentative assessment of TRIPS from the perspective of economics (being mindful, of course, that perhaps this is an overly ambitious goal). For concreteness, the following discussion is centered on a few select and critical questions that have emerged in this context.

Are IPRs, in fact, trade related? This question is suggested by the carefully chosen prefix "trade related" that first rationalized introducing IPRs into the WTO. Of course, virtually any economic regulation and/or institution will have (perhaps indirect) effects on trade and, vice versa, trade does impact the workings of specific regulations and/or institutions. But in fact, as the foregoing discussion has illustrated, it is quite apparent that weak or non-existent IPRs can affect trade in a direct and nontrivial manner. This is most evident for goods that are easily copied ("pirated," in the favorite jargon of the industries concerned), such as computer software and the optical media products of the entertainment industry (e.g., music and movies). Goods that rely on trademark protection are also quite vulnerable to weak IPR protection. Indeed, firms in virtually every industry (e.g., apparel, computer software and hardware, electronic equipment, prepared food and beverages, and pharmaceuticals) depend on trademarks for their marketing activities. Establishing a firm's reputation for quality, which can be efficiently conveyed to the consumer by known

trademarks, requires significant investments in design, production, and marketing. Such costs are not borne by producers of knockoff copies or counterfeit merchandise who, absent IPRs, could easily free ride on the efforts of others. This can bring about losses to the legitimate mark owners and weaken their incentive to invest in quality production, which can be harmful to consumers (who end up facing a generalized "lemons" problem). In fact, it seems that counterfeiting and pirating have increased significantly in recent years, especially in emerging markets such as China and countries of the former Soviet Union, and threaten to become a truly global business (*Economist*, 2003).

Whether and how stronger IPRs affect the extent and direction of trade is less clear. More trade could result, as "legitimate" products from the innovating exporting country substitute for domestic "illegitimate" copies and/or imitations. But less trade could also result, for at least two reasons: because of the incentive for IPRs holders to limit production (the monopolist effect), and because strong IPRs may make possible legitimate domestic production (possibly through foreign direct investment [FDI]) that is a perfect substitute for the formerly imported legitimate product. Although empirical evidence on such contrasting market expansion and market power effects is not conclusive, an earlier study by Maskus and Penubarti (1995) concludes that increasing patent protection does have a positive effect on bilateral manufacturing exports of OECD countries with both large and small developing countries (the effect on the imports of large developing countries being more significant). Fink and Primo Braga (1999) present results consistent with this finding. Using a gravity model of bilateral trade flows for 89 countries, and relying on the index developed by Ginarte and Park (1997) to measure cross-country differences in IPRs, they find a positive link between IPR protection and flows of non-fuel trade aggregates. (But, somewhat surprising, the effect is not significant for high technology trade flows.) Smith (1999) analyzes the exports of U.S. states to a large number of destination countries. She finds that weak patent rights can negatively affect U.S. exports, especially in countries that pose a strong threat of imitation. More recently, Smith (2002) analyzes the empirical impacts of IPRs of U.S. exports in three disaggregated drug industries. She again finds that strong foreign IPRs tend to expand U.S. exports in countries with a strong capacity to imitate (such as other developed countries), but in countries with weak imitative abilities, the effect of stronger IPRs may be that of

reducing trade because of enhanced market power. In any event, whether trade is positively or negatively affected by stronger IPRs is not necessarily the relevant question from the point of view of the integrated global economy.

The case of agriculture is of some interest here because TRIPS mandates less uniformity of IPRs for this sector. For example, new transgenic varieties can be patented (and they are) in the United States, but elsewhere they may enjoy only a weaker protection under PBRs. The example of Roundup Ready (RR) soybean seeds is instructive. The RR technology is patented in the United States, and RR soybean seeds are sold at a considerable premium (about 40 percent markup over conventional varieties' price) and under contractual obligations that prevent farmers from saving seeds. In Argentina, however, it is legal for farmers to save seeds for replanting purposes, and as a consequence, the RR soybean technology is available at lower cost to Argentine farmers than to U.S. farmers (U.S. GAO 2000). Such cost differences engineered by differing IPRs have the potential to affect the relative competitive positions of exporting countries, and certainly create tension, in the innovating country, between the interests of the innovating seed industry and the interests of the adopting agricultural sector (Moschini, Lapan, and Sobolevsky 2000).

Do IPRs belong in the WTO? Granted that IPRs are "trade related," the question still remains as to whether they should be an integral part of WTO activities. This was perhaps the hot question prior to the TRIPS Agreement and, as a matter of institutional design, it has been settled by the agreement itself. As a matter of intellectual pursuit, the problem is as interesting as ever. As noted earlier, a number of economists have expressed skepticism about the wisdom of including IPRs in the WTO. Observers from related disciplines see the TRIPS Agreement as a fundamental change from previous GATT endeavors, reaching deep behind national borders in the pursuit of an efficient international regulation through a "globalization of law" (Arup 2000). Indeed, this is precisely the point of those who argue the pros and cons of other issues—such as the environment, investment, labor standards, and competition policy—being addressed explicitly by the WTO. Maskus (2002b) concludes that the cases of IPRs and of competition policy are somewhat more suited for inclusion in the WTO, largely because of their direct bearing on market access.

But acknowledging that IPRs and trade are related, and that the solution of the cross-border externalities inextricably associated with this issue may require an integrated approach such as the one offered by the WTO, a related question still remains. *Is stronger global IPR protection desirable?* It is, after all, a fact that a main feature of TRIPS has been to require IPRs where none were present, without lowering any of the existing standards, thus resulting in a higher average global protection level. There is, in fact, no reason to presume that stronger IPRs *per se* are desirable. From a given closed (integrated) economy perspective, the optimal degree of protection for IPRs depends on the aforementioned trade-off between static (monopoly) losses and dynamic efficiency gains, that is, the need for "exclusion" versus the desire for "diffusion." But, as discussed in Ordover (1991), this trade-off may too simplistic a viewpoint, and a carefully designed IPR protection system need not be incompatible with diffusion. For example, when the patent regime is weak, innovators may choose to achieve exclusion by using methods such as trade secrets that are actually worse from the point of view of ensuring the diffusion of new knowledge. Whether or not the current IPR standards are too strong is a matter of debate. In the United States, for instance, some have worried that patent protections may be too slanted in favor of inventors, all but eliminating the distinction between discovery and invention, granting claims that are too broad and lowering the standard of novelty (e.g., Merges 1999).

A more subtle issue is whether, as the size of the market increases because more and more countries fall under a more-or-less common set of IPR standards, the optimal level of IPR protection implied by those standards should increase or decrease. As discussed earlier, because the incentive to perform private R&D under IPRs derives from the profits that a monopolist can realize, it is already directly affected by an expanding market, and no strengthening of IPRs may be necessary. Furthermore, in an international context, the strategic considerations mentioned earlier are quite germane. The temptation to free ride makes unilaterally set IPRs lower than globally optimal, and as more countries agree to set IPR protection cooperatively, the effect normally would be that of increasing the level of protection. But as a counterpoint, the analysis of Scotchmer (2002) is of some interest. She studies the abilities of IPR treaties to deal with the inherent cross-border externalities in a game-theoretic model where governments have access to two tools to foster innova-

tions: IPR protection (which spurs private R&D efforts) and public R&D spending (which produces a pure public good). Both instruments tend to create uncompensated cross-border externalities, but IPR treaties deal with only one of them. One of the conclusions that emerges in this setting is that harmonization of IPR regimes through negotiated treaties may end up providing excessively high IPR standards.

A difference between previous multilateral trade liberalization efforts and TRIPS is often noted. The argument is that previous GATT negotiations likely resulted in mutual gains for most (all?) countries through symmetric tariff rate cuts that yielded different final levels of protection, whereas, by contrast, the implementation of TRIPS commitments requires very asymmetric changes in the level of IPR protection offered by countries (e.g., Gaisford and Richardson, 2000). Thus, the TRIPS Agreement may be associated with large distributional effects, and the question then arises: *Are there winners and losers from TRIPS?* The concern specifically has been that such welfare transfer would be from the poor developing countries to the rich developed countries. McCalman (2001) provides quantitative estimates for the effects of patent harmonization as implied by TRIPS for a group of 29 countries, including both developed and developing countries. He finds that, indeed, the implementation of TRIPS has the potential to generate large transfers, and that the United States is the major recipient of those transfers. Developing countries are net "losers," but a number of developed countries (including Canada, the United Kingdom, and Japan) are also net contributors to these welfare transfers. These conclusions may reflect too much of a static viewpoint and ignore the dynamic effects that TRIPS can have on the incentives to innovate and to transfer technology. And, as displayed earlier in Table 1, a number of wealthy developed countries are also running a deficit in their technology balance of payments and arguably are getting positive impacts from the purchase of production-ready high technologies. More to the point, it is unclear what one should conclude from the evidence of asymmetric benefits and costs arising from TRIPS. Perhaps what that means is that, for an agreement of that kind, compensation is necessary to find consensus. Some would argue that the WTO negotiating platform is, therefore, ideally suited to handle the ambitious globalization of IPRs envisioned by TRIPS because it could, at least in principle, provide compensation through the economic effects of other agreements. For instance, it was widely believed,

after the conclusion of the Uruguay Round, that the developing countries, in exchange for their acceptance of TRIPS, got concessions from developed countries in the areas of textile, agriculture, and privileged market access through a continuation of the generalized system of preference.

Do stronger IPRs promote international technology transfer? This question is of direct importance for the case in favor of a positive global impact of TRIPS. That international diffusion of technological know-how is critical to development and growth is dramatically illustrated by the model of Eaton and Kortum (1996). They show that every OECD country other than the United States obtains more than 50 percent of its productivity growth from ideas originating abroad. But because such international knowledge diffusion relies on a variety of modes—including trade in innovated inputs, imitation, licensing, and FDI—whether and how stronger IPRs can affect international technology transfer remains a difficult question. Lai (1998) contrasts FDI and imitation in a general equilibrium North-South model and finds that the result depends on which of these modes applies. If imitation is the avenue for technology transfer, stronger IPRs in the South lower the rate on innovation in this region, but if technology is transferred through FDI, the opposite holds. The analytical conclusions about FDI are consistent with the empirical findings of Lee and Mansfield (1996) who, from a survey of 100 U.S. firms, conclude that the perceived strength/weakness of a country's IPR system is a critical factor in determining the volume and composition of U.S. foreign direct investment.

As Table 4 illustrates, FDI has, to date, privileged developed countries. Although stronger IPRs may not be the only relevant factor here, it is likely that they play an important role. Transfer of technology through licensing, of course, must rely critically on IPRs for the establishment of a viable "technology market" (Arora, Fosfuri, and Gambardella 2001). When considering international transactions, with the contracting distortions that may be expected in that context, it seems that technology transfer through licensing would be affected positively by stronger IPRs (Yang and Maskus 2003). Stronger IPRs in the recipient country make it easier to carry out technology transfer with the consent of the (foreign) innovator, but of course they also raise the costs of unilateral technology transfer through copying and imitation. Which of the two contrasting effects dominates may depend

TABLE 4. Foreign direct investment, selected years (millions of U.S. dollars)

		1970	1980	1990	2000	2001
World	FDI Inflows	12,586	54,945	202,782	1,491,934	735,146
	FDI outflows	14,141	53,674	233,315	1,379,493	620,713
Developed countries	FDI Inflows	9,477	46,530	164,575	1,227,476	503,144
	FDI outflows	14,110	50,343	216,562	1,271,273	580,624
Developing countries	FDI Inflows	3,109	8,380	37,567	237,894	204,801
	FDI outflows	30	3,310	16,700	104,207	36,571
Central and Eastern Europe	FDI Inflows	- - -	35	639	26,563	27,200
	FDI outflows	- - -	21	54	4,012	3,518

Source: UNCTAD, Division on Investment, Technology and Enterprise Development.
Notes: There are three components in FDI: equity capital, reinvested earnings, and intra-company loans. Inflows = capital received from an FDI enterprise by a foreign direct investor. Outflows = capital provided by a foreign direct investor to an FDI enterprise.

on a variety of factors, including the type of technology and the attribute of the recipient country. Trade flows and welfare effects are similarly ambiguous, although Maskus (2000) is, on balance, optimistic about the likely overall positive effects of IPRs on the quantity and quality of international technology transfer.

The foregoing discussion can be viewed as part of a larger question: *Is TRIPS useful for development?* This is perhaps the question that has attracted the most attention by commentators, spurred by the apparent asymmetry in adjustments called for by TRIPS, as well as the huge differences across developed and developing countries in the current extent of IPR-protected innovations. The latter point is illustrated in Table 5, which reports patent applications filed through the PCT (Patent Coooperation Treaty). These figures provide a useful indicator of the distribution of innovations that have international interest. Quite clearly, patenting is an activity mainly of developed countries. The United States, the European Union, and Japan, for example, accounted for about 87 percent of all PCT patent applications in the year 2002. Patenting activity in developing countries is insignificant. The issues involved in analyzing the impact of TRIPS on development are admittedly complex, and the literature on the subject is just too vast to be dealt with except summarily

TABLE 5. Patent applications through the Patent Cooperation Treaty

	Applications	Percent	Applications	Percent
	2002		2001	
United States	44,609	39.1%	40,003	38.5%
Canada	2,210	1.9%	2,030	2.0%
Brazil	204	0.2%	193	0.2%
Other America	189	0.2%	143	0.1%
European Union - 15	40,665	35.7%	37,571	36.1%
Germany	15,269	13.4%	13,616	13.1%
United Kingdom	6,274	5.5%	6,233	6.0%
France	4,877	4.3%	4,619	4.4%
Netherlands	4,019	3.5%	3,187	3.1%
Sweden	2,988	2.6%	3,502	3.4%
Italy	2,041	1.8%	1,574	1.5%
Finland	1,762	1.5%	1,623	1.6%
Switzerland	2,469	2.2%	2,011	1.9%
Russian Federation	616	0.5%	551	0.5%
Norway	525	0.5%	525	0.5%
Other Europe	686	0.6%	670	0.6%
Japan	13,531	11.9%	11,846	11.4%
South Korea	2,552	2.2%	2,318	2.2%
China	1,124	1.0%	1,670	1.6%
India	480	0.4%	316	0.3%
Other Asia	379	0.3%	291	0.3%
Australia	1,775	1.6%	1,754	1.7%
New Zealand	301	0.3%	279	0.3%
Israel	1,199	1.1%	1,248	1.2%
Other Middle East	103	0.1%	94	0.1%
South Africa	407	0.4%	418	0.4%
Other Africa	24	0.0%	16	0.0%
Total	114,048	100.0%	103,947	100.0%

Source: WIPO, Yearly Review of the PCT: 2002.

here. One of the most recent and authoritative statements on the subject is the report by the Commission on Intellectual Property Rights (2002), a body appointed by the British government. The overall conclusion, it seems, is decidedly skeptical on the constructive role that strong IPRs may have on development. The report notes that TRIPS imposes an onerous burden on most developing countries, and it supports the thesis that the desirable level of IPR protection depends on the stage of development: at earlier stages, weaker (not stronger) IPRs are more likely to foster economic development. The commission also emphasizes that developing countries are not a homogeneous group, that the optimal IPR system (from the perspective of development) is bound to vary from country to country, and that to insist on too much IPR harmonization may be detrimental to development. But the report also recognizes that TRIPS gives developing countries considerable latitude in implementing the higher IPR standards mandated by the agreement.

This and related analyses do provide considerable food for though and are compelling in their characterization of the complex nature of the development question. Yet they pay scant attention to the core economic problem emphasized by the theoretical work in this area: the cross-border externalities associated with the production of innovations, and the associated free rider problem. To make claims about what is an "optimal" IPR policy for a developing country abstracting from this strategic problem is unsatisfactory to say the least. Of course, any small country is likely to be better off by free riding on the innovative efforts of others. In fact, the free-rider problem in this context is even more general because, as analyzed by Yang (1998), developing countries also have an incentive to free ride on each other (in addition to free riding on developed countries), which is particularly deleterious to the development of technologies that are specifically appropriate for their needs. Thus, the choice may not be simply between getting an innovation for free or having to pay for it, as the availability of appropriate innovations for the South, and the timely and efficient distribution and adoption of these and other technologies, cannot be taken for granted. This is not to say that any IPR policy and/or standard is good. But the claim that some IPR policies are good for the North, whereas quite a different approach is good for the South, is just one (unproven) thesis. An alternative is that bad IPR policies are just as likely to be bad for the North as for the South, and what

is good in one region (in terms of solving a very real market failure and promoting innovation) may well be desirable for all regions in a cooperative equilibrium.

The (rather commonly held) view that strong IPRs are not good for development would be more convincing if we knew what, in fact, is good for development. Unfortunately, it seems we do not. Easterly (2001) provides a sobering reminder of the failures of many past and present policies meant to foster growth in developing countries and dispels what he terms the myths of benevolent development assistance. What has been learned is mostly about the things that do not work: state planning, protectionist policies aimed at import substitution, price controls, debt forgiveness, and privileging current consumption over investment. As Wacziarg (2002) notes, "Domestic policies and politics, not multinationals and capitalist imperialists, are largely to blame for unproductive rent-seeking and plunder." Whereas it is unrealistic to presume that stronger IPRs *per se* will produce extensive gains for developing countries, they probably constitute an essential element of a package that eschews the misguided policies that have failed in the past. Maskus (2000, chap. 7) argues that IPR protection in developing countries should be coupled with policies that promote dynamic competition and technical change, such as those aimed at liberalizing trade and investments, curbing corruption, promoting human capital and technical skills, as well as fostering social and economic freedom. Perhaps the most positive impact that TRIPS can have on development in the long run is to contribute to the establishment of political and social institutions that allow markets to work. Focusing specifically on agriculture, Perrin (1999) notes that, without stronger IPRs, it is unlikely that productivity rates in developing countries can begin to catch up with those of developed countries.

Current Issues and Prospects

Public Health

TRIPS figured prominently in the Doha WTO ministerial meeting in November 2001, and resulted in the Doha Declaration on the TRIPS Agreement and Public Health. The concerted effort of developed countries, assisted by the emerging influence of non-government organizations (NGOs), brought to the fore the public health problems afflicting many of them, especially those associated with HIV/AIDS, tuberculosis, malaria, and

other epidemics. The declaration stressed that TRIPS "… does not and should not prevent members from taking measures to protect public health." Specifically, the declaration (*a*) recognized that compulsory licensing could be used to procure critical drugs, at each member's discretion; (*b*) acknowledged that each member is free to adopt the desired mode of exhaustion of IPRs (which bears on whether parallel imports are allowed into a country or not); (*c*) recognized that developing countries with insufficient drug manufacturing abilities would face difficulties in taking advantage of compulsory licensing, and thus instructed the Council for TRIPS to find a solution to this problem by December 2002; and (*d*) extended until January 2016 the deadline for LDCs to implement IPR protection for pharmaceuticals and test data. The problem addressed in point (*c*) arises because TRIPS stipulates that compulsory licenses may be used primarily to supply the domestic market. But timely resolution of this issue failed, and the United States (alone among 144 WTO countries) has opposed the adoption of a compromise solution that would allow LDCs to couple compulsory licensing with imports. Possibly backtracking from an earlier position (*Wall Street Journal* 2003a), the United States is insisting that the coverage of such waivers should be limited to HIV/AIDS, tuberculosis, malaria, and similarly infectious diseases.

The scale of the public health problem confronting a number of LDCs, especially in Africa, is huge. In some sub-Saharan countries, for example, one-third of the adult population is infected with the HIV/AIDS virus. Access to drugs and health care services is a real problem. Patents on pharmaceuticals, through their impact on higher drug prices, may contribute to the problem, although they may not be the main stumbling block.[12] Many essential medicines, in developed and developing countries alike, are actually off patent. Poverty, lack of health insurance, and lack of a reliable public health care system may be the real roots of third-world health care tragedies (Maskus 2002a). Although access may be just as much of a problem for drugs already in the public domain, most analysts think that the Doha's TRIPS efforts in this area can make a positive contribution. Developments here also highlight the relevance of an open issue within TRIPS, that which relates to international exhaustion of rights.

Exhaustion of Rights and Parallel Imports

Efforts in the Uruguay Round to find a unified stance failed, and TRIPS explicitly leaves it to individual countries to decide whether they want to rely on the "international exhaustion" doctrine or whether they want to implement a "national exhaustion" principle. Under the latter, the right of the IPR holder on the product expires with the first sale in that jurisdiction, but the IPR holder retains the right to exclude (parallel) imports and exports in that region. Under the former, the right of the IPR holder expires with the first sale anywhere. Quite clearly, the main difference is that national exhaustion allows innovators to price the product differently in different markets (i.e., to practice third-degree price discrimination), whereas international exhaustion prevents that because parallel trade allows arbitrage across markets (Malueg and Schwartz 1994). It has been established that price discrimination can (albeit it need not) improve welfare for society at large, relative to standard monopoly pricing (Varian 1988). Certainly, in our international context, price discrimination (relative to uniform pricing) would improve the welfare of those importing countries for which the price is lower under discrimination, that is, countries with relatively more elastic demands. The case is particularly evident when some markets are not served under uniform pricing, as illustrated in Figure 4. Because LDCs are likely to have more elastic demands for drugs than are developed countries, price discrimination is likely to be beneficial to them. Yet developing countries are generally opposed to revisiting TRIPS stipulations on the grounds of exhaustion of IPRs.[13] Again, it seems that what is at work here is the strategic incentives facing individual countries. Although individually and as a whole, LDCs would arguably gain by cooperatively giving up the right to parallel imports, each individual country may have a unilateral incentive to deviate from this strategy because it could benefit from parallel imports from a market with lower prices. On the other hand, preliminary analysis of international sales data for AIDS anti-retroviral drugs is not particularly supportive of the notion that pharmaceutical companies will practice much international price discrimination, and the interplay of such price discrimination with parallel imports/exports can arguably be more complex than discussed here (Scherer and Watal 2002).

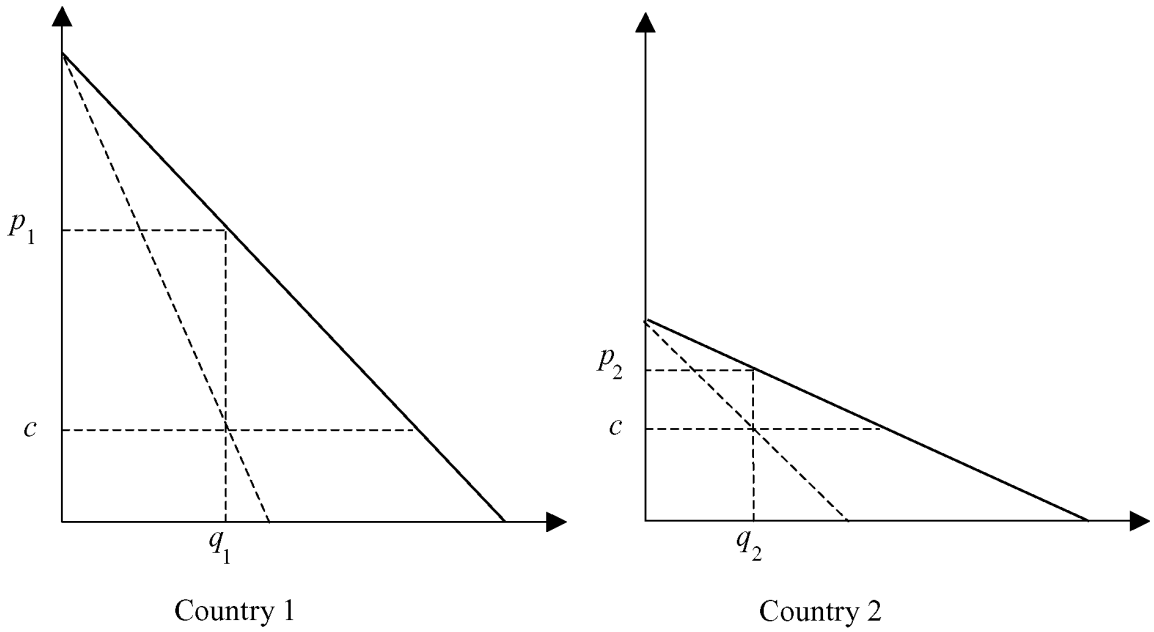


FIGURE 4.A. Monopoly with price discrimination

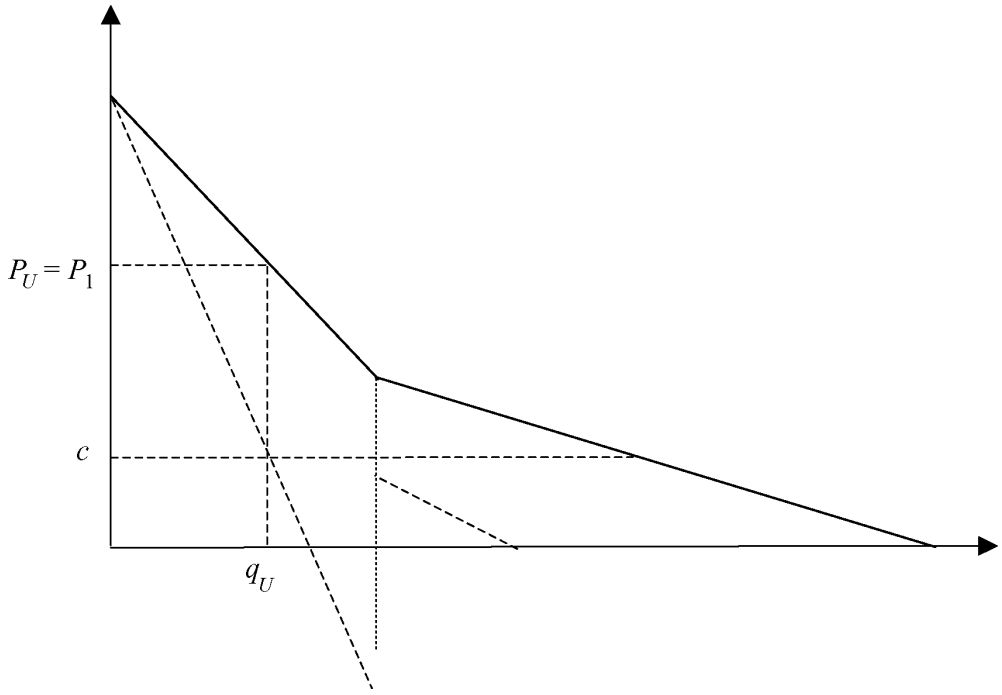


FIGURE 4.B. Monopoly with uniform pricing

Geographical indications

Geographical indications (GIs) are one of the IPRs contemplated by TRIPS, but not much has been done to implement such rights. Ongoing negotiations center on the establishment of a multilateral system of notification and registration of GIs for wines and spirits—products that were singled out by TRIPS as eligible for a stronger GI protection (they must be protected even if there is no risk of the consumer being misled or of unfair competition). Agreement is still lacking, with one group of countries (including the United States, Canada, Japan, and Australia) envisioning a registration system working like a database but with countries "voluntarily" deciding whether to grant GI protection. Another group of countries (including the European Union) envisions a system of "voluntary" registration but with mandatory protection for registered products (ICTSD-IISD, 2003). As mandated by the Doha Declaration under the "implementation" issues, the TRIPS Council is also considering requests to extend the higher level of GI protection accorded to wine and spirits to other products. Deep divisions among countries exist on this topic (see, e.g., *Wall Street Journal* 2003b), and progress is unlikely.

Biodiversity, Traditional Knowledge, and Folklore

The Doha Declaration mandated that the Council for TRIPS examine the relationship between TRIPS, the CBD (Convention on Biological Diversity), and the protection of traditional knowledge and folklore. Some countries from the developing world are requesting a modification of TRIPS to include provisions to prevent biopiracy and uncompensated use of traditional knowledge. For example, it has been suggested that patent applications in WTO countries should disclose the source/country of origin of biological material used in the invention, as a first step for the establishment of a more "equitable" sharing of benefits. Developed countries, the United States in particular, are resisting such proposals, and the outlook is not encouraging. From the perspective of economics, it seems that such proposals, and much of the philosophy underlying the CBD in this area, puts too much emphasis on "sharing" benefits as opposed to creating them. This seems to miss the point that the main function of IPRs is to provide incentives for new innovations, not to provide a rent position for already existing resources. To be sure, patents that simply recycle know-how from afar (whether or not that belongs to traditional knowledge) are just bad patents, and increased efforts are warranted to ensure the

broadest possible consideration of prior art by patent examiners. Also, "conservation" of biodiversity is in fact an activity that could be valuable from society's point of view, although its current value to the pharmaceutical industry may be too low to allow substantial funds to be mobilized through benefit-sharing mechanisms (e.g., Simpson, Sedjo, and Reid 1996).

Conclusion

Whether or not the WTO is the most appropriate forum for dealing with international coordination of IPRs remains a matter of opinion, but the TRIPS Agreement makes that question somewhat academic. An increasing share of economic activity worldwide is aimed at the production of goods and services that require considerable R&D investment, and the exchange of such goods and service relies heavily on the possibility of protecting the underlying R&D investment from expropriation by copying and imitation. Such concerns have long been addressed by the legal institutional setting of most developed countries, but insofar as goods and services are traded across national borders, national IPRs clearly do not suffice. The TRIPS Agreement represents the most ambitious attempt to date at coming to grips with these realities. The salient feature of TRIPS, as compared with previous international cooperation treaties in IPRs such as those managed by WIPO, is that it makes an extensive set of IPR protection standards mandatory for WTO membership, that is, a requirement for the continued enjoyment of the gains from freer trade made possible by a half-century of GATT efforts. In so doing, it has taken the WTO into new territory, perhaps heralding a greater future role for the WTO in nontraditional areas (such as environmental standards, labor standards, competition policy, investment, and government procurements).

As with any undertaking of this scale and scope, TRIPS is but an imperfect compromise, no matter what the viewpoint, on the many unresolved questions that it prompts. Mostly, TRIPS is a work in progress. A crucial issue in the IPRs area is "enforcement." The WTO dispute settlement procedure will have to deal with the compliance of parties with the letter of the agreement. The record so far provides some cause for optimism. Interestingly, most of the TRIPS disputes to date have pitted developed countries against each other, and not developed countries against developing countries (Matthews 2002).

This fact is at odds with the crude interpretation that sees TRIPS mostly as pitting the interests of developed countries versus those of developing countries (e.g., GRAIN, 2001). It is also useful to note that the WTO dispute settlement mechanism provides considerable more guarantees of objectivity than do the summary indictments possible with unilateral trade sanctions under the U.S. Special 301 process. Thus, the WTO forum may be more appealing for developing countries concerned with the aggressive pro-IPRs agenda of developed countries. But the real enforcement issues for TRIPS are likely to be at the national level, after TRIPS compliance of laws is achieved. It remains to be seen how effective national enforcement of nominal IPR protection will be, especially in developing countries, and how sensitive TRIPS-illegal economic behavior will be to (inevitably imperfect) enforcement.[14]

In addition to the outstanding implementation issues, there are opportunities for potential extensions and refinements of the TRIPS Agreement. What is in doubt is whether any consensus is likely to emerge given the diverging agendas of developed and developing countries. Although developed countries cannot be assumed to have a unified agenda, broadly speaking what they would like is a tightening of the existing TRIPS, the closing of loopholes, and an extension of the scope of protection under the agreement. TRIPS provides considerable flexibility in a number of areas, especially for IPRs related to newer technologies. No provision is included in TRIPS, for example, about IPRs related to Internet data transmission and e-commerce. Indeed, two treaties in this area have been completed under WIPO after the conclusion of the Uruguay Round (the Copyright Treaty and the Performances and Phonogram Treaties), and developed countries would like to see the substantial provisions of those treaties brought into TRIPS. There is also interest in clarifying the protection by patents for biotechnology innovations, and possibly in revisiting the provision that allows members to exclude plants and animals from patentability (TRIPS actually contemplates a built-in mandatory review of this clause). At a minimum, the United States would like to see the UPOV 1991 convention explicitly identified as the standard for the allowed *sui generis* protection of plant varieties. Developing countries, on the other hand, have a virtually opposite agenda on many of these issues and are intent on defending the flexibilities provided for in TRIPS (including the freedom to choose a *sui generis* system for plant varieties that is more lax than UPOV

1991, especially with reference to farmers' right to save and exchange seeds). Developing countries would also like to reconcile the provisions of TRIPS with the CBD, including, as discussed earlier, the issue of whether to require disclosure in patent applications of the source of biological materials used.

The congruence of developed countries' agendas with TRIPS should not be overestimated, however, as differences exists in many areas. One continuing bone of contention is the U.S. reliance on the first-to-invent rule for awarding patents, as opposed to the first-to-file criterion used by virtually all other WTO members. The European Union and the United States remain at odds on issues related to the patenting of plants and animals. And, as mentioned earlier, the issue of GIs is pitting European countries and a number of developing countries against the United States and other developed "new world" countries. NGOs are also going to be a factor if amendments to TRIPS were to be undertaken, as amply illustrated by their high-profile presence in the debate concerning the impact of TRIPS on access to essential medicines by poor countries. The growing disappointment of developing countries with the alleged quid pro quo of the Uruguay Round (TRIPS in exchange for concession in textiles and agriculture) also suggests that benefits and costs of changes to TRIPS may have to be traded off on their own merits, rather than relying on cross-agreement compensations. Given the fragmented interests of the various relevant constituencies, it seems unlikely that TRIPS will experience any substantial revision and/or extension in the new round of WTO multilateral trade negotiations under the Doha Development Agenda.

ENDNOTES

1. For example, IPRs are enshrined in the U.S. Constitution, where Article 1 established that "Congress shall have the power … to promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive right to their respective writing and discoveries."

2. Important kinds of scientific discoveries—such as laws of nature, natural phenomena, and abstract ideas—have traditionally been outside the statutory scope of patents. But recent developments in patenting new technologies (such as computer software, information technology, and biotechnology) are challenging a strong interpretation of such exclusions.

3. Exceptions to the national treatment obligation allowed under pre-existing WIPO conventions are permitted. Where these exceptions allow material reciprocity, the implied exception to MFN treatment is also permitted.

4. WTO members may provide a more extensive protection of intellectual property if they so wish.

5. TRIPS also mandates compliance with substantial provisions of the 1989 Treaty on Intellectual Property in Respect of Integrated Circuits, and makes explicit reference to the 1961 Rome Convention, although there is no obligation to comply with the substantive provisions of that convention.

6. Developing countries that did not provide product patent protection prior to TRIPS were given 10 years to introduce such protection. But some substitute provisions were mandated for pharmaceutical and agricultural chemical products.

7. Although, oddly enough, there is no such prohibition against patenting plants per se.

8. The European Patent Office, for example, apparently takes a rather liberal definition of microorganisms, which are held to include bacteria, yeasts, fungi, algae, protozoa, plasmids, viruses, as well as single cells from multicellular organisms (plants and animals, including humans) (Dutfield 2003).

9. Machlup and Penrose (1951) cite part of this quotation. This excerpt is from Mills (1900, Book 5, Chapter 10).

10. This brief review necessarily neglects a number of important elements in the economic analysis of patents, such as their impacts on the dissemination of information, their coordination role in avoiding wasteful duplication of innovation efforts, their

potential role in technology transfer and commercialization of new products, the potential shortcomings of excessively broad patents, the special problems that arise with patent races and with cumulative and/or complementary innovations, and the role of industry structure. For an introduction to these issues, see Langinier and Moschini 2002.

11. The nonuniqueness of the set of patent lengths that yield efficiency is anticipated in the more restrictive model considered by McCalman (2002). This paper, and that of Richardson and Gaisford (1996), also had noted that, in a North-South two-country setting, independently chosen patent policies are not efficient.

12. Attaran and Gillespie-White (2001), in a controversial study, argued that patents and patent law may not pose a major barrier to access to medical treatment in LDCs. For the case of HIV/AIDS, in any event, prevention is arguably a more pressing issue than cure, and the record of some countries on this score is disappointing.

13. Most developed countries practice the national exhaustion principle, except for Japan, where international exhaustion applies (with some qualifications). In the European Union, national exhaustion really applies to the Union as a whole, and in Australia, international exhaustion applies to trademarks (Maskus and Chen 2002).

14. Some economic issues related to TRIPS enforcement are considered by Gaisford et al. (2002) and Giannakas (2002).

Appendix

Summary of the TRIPS Agreement

Feature	Main Elements
Scope (Art. 1)	▪ All the main IPR instruments: patents, copyrights, trademarks, geographical indications, industrial designs, trade secrets
General Obligations (Arts. 3 and 4)	▪ National treatment ▪ Most-favored-nation treatment
Limitations (Art. 6)	▪ Mode of exhaustion of IPRs is left to countries' own discretion
Objectives (Arts. 7-8)	▪ Promotion of technological innovation and of technology transfer ▪ Contribute to the mutual advantage of producers and users of new knowledge in a manner conducive to social and economic welfare ▪ Balance of rights and obligations
Copyrights and Related Rights (Arts. 9-14)	▪ Comply with Berne Convention (except for obligations on moral rights) ▪ Works protected as expression, not as ideas or concepts, procedures, or methods ▪ Computer programs and compilations of data are protected (but actual data not protected as such) ▪ Rental rights, and rights of performers, producers, and broadcasters
Trademarks (Arts. 15-21)	▪ Rights conferred based on the Paris Convention (1967) ▪ Initial registration for period no less than 7 years, renewable indefinitely ▪ Equal treatment of trade and service marks ▪ Well-known marks to be protected even if not used in a country ▪ If use requirement exists, at least 3 years of nonuse are required prior to cancellation ▪ Compulsory licensing prohibited ▪ Discourage speculative registrations ▪ Discourage specious restrictions (e.g., requiring use with another mark)

Feature	Main Elements
Geographical Indications (Arts. 22-24)	▪ Provide means to prevent use of "geographic" terms that mislead public as to true origin of good ▪ Aims to prevent "unfair competition" as defined in Paris Convention (1967) ▪ Additional protection for wines and spirits: protection must be provided even when the public is not being misled
Industrial Designs (Arts. 25-26)	▪ Applies to industrial designs that are new or original ▪ At least 10 years of protection ▪ Special provision for textile designs (protection may be provided through copyrights instead)
Patents (Arts. 27-34)	▪ Should be available for any invention, in all fields of technology, including biotechnology inventions such as for microorganisms, microbiological processes, and non-biological processes. ▪ Exceptions: inventions that may be precluded from patents: - threaten *ordre public* or morality; - diagnostic, therapeutic, and surgical methods; - Plants, animals and essentially biological processes. But: ▪ Plant varieties must be protected either by patents or by a *sui generis* system ▪ Mandates nondiscrimination (e.g., local production cannot be required) ▪ Duration no less than 20 years from filing ▪ Compulsory licensing permitted under certain (stringent) conditions ▪ Reverses burden of proof for process patents in civil proceedings (defendant may be required to show it does not infringe patent)
Integrated Circuits (Arts. 35-37)	▪ Protects layout-designs ▪ Based on IPIC (i.e., Washington) Treaty, with additional protection
Undisclosed Information (Art. 39)	▪ Protects trade secrets based on Paris Convention (1967), art. 10bis ▪ Protects test data required to gain approval of pharmaceutical or agricultural chemical
Anti-competitive Practices (Art. 40)	▪ Countries may regulate licensing practices to prevent abuses by holders of IPRs ▪ Members must cooperate in investigating alleged abuse of IPRs that have international dimension

Feature	Main Elements
Enforcement (Arts. 41-62)	▪ Members must provide effective means of action for any right holder, foreign or domestic, to secure acquisition and enforcement of his/her IPRs ▪ Specifies procedure for judicial action. Remedies must include injunctions, damages, and disposal of infringing goods ▪ Custom authorities must cooperate to prevent imports of pirated and counterfeit goods ▪ Criminal procedures and penalties must be available ▪ Procedures for acquisition of IPRs should be fair, expeditious, not unnecessarily complex or costly
Dispute Settlement (Arts. 63-64)	▪ Normal WTO (new) procedures apply to TRIPS ▪ Enforcement of IPR rules can be linked to trade measures
Implementation (Arts. 65-66)	▪ One year transitional period for all countries ▪ Up to 10 years delay for some features of agreement available for developing countries (except for national treatment and MFN rule) - Additional four years transitional period for developing countries (except for national treatment and MFN rule) - Extra five years on providing patents for new areas of technology (pharmaceuticals and agricultural chemicals), subject to a 'mailbox clause' ▪ Least-developed countries can have 11-year delay on application of agreement, until January 2006. Further special extensions for pharmaceuticals (until January 2016) granted by the Doha Declaration.
Technical Cooperation (Art. 67)	▪ Developed countries shall provide technical and financial assistance to developing and least-developed countries to facilitate implementation of the agreement on mutually agreed terms
Institutional Arrangements (Art. 67)	▪ Institutes "Council for TRIPS" to monitor the operation of the agreement

Source: Compiled from the TRIPS text (WTO 1994).

References

Arora, A., A. Fosfuri, and A. Gambardella. 2001. *Markets for Technology: The Economics of Innovation and Corporate Strategy*. Cambridge and London: MIT Press.

Arrow, K.J. 1962. "Economic Welfare and the Allocation of Resources for Inventions." In *The Rate and Direction of Inventive Activity: Economic and Social Factors.* Edited by R.R. Nelson. Princeton, NJ: Princeton University Press.

Arup, C. 2000. *The New World Trade Organization Agreements: Globalizing Law Through Services and Intellectual Property*. Cambridge: Cambridge University Press.

Attaran, A., and L. Gillespie-White 2001. "Do Patents for Antiretroviral Drugs Constrain Access to AIDS Treatment in Africa?" *Journal of the American Medical Association* 286(15, October): 1886-92.

Bhagwati, J. 1991. *The World Trading System at Risk*. New York: Harvester-Wheatsheaf.

Binenbaum, E., C. Nottemburg, P.G. Pardey, B.D. Wright, and P. Zambrano. 2003. "South-North Trade, Intellectual Property Jurisdictions, and Freedom to Operate in Agricultural Research on Staple Crops." *Economic Development and Cultural Change* 51(2, January): 309-35.

Boettiger, S., E. VanDusen, G.D. Graff, P.G. Pardey, and B.D. Wright. 2003. "Intellectual Property Rights for Plant Biotechnology: International Aspects." *Handbook of Plant Biotechnology*. Edited by P. Christou and H. Klee. New York: John Wiley & Sons.

Chin, J., and G.M. Grossman. 1990. "Intellectual Property Rights and North–South Trade." In *The Political Economy of International Trade*. Edited by R. Jones and A.O. Krueger. Oxford: Basil Blackwell.

Commission on Intellectual Property Rights. 2002. *Integrating Intellectual Property Rights and Development Policy*. London, September.

David, P. 1993. "Intellectual Property Institutions and the Panda's Thumb: Patents, Copyrights, and Trade Secrets in Economic Theory and History." In *Global Dimensions of Intellectual Property Rights in Science and Technology*. M.B. Wallerstein, R.A. Schoen, and M.E. Mogee. Washington, D.C.: National Academy Press.

Deardorff, A.V. 1990. "Should Patent Protection be Extended to All Developing Countries?" *The World Economy* 13(4): 497-507.

———. 1992. "Welfare Effects of Global Patent Protection." *Economica* 59: 35-51.

Diwan, I., and D. Rodrik. 1991. "Patents, Appropriate Technology, and North–South Trade." *Journal of International Economics* 30: 27-47.

Drahos, P. 1995. "Global Property Rights in Information: The Story of TRIPS at the GATT." *Prometheus* 13(1, June): 6-19.

Dutfield, G. 2000. *Intellectual Property Rights, Trade and Biodiversity*. London: Earthscan Publications.

———. 2003. *Intellectual Property Rights and Development*. United Nations Conference on Trade and Development and International Centre for Trade and Sustainable Development. Draft, March.

Easterly, W.R. 2001. *The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics*. Cambridge, MA: MIT Press.

Eaton, J., and S. Kortum. 1996. "Trade in Ideas: Patenting and Productivity in the OECD." *Journal of International Economics* 40: 251-78.

Economist. 2003. "Imitating Property is Theft." May 27-23, pp. 52-54.

Fink, C., and C.A. Primo Braga. 1999. "How Stronger Protection of Intellectual Property Rights Affects International Trade Flows." World Bank Research Working Paper 2051, February.

Gaisford, J.D., and R.S. Richardson. 2000. "The TRIPS Disagreement: Should GATT Traditions Have Been Abandoned?" *The Estey Centre Journal of International Law and Trade Policy* 1(2): 137-51.

Gaisford, J.D., R. TarvydasJ.E. Hobbs, and W.A. Kerr. 2002. "Biotechnology Piracy: Rethinking the International Protection of Intellectual Property." *Canadian Journal of Agricultural Economics* 50: 15-34.

Giannakas, K. 2002. "Infringement of Intellectual Property Rights: Causes and Consequences." *American Journal of Agricultural Economics* 84(2, May): 482-94.

Ginarte, J.C., and W. Park. 1997. "Determinants of Intellectual Property Rights: A Cross-National Study." *Research Policy* 26(3): 283-301.

Genetic Resources Action International (GRAIN). 2001. "TRIPS-Plus through the Back Door." Report, July. <www.grain.org/publications/trips-plus-en.cfm> (accessed May 2003).

Grossman, G., and E.L-C. Lai. 2002. "International Protection of Intellectual Property." Working Paper. Department of Economics, Princeton University. September.

Heller, M.A., and R.S. Eisenberg. 1998. "Can Patents Deter Innovations? The Anticommons in Biomedical Research." *Science* 280: 698-701.

Helpman, E. 1993. "Innovation, Imitation, and Intellectual Property Rights." *Econometrica* 61(6): 1247-80.

International Centre for Trade and Sustainable Development and International Institute for Sustainable Development (ICTSD-IISD). 2003. "Intellectual Property Rights." Doha Round Briefing Series, Vol. 1, No. 5. February.

Janis, M.D., and J.P. Kesan. 2002. "Intellectual Property Protection for Plant Innovation: Unresolved Issues after *J.E.M. v. Pioneer*." *Nature Biotechnology* 20(November): 1161-64.

Lai, E.L-C. 1998. "International Intellectual Property Rights Protection and Rate of Product Innovation." *Journal of Development Economics* 55: 133-53.

Lai, E.L-C., and L.D. Qiu. 2003. "The North's Intellectual Property Rights for the South?" *Journal of International Economics* 59: 183-209.

Langinier, C., and G. Moschini. 2002. "The Economics of Patents: An Overview." In *Intellectual Property Rights in Animal Breeding and Genetics*. Edited by M.F. Rothschild and S. Newman. New York: CABI Publishing.

Lee., J-Y., and E. Mansfield. 1996. "Intellectual Property Protection and U.S. Foreign Direct Investments." *Review of Economics and Statistics*. 78(2, May): 181-86.

Machlup, F., and E. Penrose. 1950. "The Patent Controversy in the Nineteenth Century." *Journal of Economic History* 10(May): 1-29.

Malueg, D.A., and M. Schwartz. 1994. "Parallel Imports, Demand Dispersion, and International Price Discrimination." *Journal of International Economics* 37(3-4, November): 167-95.

Maskus, K.E. 2000. *Intellectual Property Rights in the Global Economy*. Washington, D.C.: Institute for International Economics.

———. 2002a. "Ensuring Access to Essential Medicines: Some Economic Considerations." *Wisconsin International Law Journal,* Annual Symposium. University of Wisconsin Law School. March.

———. 2002b. "Regulatory Standards in the WTO: Comparing Intellectual Property Rights with Competition Policy, Environmental Protection, and Core Labor Standards." *World Trade Review* 1(2, July): 135-52.

Maskus, K.E., and Y. Chen. 2002. "Parallel Imports in a Model of Vertical Distribution: Theory, Evidence, and Policy." *Pacific Economic Review* 7(2): 319-34.

Maskus, K.E., and M. Penubarti. 1995. "How Trade-Related Are Intellectual Property Rights?" *Journal of International Economics* 39: 227-48.

Matthews, D. 2002. *Globalizing Intellectual Property Rights—The TRIPS Agreement*. London and New York: Routledge.

McCalman, P. 2001. "Reaping What You Sow: An Empirical Analysis of International Patent Harmonization." *Journal of International Economics* 55(1): 161-86.

———. 2002. "National Patents, Innovation and International Agreements." *Journal of International Trade and Economic Development* 11(1): 1-14.

Merges, R.P. 1997. *Patent Law and Policy—Cases and Materials*, 2nd ed. Charlottesville, VA: Michie Law Publishers.

———. 1999. "As Many as Six Impossible Patents before Breakfast: Property Rights for Business Concepts and Patent System Reform." *Berkeley Technology Law Journal* 14: 577-615.

Mills, J.S. 1900. *Principles of Political Economy*, revised ed., vol. 2. London and New York: The Colonial Press.

Moschini, G. 2003. "Patents and Other Intellectual Property Rights." Public Policy in Food and Agriculture section, edited by A. Azzam. In *Encyclopedia of Life Support Systems* (EOLSS). Oxford, UK: EOLSS Publishers, 2003.

Moschini, G., and H. Lapan. 1997. "Intellectual Property Rights and the Welfare Effects of Agricultural R&D." *American Journal of Agricultural Economics* 79(November): 1229-42.

Moschini, G., H. Lapan, and A. Sobolevsky. 2000. "Roundup Ready Soybeans and Welfare Effects in the Soybean Complex." *Agribusiness* 16(1): 33-55.

Nordhaus, W.D. 1969. *Inventions, Growth and Welfare: A Theoretical Treatment of Technological Change.* Cambridge, MA: MIT Press.

Ordover, J.A. 1991. "A Patent System for Both Diffusion and Exclusion." *Journal of Economic Perspectives* 5(1, Winter):43-60.

Panagariya, A. 1999. "TRIPS and the WTO: An Uneasy Marriage." In *The Next Trade Negotiation Round: Examining the Agenda for Seattle*. Edited by J. Bhagwati. Proceedings of the Conference Held at Columbia University, July 23-24, 1999, Chap. 11, pp. 91–102.

Perrin, R.K. 1999. "Intellectual Property Rights and Developing Country Agriculture." *Agricultural Economics* 21(3, December): 221-29 .

Richardson, R.S., and J.D. Gaisford. 1996. "North-South Disputes over the Protection of Intellectual Property." *Canadian Journal of Economics* 29: S376-81 (special issue).

Scherer, F.M., and J. Watal. 2002. "Post TRIPS Options for Access to Patented Medicines in Developing Nations." *Journal of International Economic Law* 5(4): 913-39.

Scotchmer, S. 2002. "The Political Economy of Intellectual Property Treaties." National Bureau of Economic Research, Working Paper 9114, August.

Simpson, R.D., R.A. Sedjo, and J.W. Reid. 1996. "Valuing Biodiversity for Use in Pharmaceutical Research." *Journal of Political Economy* 104: 163-85.

Smith, P.J. 1999. "Are Patent Rights a Barrier to US Exports?" *Journal of International Economics* 48: 151-77.

Smith, P.J. 2002. "Patent Rights and Trade: Analysis of Biological Products, Medicinals and Botanicals, and Pharmaceuticals." *American Journal of Agricultural Economics* 84(2, May): 495-512.

Srinivasan, T.N. 2002. "The TRIPS Agreement." In *The Political Economy of International Trade Law: Essays in Honor of Robert E. Hudec*. Edited by D. Kenneddy and J. Southwick. New York: Cambridge University Press.

U.S. Government Accounting Office (U.S. GAO). 2000. "Information on Prices of Genetically Modified Seeds in the United States and Argentina." Report GAO/RCED/NSIAD-00-55. Washington, D.C. January.

Varian, H. 1988. "Price Discrimination." In *Handbook of Industrial Organization*, vol. 1. Edited by R. Schmalensee and R. Willig. Amsterdam: North Holland.

Wall Street Journal. 2003a. "U.S. Flip on Patents Shows Drug Makers' Growing Clout." February 6.

———. 2003b. "EU Digs in for Food Fight with WTO Over Names." February 13.

Yang, Y. 1998. "Why Do Southern Countries Have Little Incentive to Protect Northern IPRs?" *Canadian Journal of Economics* 31(4): 800-16.

Yang, G., and K.E. Maskus. 2003. "Intellectual Property Rights, Licensing And Innovation." World Bank Research Working Paper 2973. February.

Wacziarg, R. 2002. "Review of Easterley's 'The Elusive Quest For Growth.'" *Journal of Economic Literature* 40(September): 907-18.

World Intellectual Property Organization (WIPO). 2001. *WIPO Intellectual Property Handbook: Policy, Law and Use*. Publication No. 489(E). Geneva. May.

World Trade Organization (WTO). 1994. *Agreement on Trade-Related Aspects of Intellectual Property Rights*. Annex 1C of the Marrakesh Agreement Establishing the World Trade Organization. April. <http://www.wto.org/english/docs_e/legal_e/27-trips.pdf> (accessed May 2003).