Intellectual Property Rights and Economic Development

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TechNet Working Paper

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Acknowledgments

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Abbreviations and Acronyms

CIR	Community Intellectual Rights
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
ICT	Information and Communication Technologies
IPRs	Intellectual Property Rights
MEA	Multilateral Environmental Agreement
MFN	Most Favored Nation
MTA	Material Transfer Agreement
NIC	New Industrial Country
OECD	Organization for Economic Co-operation and Development
PCT	Patent Cooperation Treaty
R&D	Research and Development
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
WIPO	World Intellectual Property Organization (United Nations)
WTO	World Trade Organization

Foreword

At the beginning of this decade, the World Bank published a collection of essays surveying the economic literature on intellectual property protection (Siebeck, 1990). Since then, the intellectual property field has seen tremendous changes—with profound implications for developing countries. Rapid advances on the technology frontier have significantly expanded the range of products and technologies that are today covered by proprietary rights. On the policy side, the signing of the Trade Related-Agreement on Intellectual Property Rights, one of the outcomes of the Uruguay Round of Trade Negotiations (1986–94), marked the beginning of a new era in which owners of intellectual property will be increasingly able to pursue the protection of their rights on a global scale.

The evolution of intellectual property protection in the 1990s was reviewed in the preparation of the World Bank's 1998–99 World Development Report, titled *Knowledge for Development.* This discussion paper presents a consolidation of research conducted for this World Development Report as well as of the contributions made at an Internet-moderated conference conducted by the Bank's TechNet program (www.vita.org/technet/iprs). The authors review the evolution of intellectual property protection and its implications for developing countries. They persuasively illustrate that the new era of global protection presents the developing world with both opportunity and challenge. Opportunity exists in the creation and dissemination of knowledge addressing the particular needs of developing countries. The challenge for developing countries is to reform their intellectual property rights regimes—while limiting the potentially adverse effects of improved protection—and to facilitate access of local entrepreneurs to the intellectual property rights system.

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1. Introduction

Throughout history many societies have deemed intellectual creations—technological inventions, artistic, and literary works—as the property of inventors and authors. Intellectual property rights (IPRs) give the owners of intellectual property the legally enforceable power to prevent others from using an intellectual creation or to set the terms on which it can be used. In today's industrial countries, IPRs are part of the institutional infrastructure that encourages private investments in formal research and development (R&D) and other inventive and creative activities.

In contrast, most developing countries have not relied on IPRs protection as a major mechanism to foster innovation. Moreover, to the extent that there is significant inequality in the control of proprietary rights across nations, developing countries have traditionally preferred rapid dissemination of knowledge at the expense of the protection of IPRs of foreigners. During the past decade, however, the intellectual property field has seen tremendous changes—with profound implications for developing countries. These changes relate on the one hand to international policy shifts and on the other hand to the emergence of new technologies.

On the policy side, many developed countries have pushed for stronger protection of IPRs through bilateral, regional, and multilateral actions. In this context, the *Agreement on Trade Related Aspects of Intellectual Property Rights, including Trade in Counterfeit Goods* (the TRIPS Agreement) negotiated during the Uruguay Round (1986-94) of trade negotiations emerged as one of three multilateral agreements laying the fundamental framework under which the World Trade Organization (WTO) operates. Although the TRIPS Agreement will not promote a single standard of IPRs protection applied throughout the world, it lays the foundation for convergence toward higher standards of protection on a global scale.

The emergence of new technologies has led to the continuous adaptation of IPRs protection instruments. For example, the evolution of IPRs protection with respect to biotechnology and its implications for agriculture and the pharmaceutical industry represents one important new area that is of high relevance to developing countries. Other examples include the protection of computer software and the protection of information in a digital environment such as the Internet. IPRs regimes around the world are still in flux in these areas. Some trends are emerging, however, and being ratified by new international agreements with minimum standards of protection. They pose new challenges not only for the legal regimes of most developing countries, but also for institutions and practices that have played a prominent role in the international diffusion of knowledge. Some of these trends also raise non-economic considerations (such as ethical and religious concerns), not to mention the potential for conflicts with other existing multilateral agreements.

Against this background, this paper explores the role of intellectual property protection in economic development. Section 2 provides a short overview of what IPRs are, how they are

governed, and what determines countries' IPRs regimes. Section 3 attempts to evaluate the relationship between the protection of intellectual property and economic activity in developing countries. It concludes that, although IPRs seem in many respects irrelevant to developing countries' economies, they have gained increased importance in particular sectors. Most notably in agriculture, the decrease in publicly funded R&D, coupled with the advent of biotechnology and genetic research, has led to an increased role for the private sector and reliance on IPRs protection. Moreover, IPRs have gained importance in international transactions of goods and services. These patterns are reflected in the growing global demand for IPRs protection.

Section 4 summarizes the economic effects of IPRs protection in terms of (1) creation and diffusion of knowledge and information and (2) market structure and prices. The basic message is that IPRs imply complex trade-offs for individual countries and, so far, economic models and empirical investigations have not been able to determine the "optimal" IPRs regime. However, some insightful evidence is emerging that can be useful in evaluating some of the economic implications of IPRs protection.

Section 5 discusses other areas of public policies relating to the protection of IPRs—market-structure–related policies, standards, and rights to biological resources and indigenous knowledge. In Section 6, the paper considers the reform of intellectual property rights regimes in developing countries. It starts with the premise that many developing countries need to reform their regimes in order to comply with the provisions set forth in the TRIPS Agreement. In this context, it reviews some options on administrative and judicial reform, outlines challenges posed by new technologies, highlights the need for building consensus for IPRs reform, and describes how developed countries and multilateral organizations can assist developing countries in their reform efforts.

Two important themes are advanced throughout Section 6. First, it is important that IPRs reforms be geared toward maximizing the benefits of intellectual property protection rather than simply serving to avoid complaints under the WTO's dispute settlement system. Second, in reforming their IPRs systems, governments in developing countries should match their roles to their capabilities rather than simply copying the institutions and procedures developed by industrial countries.

The final section summarizes the main points and concludes the paper.

2. What are Intellectual Property Rights?

This section provides a short introduction into the "basics" of intellectual property protection. It gives a brief overview of the various IPRs instruments, how these instruments are administered and enforced, and how nations reach accommodation when their residents seek protection for their intellectual works abroad. The final part of this section describes the evolution of countries' IPRs regimes in view of a changing international policy environment.

Instruments of Intellectual Property Protection

Over the course of history, different legal instruments for protecting intellectual property have emerged. These instruments differ in their subject matter, extent of protection, and field of application, reflecting society's objective to balance the interests of creators and consumers for different types of intellectual works. Table 1 provides an overview of the different IPRs instruments.

Patents are legal titles granting the owner the exclusive right to make commercial use of inventions. To qualify for patent protection, inventions must be new, non-obvious, and commercially applicable. The term of protection is usually limited to 20 years, after which the invention moves into public domain. The patent system is one of the oldest and most traditional form of IPRs protection (see Box 1). Almost all manufacturing industries make use of the patent system to protect inventions from being copied by competing firms. Since the early 1980s, patents have also been granted for agricultural biotechnology products and processes and for certain aspects of computer software.[1]

As an adjunct to the patent system, some countries have introduced *utility models* (or petty patents). The novelty criteria for utility models are less stringent and are typically granted for small, incremental innovations. Their term of protection is far shorter than for "regular" invention patents (typically four to seven years). Similarly, *industrial designs* protect the ornamental features of consumer goods such as shoes or cars.[2] To be eligible for protection, designs must be original or new. They are generally conferred for a period of five to fifteen years.

Trademarks are words, signs, or symbols that identify a certain product or company. Trademarks seek to protect a product's and firm's reputation for quality. Customers are offered the assurance of purchasing what they intend to purchase. Trademarks can endure virtually indefinitely provided they remain in use. Almost all industries use trademarks to identify their goods and services. The use of trademarks has turned out to be of high significance in certain consumer goods industries, such as clothing and watches. Similar to trademarks, *geographical indications* identify a product (e.g., wine or olive oil) with a certain city or region.

Table 1: IPRs: Instruments, Subject Matter, Fields of Application, and Related International Agreements

Type of IPR	Instruments of Protection	Subject Matter	Main Fields of Application	Major International Agreements
Industrial property	Patents, utility models	New, non-obvious inventions capable of industrial application.	Manufacturing, agriculture	Paris Convention, Patent Cooperation Treaty (PCT), Budapest Treaty, Strasbourg Agreement, TRIPS
	Industrial designs	Ornamental designs	Manufacturing, clothing, automobiles, electronics, etc.	Hague Agreement, Locarno Agreement, TRIPS
	Trademarks	Signs or symbols to identify goods and services	All industries	Madrid Agreement, Nice Agreement, Vienna Agreement, TRIPS
	Geographical indications	Product names related to a specific region or country	Agricultural products, foodstuffs, etc.	Lisbon Agreement, TRIPS
Literary and artistic property	Copyrights and neighboring rights	Original works of authorship	Printing, entertainment (audio, video, motion pictures), software, broadcasting	Berne Convention, Rome Convention, Geneva Convention, Brussels Convention, WIPO Copyright Treaty 1996, WIPO Performances and Phonograms Treaty, Universal Copyright Convention, TRIPS
Sui generis protection	Plant breeders' rights	New, stable homogenous, distinguishable plant varieties	Agriculture and food industry	Convention of new Varieties of Plants (UPOV), TRIPS
	Database protection	Electronic databases	Information processing industry	European Council Directive 96/9/EC
	Integrated circuits	Original layout designs of semiconductors	Microelectronics industry	Washington Treaty, TRIPS
Trade secrets		Secret business information	All industries	TRIPS

Note: All international treaties except TRIPS, the Universal Copyright Convention, and the European Council Directive 96/9/EC are administered by the World Intellectual Property Organization. The European Council Directive 96/9/EC provides an example of the evolving definition of IPRs in the area of database protection.

Source: Adopted from Primo Braga (1996) and World Intellectual Property Organization (1997).

Copyright and neighboring rights protect original works of authorship. Copyright protection differs from patent protection in that copyright solely protects the *expression* of an intellectual creation, whereas the ideas or methods advanced in the title can be freely copied. Copyright protection typically lasts for the life of the author plus 50 to 70 years. It is applicable to literary, artistic, and scientific works. During the past decade, copyright protection has also developed as the main form of protection for computer software. Neighboring rights are accorded to phonogram producers, performers, and broadcasting organizations. Limits to exclusive rights exist in certain "fair use" exemptions, such as educational or library use or for purposes of criticism and scholarship.

Box 1: IPRs Through History

The concept of rewarding innovators or creators for their ideas can be traced back to the debate between Aristotle and Hippodamus of Miletus (who supported the concept) in the fourth century B.C. There is some evidence of the recognition of the concept of authorship, for example, from as early as 400 BC and hard evidence in Pliny the Elder's encyclopedia of the first century A.D. At least by that time, individuals in various civilizations recognized the importance of protecting human thought, or intellectual property, as distinct from divine inspiration, which could not be owned.

Systematic protection of intellectual property by governments, however, is usually traced back to Renaissance Italy. Skilled craftsmen were making world famous glass products in Venice as far back as the eleventh century. Recognizing the importance of the industry, the government encouraged the export of the products, but banned the export of the craft. As in earlier times, the secrets of making better glass were protected by guilds. But as the trade grew, more glass makers risked the Venetian fines and left to set up shop elsewhere. The government of Venice, therefore, chose to explicitly recognize the knowledge embedded in their glass products. Beginning in the 13th century, a few patents were granted for various aspects of glass making, and by the 15th century patents began appearing regularly for rewarding strangers who brought new knowledge to Venice and for protecting local craft guilds. In short, the patent was originally used as an instrument of technology transfer, and only in the 18th century did gradually its use as a lever to innovation begin to take center stage in England and in the United States.

In the same vein, copyright law initially had more to do with the regulation of the business of printing and publishing than with the encouragement of intellectual creativity. In Renaissance Italy, privileges were awarded to publishers prohibiting the publication or importation of protected books by others without authorization of the grantee. In the 16th century Venice introduced the first general copyright law, in which authorization to print was conditional on permission provided by the author or immediate heirs. Around that time, other countries also introduced copyright law and other regulations as a way to control the publishing industry and to exert censorship (e.g., as a mechanism against "heretical" literature). By the 18th century, copyright law began to assume its modern format geared to curb piracy and to foster artistic and literary production rather than being a regime of royal favor. The Statute of Anne (1710) in England is the basic point of reference in this context.

Source: Long (1991), David (1993), Durdik (1994).

Besides these traditional forms of IPRs, ongoing technological change and the unique characteristics of certain industries and products have led to additional, so-called *sui generis* forms of protection. *Layout designs for integrated circuits* protect producers of semiconductors. Protection is limited to the design of an integrated circuit and thus does not restrict reverse

engineering of a semiconductor. In this regard, protection of layout designs is similar to copyright. However, the term of protection is shorter than under copyright—typically ten years. Title holders have the right to prevent unauthorized reproduction, importation, sale or other distribution of the layout design for commercial purposes. *Plant breeders' rights* (PBRs) protect new plant varieties that are distinct from existing varieties, uniform, and stable. Exclusive rights, in principle, include the sale and distribution of the propagating materials for a minimum of 15 years. Exclusive rights are typically subject to two general exemptions: the "research exemption," which permits the use of a protected variety as a basis for the development of a new variety; and the "farmers' privilege," which gives farmers the right to re-use seeds obtained from their own harvests. With the advent of biotechnology, however, many breeders in industrial countries are increasingly using the regular patent system for protecting agricultural products and processes. Breeders enjoying patent protection can not only prevent their competitors from using their protected material for breeding purposes, but also prevent farmers from reusing harvested seed.

Finally, the *protection of trade secrets* is part of many countries' IPRs systems. Trade-secret protection differs from other forms of protection in that it does not grant an explicit title to the creator of an original work. Instead, it protects businesses from the unauthorized disclosure or use of confidential information. Such confidential information includes inventions not yet at the patenting stage, ways of organizing business, client lists, purchasing specifications, and so on. In agriculture, breeders rely on trade secrets to protect hybrid plant varieties, if they can be kept secret. Copying through reverse-engineering does not infringe trade-secret laws. In essence, all industries possessing secret business information rely on trade-secret protection to safeguard their (often otherwise unprotectable) intangible assets.

Governance of Intellectual Property Rights

These legal instruments are just one of the pieces that form a national system of intellectual property protection. Also crucial to the system's overall effectiveness are the institutions administering these instruments, the mechanisms available for enforcing IPRs, and the rules regarding the treatment of non-nationals.

The administration of IPRs is most significant in the area of patents, industrial designs, trademarks, and plant breeders' rights. To obtain protection for these types of intellectual property, applicants have to submit their intellectual creations to a national IPRs office, which examines their eligibility for protection. Copyright and neighboring rights protection typically applies automatically upon creation of the intellectual work, although for evidentiary purposes authors may choose to register their works at copyright offices.

The enforcement of intellectual property rights relies on a country's judicial system. Title holders fight infringement of their exclusive rights in front of courts. To immediately stop infringing activities, they can request seizures or preliminary injunctions. If the claim of infringement is verified by trial, courts can demand the payment of punitive charges to the infringed title holder (or secret holder in the case of trade secrets).

IPRs are created by national laws and therefore apply at the level of each jurisdiction, independent of such rights granted elsewhere. Accordingly, nations must reach accommodation as their residents seek protection for their intellectual works abroad. Numerous international treaties to promote cooperation among states in the protection of intellectual property have been negotiated over the last 100 years. Most of these treaties and conventions are administered by a specialized agency of the United Nations, the World Intellectual Property Organization (WIPO). WIPO conventions typically require their signatories to follow national treatment in the protection of IPRs, but mostly do not impose common standards of protection. Table 1 illustrates the most relevant international conventions for each type of intellectual property.

Determinants of Countries' IPRs Regimes

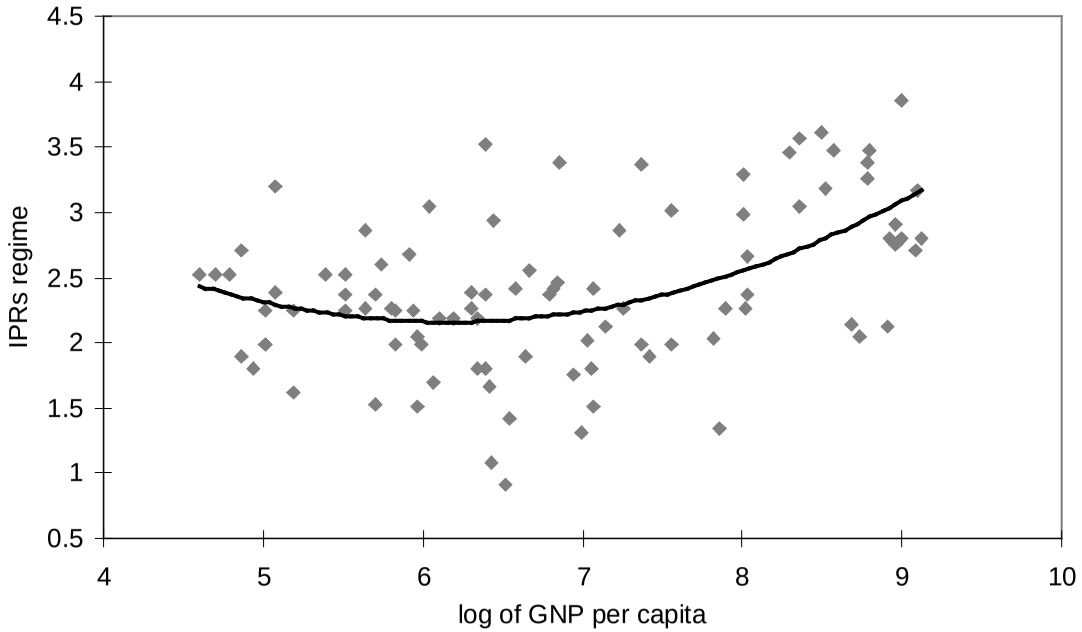
IPRs systems vary significantly from country to country. In many respects, the United States is considered to have one of the strongest IPRs regimes in the world. It protects all types of intellectual property, has a responsive institutional system for administering IPRs, ensures effective enforcement of intellectual property rights, and provides equal treatment of nationals and non-nationals through adherence to most international IPRs conventions.[3] The IPRs regimes of other developed countries come close to the U.S. standard, although there are differences in the legal coverage and governance of IPRs. The standards of protection in developing countries range from very low—some countries only protect few types of intellectual property with rudimentary administration and limited enforcement mechanisms—to the high levels of protection prevailing in most developed countries.

Traditionally, one could explain reasonably well the standard of IPRs protection in a given country by noting its level of economic development and its historical and cultural circumstances. The least developed countries supplied the weakest standards of protection, unless colonial influences led to the adoption of a regime based on the standards of more advanced countries. The weak standards of protection were driven by the view that these countries had a limited ability to create much intellectual property and thus little to gain from IPRs protection to the extent that they would be mainly granting "monopolies" to foreign patentees.[4] As countries moved up the development ladder, they adopted higher standards of protection both because they had more resources devoted to the creation of intellectual property and because they represented more attractive markets for industrial countries and thus faced growing pressures for protection from abroad. Figure 1 illustrates that, in 1975, the level of economic development generally served as a good predictor for the strength of a country's IPRs regime, although one finds many exceptions—in particular several (former colonial) low-income countries with relatively high standards of protection.

Beginning in the early 1980s, however, a significant shift occurred in the determinants of developing countries' IPRs policies. Pressures from industrial countries for strengthened protection gained momentum and international disputes over IPRs became common. A "marriage of convenience" between trade law and IPRs law emerged as some developed nations began to use trade measures to curb "piracy" abroad. The United States, for example, via Section 301 of the Omnibus Trade and Competitiveness Act of 1988, raised the issue of weak foreign protection for U.S. intellectual property to a priority status for negotiations concerning trade preferences and as a basis for potential trade retaliation.

Figure 1: Judging the Strength of IPRs Protection by the Level of Economic Development

Strength of IPRs regime and GNP per capita for 95 countries, 1975



Note: The strength of countries' IPRs regimes is measured by the index developed by Park and Ginarte (1997). This index grades national IPRs regimes on a scale from zero to five. Five different categories—extent of coverage, membership in international patent agreements, provisions for loss of protection, enforcement mechanisms, and duration of protection—are adopted to compute a country's ranking. For each category, using several benchmark criteria (e.g. patentability of pharmaceuticals for extent of coverage), the share of "fulfilled" criteria is computed. A country's score is the unweighted sum of these shares over all categories. GDP per capita is calculated using the World Bank Atlas method.

Source: Park and Ginarte (1997) and World Development Indicators (World Bank).

At the multilateral level, developed countries pushed for the inclusion of trade-related IPRs issues in the Uruguay Round of trade negotiations. Developing countries initially opposed this step, but in the end signed on to the TRIPS Agreement (see Section 1), which is the most comprehensive and far-reaching international agreement on intellectual property rights ever reached. As of early 1999, the Agreement was binding to all of the WTO's 134 members and would also become binding to all potential new entrants to the WTO.[5] The main features of TRIPS are outlined in Box 2.

Box 2: The TRIPS Agreement in a Nutshell

The Agreement on Trade-Related Aspects of Intellectual Property Rights (the TRIPS Agreement) is one of the pillars of the new multilateral trade order under the World Trade Organization (WTO) that emerged from the Uruguay Round negotiations of 1986-94. It requires its signatories to apply the principles of most-favored nation (MFN) and national treatment to intellectual property protection. Unlike most other international agreements on intellectual property rights, TRIPS sets minimum standards of protection with respect to all forms of intellectual property: copyright, trademarks and service marks, geographical indications, industrial designs, patents, layout designs of integrated circuits, and trade secrets.

In respect of each of these areas of intellectual property, the Agreement defines the main elements of protection, namely, the subject-matter to be protected, the rights to be conferred, and permissible exceptions to those rights. For the first time in an international agreement on intellectual property, TRIPS addresses the enforcement of IPRs by establishing basic measures designed to ensure that legal remedies will be available to title holders to defend their rights. The Agreement also makes disputes between WTO members with respect to their TRIPS obligations subject to the WTO's integrated dispute settlement procedures.

Although the TRIPS Agreement lays the foundation toward higher standards of protection for intellectual property rights on a global scale, it leaves its signatories with some flexibility in designing national IPRs regimes. For example, the criteria used for determining the novelty, non-obviousness, and usefulness of inventions can to some extent be defined differently across countries—as can the conditions for the use of compulsory licenses. The TRIPS Agreement does not address the exhaustion of intellectual property rights, thus leaving the choice open whether to restrict parallel importation of goods and services.

The provisions of TRIPS became applicable to all signatories by the beginning of 1996 and are binding to each WTO member. However, developing countries and economies in transition are entitled to a four-year transition period except for obligations pertaining to national and MFN treatment. Developing countries are also entitled to an additional five-year transitional period for product patents in fields of technology that were not protected at the date of application of the Agreement. For pharmaceuticals and agricultural chemicals, however, developing countries must accept applications for product patents and grant exclusive marketing rights for five years or until the patent is granted or rejected, whichever is shorter. Least-developed countries are entitled to a 10-year transitional period to comply with the obligations of the Agreement (again, except for national and MFN treatment), which period can be extended upon request.

Source: Primo Braga (1996).

The TRIPS Agreement builds on previously existing international IPRs conventions, but additionally sets out minimum standards of protection for all forms of IPRs, including basic enforcement measures, and establishes dispute settlement procedures with multilateral sanctions for non-compliance with TRIPS obligations. The provisions of the Agreement entered into force

at the beginning of 1996. However, developing countries are granted various transition periods to enable them to comply with the obligations of theAgreement. TRIPS will not promote one single world standard of protection in that it leaves its signatories with some flexibility in designing national IPRs regimes. In addition, the "TRIPS standards of protection" can be considered less stringent than the standards of protection currently prevailing in many developed countries (e.g., the United States). Nevertheless, the TRIPS Agreement lays the foundation toward higher standards of protection for intellectual property rights on a global scale.

Facing these trade-related bilateral and multilateral pressures, numerous developing countries have began to reform their IPRs regimes.[6] Reflecting this trend, membership of developing countries in WIPO Conventions has steadily grown (see Figure 2). By late 1999, a total of 171 developed and developing countries were parties of WIPO-administered treaties onIPRs.

Figure 2: The Growing Adhesion of Developing Countries to International IPRs Conventions

Number of Developing Countries that have signed the Paris and/or Berne Convention, as of early 1998

Note: The Paris Convention is the main international treaty in the area of patents and trademarks. The Berne Convention is the main international convention on copyright and neighboring rights.

Source: Institute for Economic Research (1996) and www.wipo.int.

3. Intellectual Property Rights and Economic Activity

This section evaluates the importance of IPRs in economic activity and highlights some emerging trends in the IPRs field. The first part relates IPRs protection to the structure of developed and developing economies and attempts to analyze how important IPRs are in the creation of intellectual assets as well as in the use of proprietary knowledge and information. The second part examines the role of IPRs in international transactions in goods and services. The final part of this section presents information on individual types of intellectual property rights, describes some emerging trends in this context, and illustrates the uneven distribution of intellectual property ownership between developed and developing countries.

In general, an evaluation of the overall significance of intellectual property rights in economic activity in developing countries is constrained by the indirect way in which these rights influence economic behavior and because data on intellectual-property–related transactions is scattered and often difficult to interpret. This notwithstanding, the main conclusion of this section is that although IPRs still do not appear as a top policy priority for developing countries, they have become more relevant in selected sectors—particularly in agriculture—and have gained importance in international transactions of goods and services. These patterns are reflected in an increasing global demand for IPRs protection.

The Importance of Intellectual Property Rights in Economic Activity

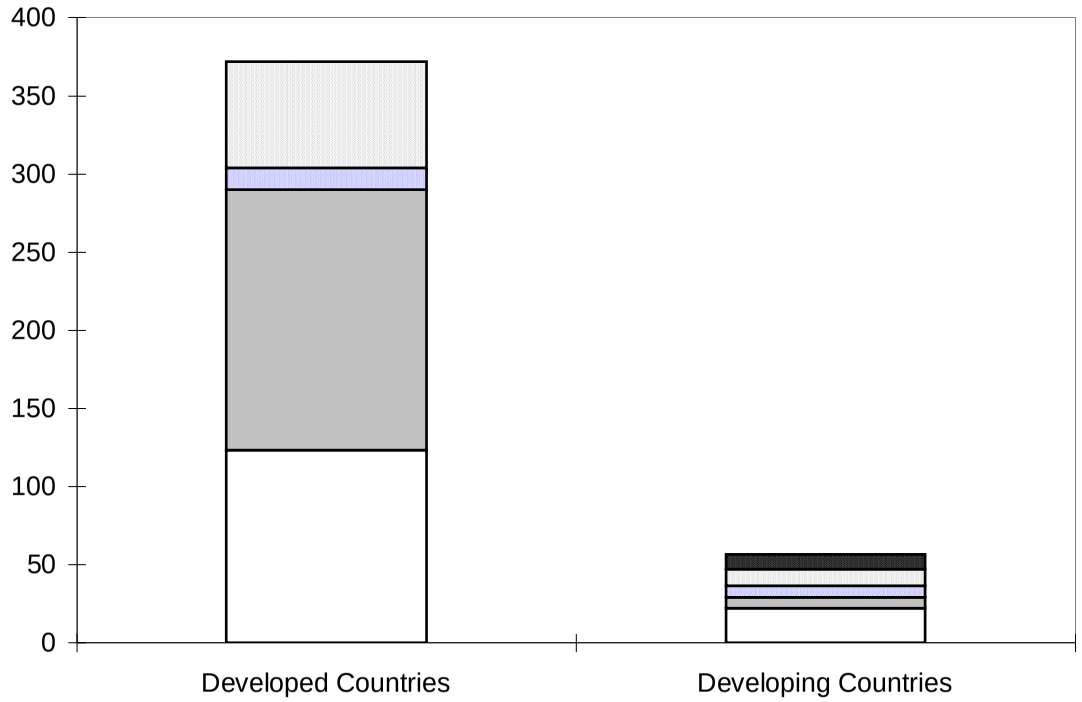
The significance of intellectual property rights in economic activity differs across countries and depends (1) on the amount of resources countries devote to creating intellectual assets as well as (2) the amount of protected knowledge and information used in production and consumption.

One useful indicator for the magnitude of resources devoted to the creation of new knowledge and information is a country's expenditure on research and development (R&D). Figure 3 shows the global distribution of R&D activities. In 1992, developed countries spent $372 billion,[7] or a little more than 2 percent of GDP, on R&D.[8] The United States had by far the greatest expenditure on R&D—around $167 billion, or 2.8 percent of GDP. Developing countries spent much less money on R&D (in total around $57 billion) and in most developing countries the portion of GDP devoted to R&D was below 1 percent. The major R&D spenders among developing countries include China, Brazil, India and the Asian new industrial countries.

There are also differences in the type and sectoral composition of R&D activity between developed and developing countries. In general, one can identify a growing importance of the private sector as a source of R&D funding and, as a result, increased reliance on IPRs protection as a mechanism to foster the creation of new knowledge and information. Within this process, however, it should be noted that the privatization of R&D funding is concentrated in developed

Figure 3: Global Distribution of Research and Development Activities

Gross domestic expenditure on research and development, 1992 ($billions)



Note: The figures should only be considered orders of magnitude because (1) definitions of "R&D activities" vary and (2) for some countries purchasing power parity was used, whereas for other countries official exchange rates were used.

Source: UNESCO (1996).

countries.[9] Moreover, industrial countries have a tradition of reliance on IPRs that is alien to many developing economies.

The second channel through which IPRs influence economic activity is in the use of proprietary knowledge and information—owned by both domestic and foreign residents—in production and consumption. Figure 4 shows the structure of output for low-, middle-, and high-income countries. For low-income countries, the share of agricultural output is higher and the share of services is much lower than in high-income countries. This would suggest that IPRs, as they relate to agricultural processes and products, are more important in developing countries than in developed countries. However, the critical question in this context is: What share of information and knowledge in a given sector and country is proprietary, and what share of knowledge that would contribute to the development of a given sector is protected by IPRs? There are no obvious answers to these questions.

Traditionally, the relevance of intellectual property protection in agricultural research has been limited because most agricultural R&D was conducted by public sector institutions in both developed and developing countries. Consequently, the dissemination of seeds and farming technologies that were in the public domain had—and in many respects still has—the most significant development impact.[10] The development and dissemination of the technologies which led to the green revolution, for example, did not pose substantial conflicts around IPRs. Until recently, many national patent laws explicitly excluded agricultural inventions from protection.[11]

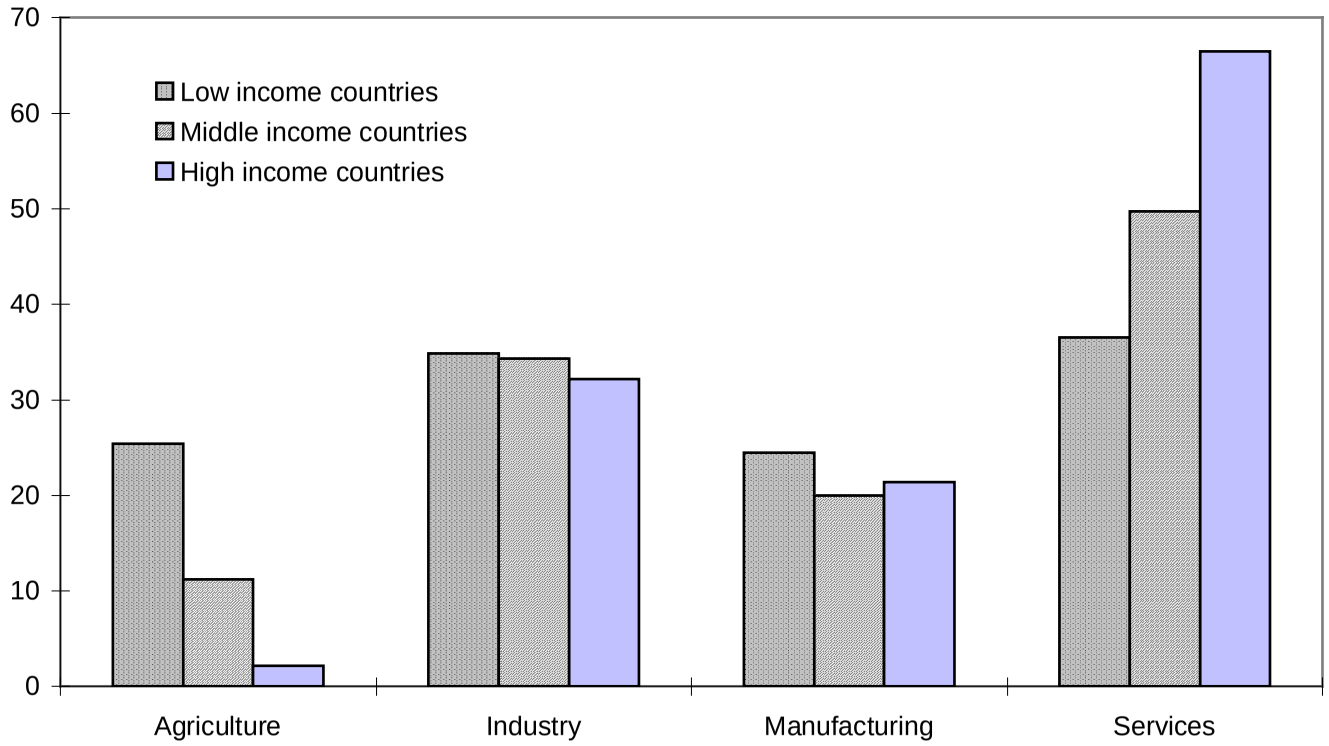
Since the early 1980s, however, there has been a significant shift in the policies and institutions of agricultural research. After a long period of sustained growth in public funding for R&D, growth has slowed beginning in the 1980s in most developed and developing countries and public agricultural R&D budgets have stagnated and in some cases even declined. At the same time, the role of the private sector in agricultural R&D has increased significantly. In developed countries, almost one-half of agricultural R&D is currently funded by the private sector and, through public support, an even bigger share is performed by the private sector. Aside from general fiscal restraint (combined with a more skeptical view of the social benefits from investments in science), the major driver towards privatization of research in agriculture has been the evolution of the science of genetics, which has led to modern biotechnologies based on recombinant DNA techniques, monoclonal antibodies, and new cell and tissue technologies.[12]

The privatization of agricultural research, in turn, is fostering a trend towards increased reliance on IPRs. Although most private agricultural R&D is conducted by firms in developed nations, this trend has also increased the relevance of IPRs for developing countries' agricultural sectors as an increasing share of new seeds and farming technologies is proprietary. In addition, as will be explained in Section 5, IPRs issues are becoming even more complex as developed-world researchers sometimes rely on biological and genetic material originating in the gene-rich developing world.

In manufacturing, although its share in total output is similar among low-, middle-, and high-income countries, this does not imply that the underlying technologies and products are similar. One could argue, for example, that technologies optimal for the factor endowments of developing countries differ from (e.g., are more labor intensive) developed countries' technologies and

Figure 4: Differences in the Structure of Output Across Income Groups

Percentage of value added in GDP, 1993



Note: *Agriculture* corresponds to International Standard Industrial Classification (ISIC) divisions 1-5 and includes forestry and fishing. *Industry* comprises value added in mining, manufacturing, construction, electricity, water, and gas. *Manufacturing* refers to industries belonging to ISIC divisions 15-37. *Services* correspond to divisions 50-99. It should be noted that the output shares presented do not take into account the unreported and informal economy. In developing countries, a large share of agricultural output, for example, is either not exchanged or not exchanged for money. Similarly, piracy or imitating activity, where illegal, is not captured by national accounts statistics.

Source: World Development Indicators (The World Bank).

proprietary rights of these technologies may already have expired. However, very little systematic research has been done in this context and it is thus difficult to evaluate how important or unimportant IPRs are for developing countries' manufacturing sectors.

In services, copyright protection affects mainly industries such as software production, publishing, and entertainment. In 1996, for example, the U.S. software market was valued at $102.8 billion, or 1.3 percent of GDP; the production of motion pictures was valued at $29.9 billion, or 0.4 percent of GDP.[13] For developing countries, the share of services in output is much smaller compared to developed countries and the relevance of copyright is usually limited to artistic and literary property. Notable exceptions here are large developing countries such as India, China, and Brazil, which have established considerable motion picture and television industries. In addition, selected developing countries have been successful in establishing their own software industries—most prominently the Indian software industry.

In the 1990s, copyright has gained additional attention for its role in protecting digital information on the Internet. The protection of digital content is still not a major issue in developing countries, where computer and network penetration is much lower compared to industrial countries. In early 1998, there were, for example, only 0.2 Internet host per 1000 inhabitants in developing countries compared to 31 in developed countries.[14] Nevertheless, with a persistent trend toward liberalization of telecommunications services and plummeting costs of computing and telecommunications technologies, it is reasonable to expect sustained growth of the Internet in developing countries and thus increased relevance of copyright protection with regard to digital content on a worldwide level.

Finally, the protection of trade secrets relates to almost any kind of formal or informal business activity. By their very nature trade secrets leave few traces, and as a result their overall economic significance is hard to evaluate. Sometimes the economic significance of this form of IPRs protection is revealed in legal claims related to the violation of trade secrets, as in the recent dispute between General Motors and Volkswagen.

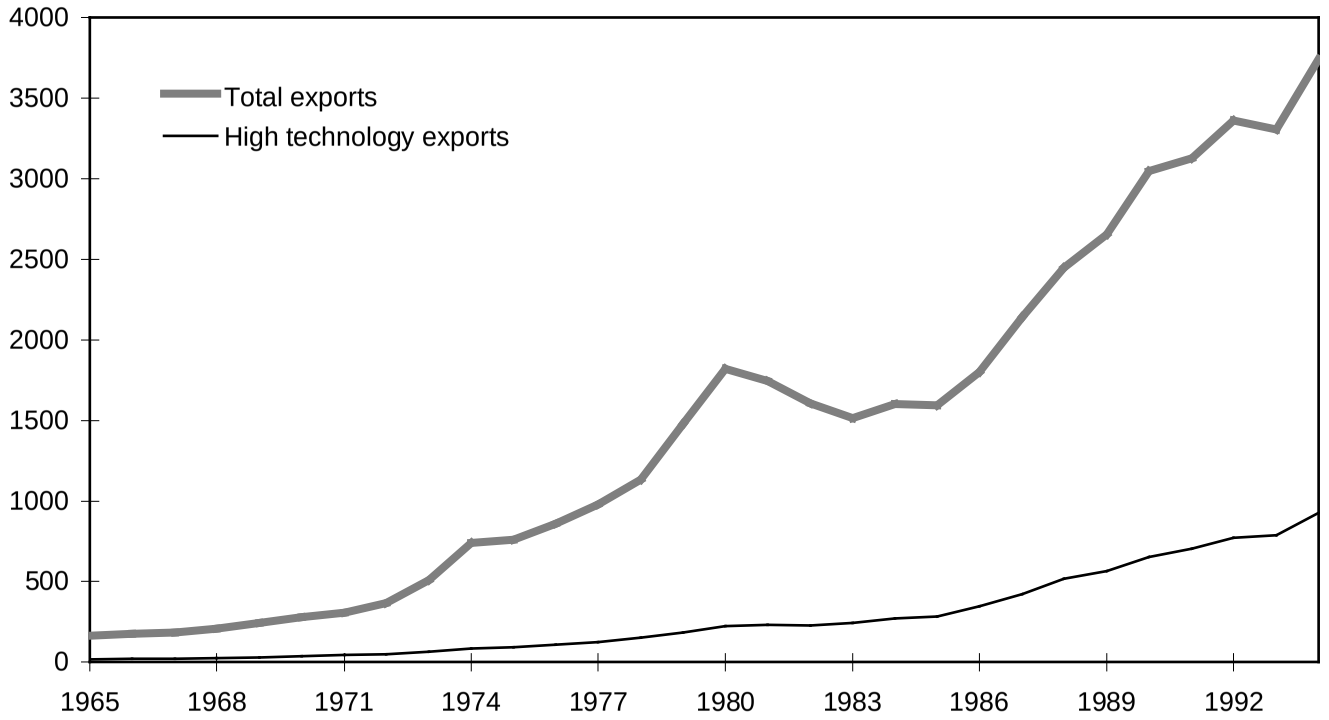
The Growing Importance of IPRs in International Transactions

IPRs have gained increasing significance in international transactions in goods and services. Since the 1980s export growth has exceeded the expansion of world output and the share of knowledge-intensive or high technology products in total world goods trade has doubled between 1980 and 1994 from 12 to 24 percent (see Figure 5).[15] It should be noted, however, that most international trade in high technology goods is among developed economies.[16]

Services have been a dynamic component of world trade: the share of services in global trade grew from 15 percent in 1980 to 18 percent in 1995.[17] Nonetheless, it is difficult to evaluate the overall significance of IPRs in services trade. Balance of payment statistics typically report only three different major service categories: transportation, travel, and "other services." IPRs are most relevant for "other services," which include "computer and information services" and "royalties and license fees." Royalties and license fees relate to the authorized use of intangible assets, IPRs titles, and franchises as well as the use, through licensing agreements, of produced

Figure 5: The Growing Importance of Knowledge-Intensive Activities in International Goods Trade

World total and high technology exports, 1965-94 ($billions)



Note: The definition of *high technology exports* relies on the classification developed by Primo Braga and Yeats (1992).

Source: Comtrade Database (United Nations).

originals or prototypes, such as manuscripts and films. However, definitions vary among reporting economies. Some countries, for example, also record the acquisition or sale of proprietary rights under royalties and license fees. Moreover, data availability is scattered, especially for developing countries.

The biggest exporter of proprietary rights and thus the largest recipient of royalties and license fees has traditionally been the United States. Total receipts of royalties and license fees increased from an average of $6.7 billion in 1980-82 to an average of $23.2 billion in 1993-1995. However, the share of receipts of royalties and license fees in total services exports did not change significantly (around 12 percent in both periods). In 1993-95, royalties and license fees represented 3.3 percent of U.S. total exports of goods and services.[18]

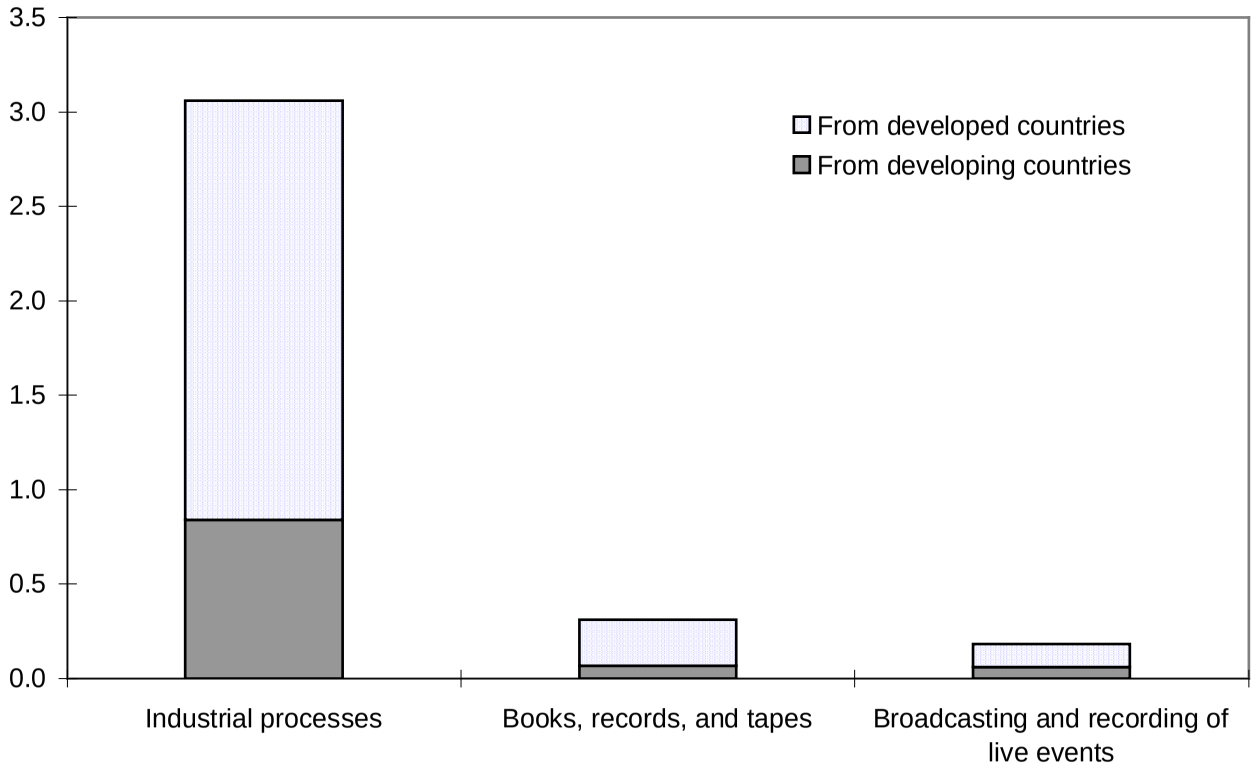
Most U.S. exports in intellectual property are intra-firm, that is, from U.S. parent companies to their foreign affiliates. Of the $23.2 billion of royalties and license fees in 1993-1995, around $18.2 billion were intra-firm. Figure 6 presents U.S. receipts from unaffiliated foreign parties in three intellectual property–intensive industries: industrial processes; books, records, and tapes; and broadcasting and recording of live events. Receipts from developing countries represented 27 percent of all receipts for industrial processes; 22 percent for books, records, and tapes; and 34 percent for broadcasting and recording of live events.[19]

The increasing importance of IPRs in international transactions is also manifested in the growth of international production. The global foreign direct investment (FDI) stock—a measure of the investment underlying international production—increased fourfold between 1982 and 1994; over the same period, it doubled as a percentage of world gross domestic product to 9 percent. FDI flows to developing countries surged in the early 1990s (see Figure 7). In 1996, FDI flows to developing countries amounted to about $110 billion—corresponding to roughly one-third of world total FDI inflows. However, FDI flows to the developing world are concentrated among few countries. In both 1994 and 1995, four countries—China, Mexico, Malaysia, and Brazil—accounted for 55 percent of all FDI flows to developing countries and the top 10 recipients for more than 70 percent of all FDI flows.[20] Moreover, the importance of foreign direct investment flows relative to domestic capital formation is only significant for selected economies (see Table 2) and FDI flows have been subject to large volatility—most recently in the context of the Asian crisis.

For the United States, about 50 percent of FDI outward stock in 1995 was in services (including wholesale trade, banking, finance, insurance, and real estate) and 36 percent related to manufacturing activities.[21] In general, there are reasons to believe that IPRs are relevant for FDI. Many analysts have pointed to the existence of intangible assets as one of the main reasons for firms to become transnational instead of supplying a foreign market via an arm's length export relationship. These assets take the form of new technologies, know-how among employees, management skills, reputation for quality, and so on—assets that often translate into explicit ownership of intellectual property. R&D spending, for example, serves as a good predictor for the degree of multinational activity in a given industry (see Figure 8) and 50 multinationals from developed countries accounted for 26 percent of all patents granted in the United States between 1990 and 1996.[22] Indeed, part of the increase of trade in high technology goods and IPRs-related

Figure 6: Direct International Trade in Intellectual Property

U.S. receipts of royalties and license fees, average of 1993-95 ($billions)

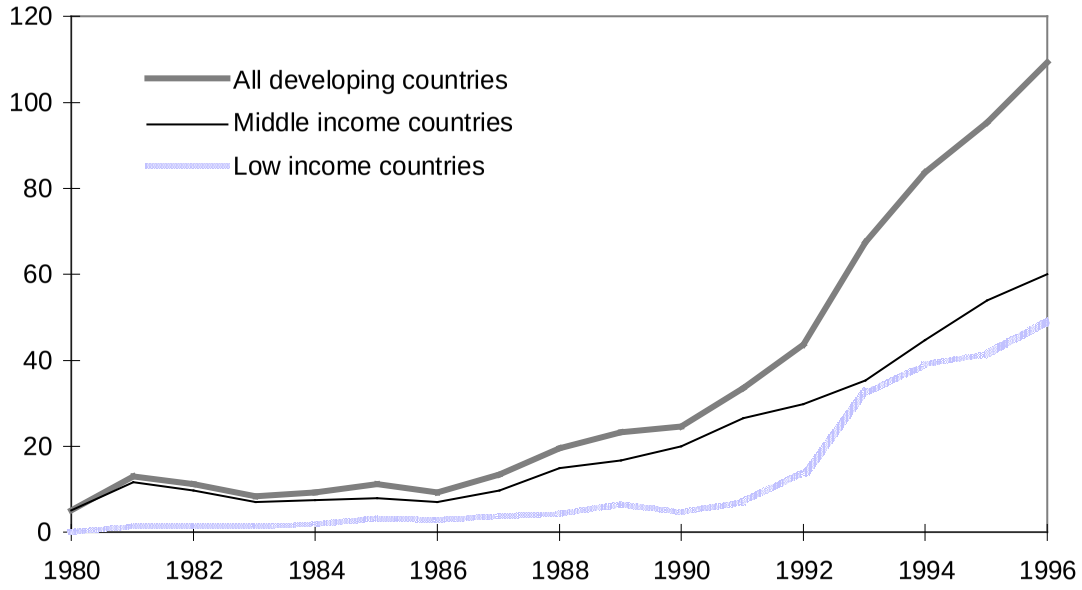


Note: Data refer to receipts of U.S. entities from *unaffiliated* foreign parties.

Source: Authors' estimate based on U.S. Bureau of Economic Analysis data.

Figure 7: The Surge of Foreign Direct Investment to Developing Countries

Net inflows of foreign direct investment, 1980-96 ($billions)



Note: Foreign direct investment is defined as investment that is made to acquire lasting management interest and is the sum of equity capital, reinvestment of earnings, and intra-company loans.

Source: Global Development Finance (The World Bank).

Table 2: The Relative Importance of Foreign Direct Investment (FDI)

	Inward FDI flows as a percentage of gross fixed capital formation				Inward FDI stock as a percentage of gross domestic product			
	1985-90	1991	1993	1995	1980	1985	1990	1995
World	**5.4**	**3.1**	**4.4**	**5.2**	**4.6**	**6.4**	**8.3**	**10.1**
Developed countries	5.5	3.2	3.7	4.4	4.8	6.0	8.3	9.1
Developing countries	8.0	4.4	6.6	8.2	4.3	8.1	8.7	15.4
China	14.5	3.3	20.0	25.7	..	1.2	3.6	18.2
Malaysia	43.7	23.8	22.5	17.9	24.8	27.2	33.0	52.1
Singapore	59.3	33.6	23.0	24.6	52.9	73.6	76.3	67.4
Mexico	16.9	8.5	6.0	17.1	4.2	10.2	13.2	25.6
Brazil	3.1	1.4	1.3	4.7	6.9	11.3	8.1	17.8
Sub-Saharan Africa	9.2	7.3	8.2	13.2	3.1	6.8	11.9	16.8

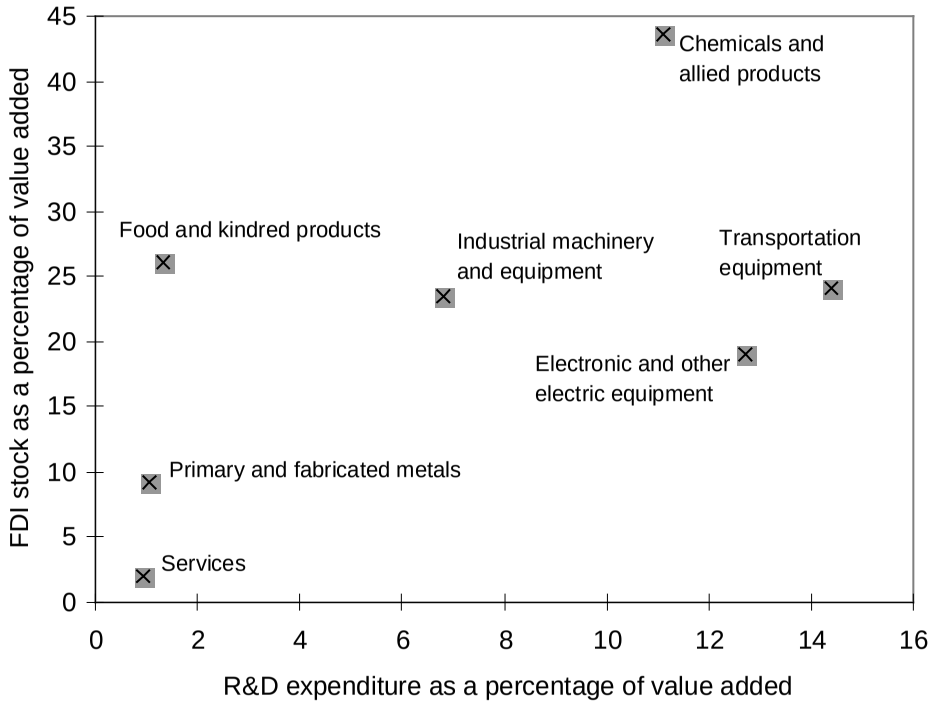
.. = Not available

Note: The definition and country classification differs from the data used in Figure 7. Singapore, for example, is classified as a developing country, whereas in the World Bank classification it counts as a high-income country.

Source: United Nations (1997).

Figure 8: R&D Spending as a Predictor of Foreign Direct Investment

U.S. foreign direct investment and research and development intensities, 1995



Note: R&D expenditure refers to company and other (except federal) funds for industrial R&D performance.

Source: U.S. Bureau of Economic Analysis and National Science Foundation.

services described previously is due to increased intra-firm trade and caused by the growth of international integrated production systems.

In sum, IPRs have gained increased significance in international transactions in goods and services. In fact, this development has been one of the fundamental drivers for the growing pressures for higher standards of protection in developing countries described in the previous section.

Global Demand and Distribution of IPRs

The increase in global demand for intellectual property protection since the 1980s can best be documented in the area of industrial property—trademarks, patents, industrial designs, and utility models—where firms and individuals file applications to obtain protection. Figure 9 presents the average number of worldwide annual grants for industrial property rights in both 1981-82 and 1994-95, showing that the number of trademark registrations increased 2.6-fold, from about 420,000 in 1981-82 to 1.1 million in 1994-95. Similarly, the number of patents granted in these two periods increased twofold, from 320,000 to 670,000. For industrial designs and utility models, one can also document a growing demand for protection, although the increase in the number of granted titles is smaller.

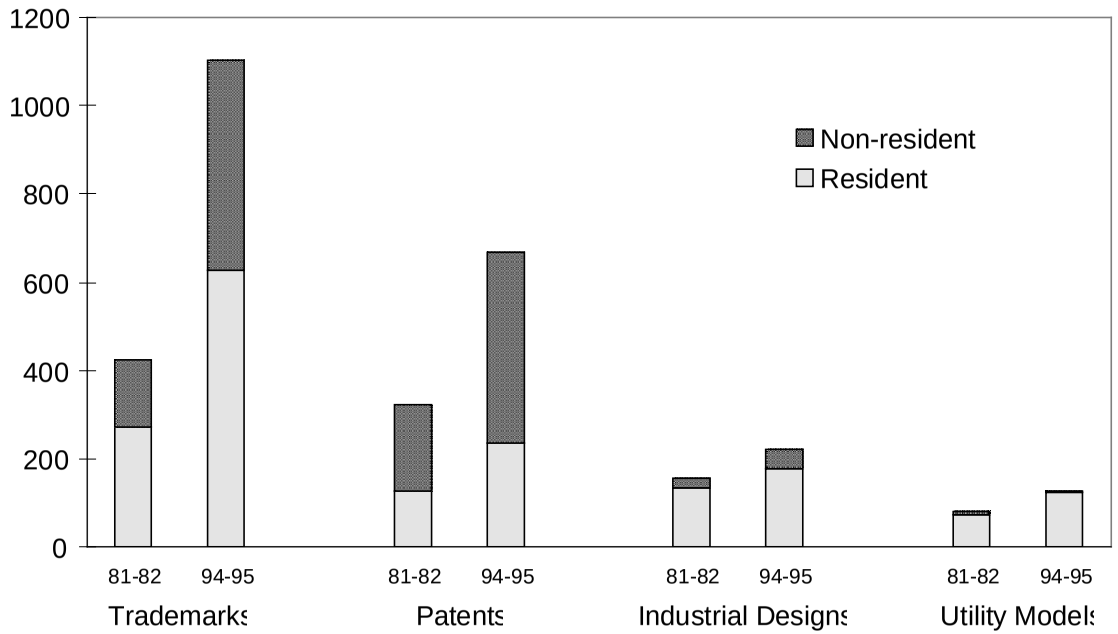
There are several forces behind this increasing demand for IPRs protection. One relates to the growing importance of IPRs in international transactions, as described previously. This has led patentees and owners of trademarks to seek broader geographical coverage for their intellectual property. Indeed, part of the growth in the number of worldwide grants for industrial property rights can be explained by the increase in the number of countries in which the same application is filed. As illustrated in Figure 9, the number of grants for non-residents has dramatically increased for both trademarks and patents.[23] This "globalization effect" is reinforced by the trend toward strengthened IPRs regimes observed in many countries since the 1980s, which has rekindled the interest for protection by knowledge- and information-intensive firms.

But globalization can only partly explain the growing demand for protection. As can be seen in Figure 9, the increase in the total number of industrial property grants is only partially due to multiple filings across countries; the number of grants to "residents only" has also gone up. In the case of patents, this empirical pattern could point to an acceleration in the creation of new technologies. Alternatively, the increase in the number of domestic grants may also reflect changes in the behavior of firms regarding their propensity to apply for patent protection. The increase in R&D costs of certain industries, as well as the shortening of the life cycle of new products, have created additional incentives for companies to use IPRs as a competitive "weapon." Moreover, the changing nature of innovation in new areas of knowledge, such as information technology and biotechnology, has required changes in IPRs regimes, leading to the expansion of the subject matter under protection.

Increased reliance on the patent system and the associated increase in the number of domestic grants may also reflect changes in the legal environment for title holders. However, for the United States at least, the surge in patenting between 1985 and 1996 cannot be fully explained by

Figure 9: Growing Global Demand for Industrial Property Protection

Number of worldwide annual grants for industrial property rights in thousands, 1981-82 vs. 1994-95



Note: For various reasons, numbers should be considered orders of magnitude only. First, the number of countries included in the two different periods differed because of political changes. Second, the availability of protection, the strength of protection, and the quality of the administration system for industrial property rights differ significantly across countries. In some countries, for example, inventors may be deterred to file a patent because enforcement is weak or because it takes several years until the patent is examined. Finally, the collection of industrial property statistics in some developing countries is unreliable and reporting practices to the World Intellectual Property Organization are not consistent countries.

Source: Authors' estimates from WIPO data.

the observed strengthening of legal protection (see Box 3). In other words, one cannot dismiss the possibility that such a surge is related to a "real" increase in the number of patentable discoveries.

Box 3: What is Behind the Recent Surge in Patenting in the United States?

Between 1985 and 1995 the number of applications for U.S. patents by U.S. inventors rose (in absolute and percentage terms) faster than in any other decade in this century. From the turn of the century until the mid-1980s, applications fluctuated between 40,000 and 80,000 per year, but in 1995 U.S. inventors applied for more than 120,000 patents.

Two hypotheses have been put forward to explain this jump in patenting. One is that the increase in the propensity to patent inventions is driven by changes in the legal environment for patent holders. In 1982, a specialized appellate court was established by the U.S. Congress to hear patent cases—a development that has been perceived as strengthening the rights of patent holders. The other alternative explanation is that the jump in patenting reflects a widening set of technological opportunities. In particular, the past two decades have seen an explosion of new firm formation and innovation in the high technology sector: biotechnology, information, and software industries.

Kortum and Lerner (1997) reviewed evidence from several sources in studying this phenomenon, including aggregate statistics on international patent applications, detailed statistics by technology class and assignee of patents granted in the United States, and aggregate measures of research effort. The friendly court hypothesis would suggest that the upturn in patenting should be driven by changes in the United States as a destination. Both U.S. and foreign firms should find patenting in the United States increasingly attractive, and the increase in patenting should be relatively uniform across technologies and patentees. The alternative view would suggest other patterns.

Kortum and Lerner's results show that, contrary to the suggestion of the friendly court hypothesis, the United States has not become relatively more attractive as a destination for patents. Rather, the increase in U.S. patenting seems to be a consequence of a worldwide increase along with a recent improvement in the relative performance of U.S. inventors.

Source: Kortum and Lerner (1997).

Although industrial property statistics from developing countries suffer from many shortcomings, the dominance of industrialized countries in worldwide ownership of industrial property is clear.[24] This is most pronounced in the case of (1) patents, where less than 5 percent of worldwide patents granted to "residents only" (approximating first filings) in 1994-95 belonged to developing countries; and (2) industrial designs, where less than 1 percent of domestic grants originated in the developing world.[25] Industrialized countries are less dominant in trademark and utility model ownership: about 32 percent of domestic trademark registrations and 29 percent of domestic utility models granted in 1994-95 belonged to residents of developing countries.

Industrial property statistics also show a relatively stronger dominance of foreign residents in national grants for patents and trademarks in developing countries. In 1994-95, only 21 percent of patents granted in developing countries were awarded to domestic residents—compared to 34 percent for developed countries—and 41 percent of trademarks registered in developing countries belonged to domestic residents—compared to 69 percent for industrial nations. This pattern is

less pronounced for industrial designs, where the majority of titles were awarded to domestic residents in both developing countries (74 percent) and industrial countries (81 percent). Utility models are almost exclusively granted to domestic residents.

The growing global demand for intellectual property protection can also be documented in the area of plant breeders' rights—although only high-income and a few middle-income countries currently provide protection for this type of intellectual property. The number of worldwide plant variety registrations increased 2.7-fold between 1981-82 and 1994-95, from about 2,500 in to 6,600. Again, increased filings by non-residents contributed significantly to this trend, as did the introduction of plant-variety protection systems in several developed and developing countries. But one can also identify an increase in domestic plant-variety registrations throughout the world—suggesting either an accelerated creation of new varieties or an increased reliance of firms on the plant breeders rights' system, or a combination of both. Because only very few developing countries provide plant variety protection, it is not surprising to find a clear dominance of industrial countries in plant variety registrations—only 10 percent of worldwide domestic grants in 1994-95 originated in the developing world. During this time period, aboutone-half of total plant breeders' rights grants were awarded to foreigners in both developed and developing countries.

The global demand for copyright protection is more difficult todiscern because copyright titles are typically not registered. Copyright protection has gained importance along with the emergence of sophisticated copying technologies (for example, photocopying machines and videocassette recorders) and the rapid globalization of the entertainment industry. The use of copyright in protecting computer software has significantly broadened the scope for this type of protection. Finally, the rapid expansion of the Internet has brought additional demand for copyright protection in the area of digital information and, as mentioned previously, this demand is likely to gain momentum in the future.

4. The Economics of Intellectual Property Rights Protection

The protection of intellectual property rights is widely considered to be part of economic policymaking, although economic theories of growth and development have so far ignored, or only peripherally considered, the role of IPRs policy. Available economic models and empirical evidence are inconclusive about the role of IPRs in the development process.[26] Most analysts conclude that the impact of IPRs protection in a given country depends on circumstances such as educational attainment, openness to trade and investment, and related business regulations.

Stronger protection of IPRs implies trade-offs for a country. Costs stemming from the increased market-power of IPRs holders and by the administration and enforcement of these rights should be compared with benefits such as the additional incentive to invest in R&D and the attraction of foreign direct investment. The design of the appropriate IPRs regime—the breadth, strength, and length of protection—should consider these trade-offs.

This section distinguishes among three main, interrelated economic effects of IPRs protection:

- Its effect as an incentive for creating new knowledge and information,
- Its implications for the diffusion of knowledge and information within and across economies, and
- Its effect on market structure and prices and its distributive consequences.

The discussion highlights the many gaps still remaining in our understanding of the economic implications of IPRs protection, but also points to some emerging evidence—albeit mostly from developed countries—that can be useful in evaluating some of the economic effects of IPRs protection.

Creation of Knowledge and Information

Intellectual creations have some characteristics of public goods. The blueprint for a new machine, the computer code for a software application, the script for a play, or a television broadcast can be simultaneously consumed by many economic agents at zero (or at a very low) marginal cost. In short, the cost of *re*production of intellectual creation is typically a fraction of the cost of production. Although pricing at marginal cost would maximize consumer welfare from a static perspective, it would curtail incentives for investing in the creation of new intellectual works or improving existing knowledge. By granting temporary exclusive rights, IPRs are intended to allow property-holders to price their products above marginal cost and to recoup the initial knowledge- or information-generating investment.

In this context, patents can be understood as a second-best solution to the problems created by the public-good characteristics of knowledge. In theory, the term of patent protection could be set such that it would stimulate the development of new products and production processes at a socially optimal rate—taking into account the static distortions patents create through enhanced market power as well the administrative costs of maintaining a national patent office.[27]

Patents are considered to play an important role in the innovation process for certain industries. In the pharmaceutical industry, for example, the availability of patent protection is considered critical. The investment necessary to develop, test, and market a new drug is estimated at more than $200 million. Once developed, however, pharmaceutical compounds can be easily imitated in the initial stages of the long product cycle—unless legally protected by patents. This trend is reinforced by the introduction of biotechnology to pharmaceutical research because genetic processes and products are easily copied once invented. Similarly, the emergence of biotechnology has made patent protection a pivotal issue in modern agricultural research.

Aside from the pharmaceutical and chemical industries and modern agricultural research, studies in the 1950s and 1970s showed that firms in most industries did not find patents to be a particularly effective means of appropriating returns from R&D in the United States and the United Kingdom. More recent studies for the United States, Japan, and Europe tend to confirm these findings. Firms in "high tech" industries—such as the aircraft and semiconductor industries—usually classify first-to-move advantage, and rapid movement down the learning curve as more effective methods to profit from R&D than patent protection.[28]

In some cases, overly strong patent protection—as reflected in very broad patent claims—is considered to restrict the innovation process as researchers find it difficult to further develop a technology without infringing the rights of patent holders. In the U.S. electronics industry some analysts have pointed out that companies seek patents mainly to possess a legal tool to deter the entry of competitors and defend their market position. Similarly, the development of new biotechnology research tools has increased the pressure on the traditional patent system. Many developed countries began to provide patent protection for biotechnology innovations (such as gene sequences, proteins, transgenic plants, animals, and methods of human gene therapy) far beyond the protection granted to traditional pharmaceutical chemicals or plant varieties. Accordingly, many developed-nation firms have acquired patents covering fundamental research tools and important genes and techniques to such a degree that it may be difficult for others to enter this new industry.[29] These trends have highlighted the importance of ensuring that past discoveries can be used at reasonable costs in future innovation processes in order to promote dynamic competition.

Limited evidence exists regarding the usefulness of the patent system in promoting the creation of new knowledge and information in developing countries. As already pointed out, developing countries do not have a tradition of reliance on patents as is common in most industrial countries. Moreover, the strong novelty criteria for patent grants, for example, may not be apt for promoting small, incremental, and adaptive innovations typical for developing countries. This is confirmed by evidence from India on the value and decay rates of patents (see Box 4). Some analysts have therefore pointed to the role of the utility model system or other innovation-registry–type systems that potentially could be more useful to researchers in developing countries.

Box 4: Estimating the Value of Patents Through a Patent Renewal Model: The Case of India

Several researchers have used patent renewal models to estimate the values and decay rates of patents. The idea behind such a model is that patent holders are only willing to pay renewal fees if these fees do not exceed the private value derived from holding onto the patent. With some assumptions on the distribution of patent values and behavior of the patent holder, one can estimate initial patent values and the rate of decay of these values. Several such models have been estimated for the major developed countries.

Luthria (1996) estimated the first patent renewal model for a developing country, India, based on 15,000 random sampled individual patents from the Indian Patent office. Overall, Luthria's results indicate that, compared to developed countries, the Indian patent system has not been very "valuable" for patent holders. Initial values of patents are low compared to similar estimates for industrial countries—on average only around $1,500. Decay rates are as high as 60 percent and the average total lifetime value of patents is around US $3,000 (compared to estimates of the average total lifetime earnings of $30,000 for the French and U.K. patent system and $80,000 for the German patent system). These results were used to estimate appropriability ratios of R&D investments through Indian patents, which turned out to be very close to zero—between 0.5 and 2 percent compared to around 15 to 20 percent for developed countries. This evidence would indicate that the Indian patent system has not been successful in stimulating investments in R&D. However, one should keep in mind that the low patent values and R&D appropriability ratios may also reflect the relatively small size of the Indian market and the limited scope of protection extended to Indian patent holders. For example, when comparing pre-1972 and post-1972 periods, which coincided with a respectively stronger and weaker regime, Luthria found that the post-1972 (weaker) regime showed higher decay rates and smaller total patenting values.

Luthria's study points to further interesting evidence. First, patent values differed significantly across industries: chemicals, metallurgy and medical equipment exhibit much higher patenting values compared to other industries, confirming similar findings for developed countries. Second, process patents had significantly higher decay rates than product patents, suggesting that product patents are either more profitable or more effective in limiting competition. Finally, although most patents in India are of foreign origin, foreign patents tend to lose value faster than domestic patents. This result suggests that foreign domination in patenting does not translate into preferential application or enforcement of patents. More fundamentally, given the relatively small observed overall patent values, this research suggests that the forgone profits from "patent piracy" in India may not be as high as often indicated by producers in the developed world.

Source: Luthria (1996).

Similar reasoning is typically used to explain the basic rationale for plant breeders' rights and copyright protection. As already mentioned, the scope and term of protection and exemptions to exclusive rights differ from the patent system—reflecting the different environments in creating new plant varieties, books, recordings, software, and so on.

Evidence from the United States suggests that the introduction of plant variety protection has increased the number of private sector breeders, as well as the number of private varieties developed. However, aside from anecdotal evidence from Argentina and Chile pointing to a positive effect of PBRs on private breeding, the usefulness of PBRs in stimulating private breeding activities in developing countries is not well understood.[30]

For trademarks and geographical indications, the basis for protection is frequently framed in terms of incentives for investments in quality rather than innovation. They contribute in reducing asymmetries of information between producers and consumers regarding the quality of products. There is an important difference between trademarks and the other, innovation-stimulating forms of IPRs. In contrast to investments in knowledge creation, investments in quality are typically "appropriable" from the viewpoint of the investing company (e.g., the increased use of quality control mechanisms). In theory, trademarks therefore do not restrict imitation or copying of protected goods, as long as they are sold under a different mark. In practice, however, firms often use trademarks—combined with promotional activities—to differentiate their products from competitors and thus to create market power.

As outlined in Section 3, trademark registration in developing countries is more widespread compared to the use of other types of intellectual property. There is also some anecdotal evidence that, under the right circumstances, trademarks can contribute to business development among low- and middle-income producers in the developing world. However, systematic evidence in this area also is scarce.

Trade secrets are sometimes seen as a necessary supplement to the patent system: before a patent application can be filed, an invention is typically protected as a trade secret. More generally, trade secrets are rationalized as a mechanism to foster innovations that do not comply with the strict requirements for the patentability of products and processes. Comparing trade secrets to patents, one should point out that trade secrets do not incur administrative costs in the form of application and grant procedures. Yet, unlike patents, trade secrets do not add to the base of knowledge available to the public.

It should be noted that IPRs are just one of the many solutions available to stimulate the production of new knowledge. The direct production of knowledge by public institutions (as exemplified by the R&D institutes of the former socialist economies), the use of subsidies and targeted procurement policies by governments (as in the case of defense contracts in many industrialized countries), as well as the recognition awarded by the scientific community to those able to establish priority of discovery, illustrate alternatives and/or complements to the proprietary approach. In the digital environment, some content providers offer their information and services for free while charging for ancillary services. A second alternative in the digital environment is encryption, where technology provides an important alternative mechanism to protect intellectual property.

Limited data exist regarding the economy-wide impact on R&D investment of the availability of IPRs protection. In part, this reflects the difficulties in establishing causality to the extent that not only IPRs may stimulate R&D, but also the demand for protection is higher in countries that invest more in R&D. Some analysts, however, have found that IPRs protection has a small positive impact on economic growth across countries, a result attributed to the role of IPRs in fostering R&D investments.[31]

Finally, one can consider the role of national or regional IPRs regimes on the composition of global R&D. It is sometimes argued that stronger patent protection in developing countries could stimulate research in developed economies on issues that are of special concern to developing

countries.[32] Examples include the development of new drugs and plant varieties—especially for tropical and temperate climates prevailing in developing countries. Once again, the available evidence is limited, although one would expectIPRs to be one among many factors influencingthe decisions of private companies to engage in such investments.

Diffusion of Knowledge and Information Within and Between Economies

By granting exclusive rights,IPRs restrict in many ways the diffusion of knowledge and information. Patents, for example, prevent others (at least temporarily) from using proprietary knowledge. Monopolistic or oligopolistic behavioramong intellectual property title holders(i.e., relatively smaller output and higher prices) can lead to less than (statically) optimal dissemination of new knowledge and information. As explained above, this should be considered as part of the trade-off related to IPRs protection: enhanced market power allows intellectual property owners to recover their initial information- and knowledge-generating investments.[33]

At the same time, IPRs can play a positive role in diffusion.[34] Patents are granted in exchange for the publication of the patent claim. In exchange for temporary exclusive rights, inventors have an incentive to disclose knowledge to the public that might otherwise remain secret. Although other agents may not directly copy the original claim until the patent expires, they can use the information in the patent to further develop innovations and to apply for patents on their own.[35]

Moreover, an IPRs title defines a legal tool on which the trade and licensing of a technology can be based. Protection can facilitate technology disclosure in anticipation of outsourcing, licensing, and joint-venture arrangements. The IPRs system thus plays a role in the creation of markets for information and knowledge by providing buyers and sellers of technology with more information. Similar to rights on tangible property,IPRs can make markets for intangible property more efficient and reduce transaction costs.

IPRs also influence the diffusion of knowledge between economies by influencing international transactions.[36] Internationally, technology is diffused through various channels such as trade, FDI, international licensing agreements, and technical assistance. In fact, for most developing countries, access to technology occurs mainly through these channels of diffusion rather than via domestic innovation.

To the extent that IPRs protection may increase the range of internationally traded goods and services, this may stimulate the development of technological capabilities in developing countries. One study even finds the growth-enhancing impact of patent protection to be more pronounced the more open economies are.[37]

From a theoretical perspective, however, the impact of strengthened protection on trade flows is ambiguous. Stronger patents enhance the market power of a foreign firm inducing fewer exports of its patentable product. But the perceived market size of this firm is larger due to the reduced abilities of local firms to imitate the protected product. Several studies have tried to estimate the effects of different levels ofIPRs protection on trade flows. While some of them find a positive IPRs-trade link at an aggregate level, this positive link does not seem to hold for high technology trade.[38]

A second channel of international knowledge diffusion is foreign direct investment. In joint-venture agreements, for example, multinational companies externalize proprietary knowledge to their local partners. Even wholly owned subsidiaries hire and train local employees and transfer some of their knowledge through contractual relationships (suppliers, buyers) with local firms. If stronger IPRs induce more FDI, one could expect higher knowledge spillovers from foreign to local firms and workers.

Evidence based on surveys of multinational corporations from Germany, Japan and the United States shows that intellectual property protection does affect FDI decisions. The impact, however, varies across industries: again, pharmaceutical and chemical firms seem to be more sensitive to the host-country's IPRs regime.[39] Moreover, the quality of a country's IPRs regime is just one of the many variables determining the overall investment climate of the country from the perspective of foreign investors.[40]

Another element regarding the role of IPRs in the international diffusion of knowledge is the way in which protection affects the vertical integration of multinational firms. Without strong protection firms may be reluctant to invest abroad into stages of production that involve a significant transfer of proprietary knowledge, which could easily leak to competitors. Surveys find the IPRs regime of the host country to be highly relevant for decisions to invest in R&D facilities, moderately important for FDI in manufacturing, and of limited relevance for investments in sales and distribution outlets. With respect to the manufacturing process alone, IPRs protection is found to be more relevant for decisions on investment in facilities to manufacture complete products, than in the case of plants that produce components or with respect to assembly facilities.

Direct technology transfer through licensing agreements provides another channel for international knowledge diffusion. Firms may be reluctant to license their technology to unrelated firms in countries with weak IPRs protection. Surveys indicate that U.S. firms, for example, tend to regard intellectual property protection as more important in decisions regarding the transfer of advanced technology than in investment decisions. Limited empirical research has been done in this area, however.

Market Structure and Prices

As already pointed out, increased protection of IPRs could confer considerably greater market power on rights-holders in the future.[41] If so, such firms might be expected to reduce sales or output in particular markets, supporting higher monopolistic prices for consumer goods and industrial inputs. In addition, in an economy that imports technologies, which is overwhelmingly the case in developing countries, the rent transfers from consumers to suppliers may be repatriated abroad.

No aspect of the TRIPS Agreement has been more controversial than the introduction of patents for pharmaceutical products. However, it is remarkable how little is confidently known about the potential impacts of this fundamental policy change, despite the fact that the pharmaceutical sector is the most extensively studied of all IPR-sensitive industries. A key determinant is the structure of market competition before and after the introduction of patents for pharmaceutical products.

Roughly stated, (1) the more competitive the local drugs market is before patents are awarded, the larger will be the pre-patent share of drug production that consists of copies of patentable drugs; and (2) the more inelastic demand is for pharmaceutical products, the higher will be the increases in prices associated with patents.

Some evidence on the potential impact of product patents on prices is available for India. Following the abolishment of pharmaceutical product patents through the Patents Act of 1970, India has developed a highly competitive pharmaceutical sector and drug prices that are quite low on a world scale.[42] In such a context, the introduction of pharmaceutical product patents could be expected to raise prices considerably if they are uncontrolled. One study simulating the hypothetical effect of product patent protection in India in 1994 shows a range of price increases from 9 to 76 percent, depending on various assumptions on market demand. It is worth noting, however, that by 1993, less than 10 percent of registered drug sales in India were of products containing substances patented elsewhere.[43] With regard to particular drugs, the price increase would depend on whether new products dominate a therapeutic application and/or whether (and how quickly) alternative treatments (both on-patent and off-patent) are available.[44] In addition, the Indian government could attempt to counter dramatic price increases by various market structure-related policies (see Section 5).

A second area of particular concern to developing countries is the possibility of price increases for new plant varieties upon the introduction of plant breeders' rights protection. Hardly any evidence is available on the price impact of PBRs. One recent study on Argentina, Chile, and, Uruguay found that the introduction of plant breeders' rights protection improved the ability of private breeders to control local seed markets and prevent unauthorized trade in protected plant varieties. In consequence, seed prices appeared to have risen, although it was not reported by how much.[45] It should be noted that because of the "farmers' privilege" (see Section 2), price increases would mostly effect initial seed purchases and the potentially adverse impact of PBRs on farmers may be very small. In addition, it has been pointed out that compulsory registration requirements for seeds in developing countries have a far bigger impact on market structure than the protection of plant breeders' rights. Nevertheless, with an increased reliance on the patent system for protecting agricultural products, monopolistic pricing may very well become a serious cause of concern in the future.

A third area commonly cited has having potentially adverse distributive implications is the protection of computer software. It is often argued that prices for computer programs would be much higher in light of comparisons between retail prices of legitimate and copied programs. If strong enforcement were to support the substantially higher price of the legitimate programs as counterfeit programs disappear, the price impact on computer users would potentially be severe. However, software firms often prefer to sell in developing countries with significant piracy rates at low volumes and substantial markups, reflecting small markets (e.g., corporations, banks, and governments) with inelastic demand. In this context, it is likely that, as markets develop under copyright protection, software firms will choose to supply more legitimate copies of programs at considerably lower prices. Predictions of drastic price increases for software, based on the enormous observed price gaps between copied and legitimate software, are unlikely to hold in actual practice.

5. Intellectual Property Rights and Other Areas of Public Policy

Intellectual property rights interact in complex ways with many other areas of public policy. Sometimes, complementary policies and regulations can increase the benefits or minimize adverse implications of a given IPRs regime. In other situations, IPRs pose conflicts with economic, social, and environmental regulations or multilateral agreements and appropriate mediation is necessary. This section briefly highlights the main related areas of public policy and considers the influence of alternative policy options on the impact of IPRs. It touches on three policy fields in this regard: policies related to market structure; standards; and rights to biological resources and traditional knowledge.

Policies Related to Market Structure

Governments can use policies related to market structure to limit or further define the scope of exclusive rights conferred by an intellectual property title. Such policies are employed to reduce market concentration related to IPRs protection and to ensure the "adequate" availability of protected products. Four such policies are reviewed here: price controls, compulsory licenses, parallel trading, and the control of anti-competitive practices.

Price Controls

One possibility for governments to reduce potentially adverse price movement related to IPRs-induced market power is to explicitly control prices through reference prices or administrative price ceilings. Price controls are allowable under the TRIPS Agreement. In the pharmaceutical industry, price regulations are a common strategy of many developed and developing country governments—especially with regard to essential drugs and drugs procured by public budgets. In theory, if prices are fixed close to production costs, potential consumer surplus losses related to a firm's patent-induced market power can be reduced or eliminated. Of course, by fixing prices at cost-oriented levels, governments diminish the profitability of the drug market and, as such, offset at least some of the incentive to invest in research and to develop new drugs. Some governments have therefore tried to control prices in such a way that they allow firms to generate "normal" profits to recoup R&D investments, while at the same time avoid extreme price hikes which would emerge in an unregulated environment.

In controlling pharmaceutical prices in practice, several complications arise. First, it is inherently difficult to compute production costs or to define "normal" profit levels. Moreover, in setting prices, regulators must rely on data and information provided by pharmaceutical companies, which have an incentive to overstate actual costs or underreport profits. At the international level, if price regulations are stated on a "cost-plus" formula, as is often the case, foreign firms are

encouraged to set high transfer prices on imported ingredients, such that price controls can actually raise final retail prices. Second, foreign companies that are awarded patents may choose not to supply a country at the regulated prices. Finally, it seems that price ceilings set in key developed countries, such as the United States, Canada, and France, are increasingly tied to reference indexes of prices in other markets. Accordingly, firms have an incentive to bargain for the highest possible prices in the low-price developing economies in order to gain a higher set of global reference prices.

Compulsory Licenses

Compulsory licenses are official permissions to use protected intellectual property without authorization of the title holder. The intellectual property owner typically receives a license fee either negotiated between the title holder and a designated official institution or the licensee, or mandatorily set by national authorities. Compulsory licenses are justified to protect public interest—such as the provision of social services (e.g., health and nutrition), national emergencies, anti-competitive practices (see below), non-commercial use of intellectual property, exploitation of dependent patents, and technology transfer. The use of compulsory licenses can, in theory, play a role in offsetting the underprovision of essential goods due to monopolistic market structures or the increase in the cost of research due to overly broad patent ownership. At the same time, extensive use of compulsory licenses reduces the perceived strength of an IPRs regime because knowledge and information creators fear they may not be adequately rewarded for their innovative goods and services even though they may be granted an IPRs title. Compulsory licenses are generally permissible under the TRIPS Agreement, although certain provisions in the Agreement limit their use.[46]

Parallel Trading

Parallel trading occurs when a product under IPRs protection, which is put on the market by an authorized firm in a foreign country (e.g., a foreign licensee or subsidiary), is exported to a country in which the same product is also sold by an authorized local firm (e.g., the IPRs title holder).[47] The question is whether and to what extend governments should restrict parallel trading and allow intellectual property owners to segment their national or regional markets.

In national laws, parallel trading is governed by the so-called exhaustion doctrine, which specifies the rights of title holders after first sale of the protected product. National (or regional) exhaustion entitles an intellectual property owner to prevent parallel importation of his good after its first distribution. The European Union, for example, has a system of regional exhaustion: it allows protected products to flow freely across EU boundaries, but entitles IPRs holders to prevent parallel imports from non-EU countries. In contrast, in a system of international exhaustion, the title holder loses his exclusive rights after first distribution, thus allowing parallel imports. The TRIPS Agreement does not specify rules regarding the exhaustion of rights and countries are therefore free to adopt either regime.[48]

From the viewpoint of developing countries, it is unclear whether parallel trading brings net benefits to the economy. Several interrelated effects have to be considered. From the perspective of a developing-country consumer, many analysts have argued that parallel trading increases competition and drives down prices. Accordingly, parallel imports could offset potential price

increases associated with the introduction of IPRs protection. At the same time, however, parallel trading, if universally adopted, limits the ability of intellectual property owners to discriminate prices across countries or regions. To the extend that prices already tend to be the lowest in low-income countries with limited purchasing power, the threat of parallel trading may actual lead title holders to raise prices in developing countries or to not serve a particular market in order to protect higher prices in developed countries. Unfortunately, no empirical evidence exists to document price movement in developing countries related to parallel trading.

These conclusions hold for all types of intellectual property where parallel trading is possible, although additional considerations arise for individual types of IPRs. In the area of trademark protection, for example, parallel imports (or so-called gray imports) may undermine the efforts of the right owners to guarantee consistent quality and to maintain pre-sales and after-sales services. These factors should be considered when designing rules regulating parallel trading.[49]

Control of Anti-Competitive Practices

The control of anti-competitive practices refers to policies and regulations that seek to prevent the abuse of IPRs, that is, the attempt of intellectual property owners to exploit the granted IPRs title beyond the established limits. Such abuses relate mostly to business strategies, including selling practices and licensing restrictions. Several types of behavior may be considered anti-competitive. First, IPRs may facilitate cartelization of potential competitors through cross-licensing agreements that fix prices, limit output, or divide markets. Second, IPRs-based licensing agreements can be used to exclude competitors in particular markets by raising entry barriers through tie-in sales or restrictions on the use of related technology. Third, a firm may aggressively seek to strengthen its market power beyond its own intellectual property portfolio by purchasing exclusive rights to competing goods and services—effectively leading to horizontal mergers. Fourth, IPRs titles can be used to predate competitors by threatening or initiating bad-faith litigation and opposition proceedings—raising market entry barriers, particularly for new and small enterprises. In particular, there is the danger that abusive IPRs strategies may favor industry leaders and discourage competition and technological change.

For governments, the first step in controlling potentially abusive behavior is to establish whether a particular practice has anti-competitive effects. In some cases, restrictive licenses may actually be in the interest of consumers—such as vertical licensing agreements that ensure downstream product quality on the part of local vendors. Second, governments need to determine whether such practices lead to significant market concentration and have substantial adverse impact on, for example, prices or technical progress. Once such harmful effects are identified, governments have several options to counter abusive effects. They can grant compulsory licenses, revoke intellectual property titles, or restrict mergers and acquisitions. In doing so, governments must carefully weigh the benefits of such actions against potential costs in the form of quality losses or inefficient distribution systems. The control of anti-competitive practices gains an additional level of complexity when abusive practices involve firms and consumers in two or more countries. This is because anti-competitive effects may be harder to evaluate and, depending on a country's legal systems and international agreements, it may be hard to establish regulations countering these effects.

The TRIPS Agreement explicitly recognizes that some licensing practices or conditions related to IPRs could have anti-competitive effects, particularly on trade and the transfer and dissemination of technology. It gives its signatories the freedom to adopt measures to prevent and control such practices.

Standards

Standards play an important role in ensuring product quality; in guarding the interest, health, and safety of consumers; in promoting competition and consumer choice; and in protecting the environment.[50] They are either mandatorily set by governments (e.g., in the case of many health, safety and environmental standards) or standard setting organizations, by market forces (e.g., in the case of VHS video cassette recorders) or voluntarily by custom and consensus. To guarantee their widest possible dissemination, standards need to be widely accessible to interested parties on fair and reasonable terms. There is thus a potential conflict when knowledge and information covered by IPRs become incorporated in standards.

Typically, standard-setting bodies try to avoid incorporating knowledge and information covered by IPRs protection into a standard. If this is not possible, these bodies can ask the intellectual property owner to give his irrevocable consent to either abandon his exclusive right or to grant licenses on fair, reasonable, and non-discriminatory terms in return for incorporation of his proprietary knowledge or information into the standard. If the intellectual property owner refuses, standard-setting bodies usually exclude the proprietary knowledge or information from the standard.

Conflicts occur when the IPRs owner does not consent to the use of his proprietary knowledge or information in setting a standard and there is no alternative available to be substituted in the standard. A second area of friction between IPRs and standards arises when IPRs owners attempt to charge unreasonable royalties after a standard has been set. There have been various attempts in developed countries to resolve such frictions through revocation of IPRs, compulsory licenses, and other means (see Box 5). Conflicts between IPRs and standards are likely to become more common in the future because there is an increasing demand for prior standardization in areas such as information technology and telecommunications, where technology is changing rapidly, resulting in a greater likelihood of encountering IPRs that are essential for inclusion in standards.

An additional case of friction between IPRs and standards has been brought by multilateral environmental agreements (MEAs). Some MEAs set global environmental standards in terms of reduction of the use of environmentally harmful substances and technologies within a fixed time frame. One rationale behind such environmental standards is to foster R&D for viable substitutes. But if new substances and technologies are covered by IPRs protection, there is concern that IPRs owners would want to maximize their returns by charging high prices and setting restrictive licensing terms. This would restrain the wide diffusion of the substitute and slow down the fulfillment of the environmental standard, especially for low-income countries. To address such concerns, the Montreal Protocol on Substances that Deplete the Ozone Layer, for example, has provisions where it is agreed that developed countries would make every effort to ensure that the best available, environmentally safe substitutes and related technologies are transferred to

developing countries at "fair and most favorable" conditions. Again, with the conclusion of future MEAs, such conflicts are likely to arise more often—and appropriate solutions and safeguards, which carefully balance the trade-off between creation and dissemination of knowledge related to IPRs, will be necessary.

Box 5: How IPRs Interfere with Standards: The Case of Dell's "VL-Bus Patent"

A recent far-reaching judgment by the U.S. Federal Trade Commission related to Dell Computer's "VL-bus patent" illustrates the case of charging high royalties once a standard has been set. In June 1992, Dell representatives participated in the standard-setting exercise at the U.S.-based Video Electronics Standards Association (VESA) for the design of a "computer bus" that carries information or instruction between the central processing unit and peripheral devices. About a year earlier Dell had received U.S. patent 5036481 for the mechanical slot configuration used on the motherboard to receive the VL-bus card. However, at no point prior to the finalization of the standard did Dell disclose this to the standard setting committee. After the VL-bus standard became successful Dell claimed that several users of the standard were infringing its patent and attempted to negotiate terms for the use of Dell's exclusive rights. The FTC held that Dell had acted in such a manner as to restrain competition and Dell accepted a proposed consent judgment that it shall not enforce its patent. This decision was issued with a dissenting note and has raised a debate in the United States on whether such mandatory orders for the free use of patented technologies in standards chill the participation in standard-setting exercises. On the other hand, standards are to be widely used and users do not want to be burdened with unreasonably high payments for their use, especially if there are a large number of components or sub-components covered by separate IPRs.

Source: Watal (1997b).

Rights to Biological Resources and Traditional Knowledge

Driven by the advent of biotechnology tools and innovations, research-based corporations in developed countries' pharmaceutical and agricultural sectors have recognized the value of "gene-rich" biodiversity and the indigenous knowledge of local communities regarding traditional plants and medicines. In many cases, researchers from the developed world have invented novel, patentable products based on starting biological materials from the developing world (see Box 6). In principle, the IPRs system can play an important role in stimulating the development of new plant varieties and pharmaceutical products in this context—to the benefit of both developed and developing countries. Specifically, strong IPRs could foster local research or the formation of research joint-ventures with foreign companies, e.g. in the initial screening process of biological material and in the early research stages. However, there is concern that developing countries are not adequately compensated when foreign researchers develop products that are based on existing material or knowledge once taken out of the public domain of developing countries.

This has led to a debate in international fora on the rights of developing nations and local communities to biological resources and traditional knowledge. The United Nations Convention on Biological Diversity, one of the outcomes of the 1992 Rio Earth Summit, affirms a strong principle of national sovereignty over genetic resources and indigenous knowledge. The Convention gives nations the right to require foreign researchers to enter into material transfer agreements (MTA), under which any profits from the sale of materials based on domestic genetic resources are shared. Although several such MTAs have been negotiated (see Box 6), only few

countries have implemented formal MTA systems—and their effectiveness has been criticized because MTAs involve negotiations between two groups that have very different information levels, bargaining powers, and resources.

Box 6: Bioprospecting in Developing Countries: Some Examples

Merck Pharmaceuticals negotiated one of the first and best known bioprospecting contracts with INBio, a private, nonprofit national biodiversity institute created by the Costa Rican government. In a landmark partnership entered into in October 1991 and renewed in 1994, Merck provided $1.1 million initially and promised a share of any royalties on commercial products developed from the accessions, in exchange for 2,000 to 10,000 extracts from plants, insects, and microorganisms found in Costa Rica. No payments have been made towards royalties because no product has yet been marketed by Merck since this Agreement. INBio now has nine research agreements with the private sector that allow limited access to biological resources in return for financial compensation and transfer of technology.

Shaman Pharmaceuticals, a U.S.-based company, uses ethno-botanical science as a drug discovery technique and has several patent claims already pending. This company has established collaborative relationships with local communities, traditional healers, and scientific institutions in Nigeria and has pledged to return a portion of its sales from drugs derived from community-based knowledge to the communities involved through its non-profit arm, the Healing Forest Conservancy.

Source: Watal (1997a).

Some analysts have proposed legislative changes to strengthen countries' legal rights to biological resources and traditional knowledge. One suggestion, for example, has been to create "community intellectual rights" (CIRs), which would define and protect the rights of communities over their traditional knowledge. However, most proposals for CIRs have not fully addressed how a community would receive financial benefits from the use of its traditional knowledge. Another suggestion, in the specific context of plant breeders' rights, has been to introduce the concept of "farmers' rights," giving farmers the legal right to control a particular variety's use and enjoy the benefits of any future profits from commercial success.[51] Although several developing countries have initiated legislative changes to create CIRs or farmers' rights, so far, none of these (and other) proposals have been translated into internationally recognized legal instruments regulating the use of biological resources and traditional knowledge.

6. Reforming Intellectual Property Rights Regimes: Challenges for Developing Countries

Commitments made under the TRIPS Agreement are fostering reform in many developing countries' IPRs regimes. Many countries, however, have yet to comply with the provisions set forth in the Agreement. It is reasonable to expect that IPRs reforms will gain momentum as the various transition periods approach expiration. Table 3 provides some indication of the adjustment requirements in the developing world based on membership in international IPRs conventions used as references by TRIPS. Membership in the relevant conventions is just a partial indicator of a country's "pre-TRIPS standards of protection." A number of countries will need to adopt comprehensive new legislative and judicial instruments and create new or renovate old institutions for the administration of IPRs, whereas others will only need to modify certain aspects of their legal, administrative, and judicial systems.[52] Notwithstanding, many developing countries will face significant financial and institutional challenges in implementing the required changes.

This section explores the reform of IPRs in developing countries in more detail. It reviews some options with regard to administrative and judicial reform, outlines challenges posed by new technologies, highlights the need for building consensus for IPRs reform, and describes how assistance from developed countries and multilateral organizations can assist developing countries in the reform process.

Two important themes are advanced throughout this section. First, it is important that IPRs reforms be geared toward maximizing the benefits from intellectual property protection rather than simply serving to avoid complaints under the WTO's dispute settlement system. Specifically, reforms should target local entrepreneurs and facilitate the dissemination of domestic and foreign knowledge. Second, in reforming their IPRs systems, governments in developing countries should match their roles to their capabilities. Given a different structure of demand for IPRs protection and more limited government resources in developing countries, it would not be efficient to simply copy the institutions and procedures developed by industrial countries over several decades.

Administration of IPRs

The administration of IPRs rights relates mostly to industrial property rights and plant breeders' rights.[53] The tasks of industrial property offices typically fall into two categories: (1) the grant of industrial property titles involving the registration and examination of applications as well as the renewal of granted rights; and (2) the publication of industrial property titles or, more generally, the information services provided to the public.[54] The TRIPS Agreement obliges its members to

Table 3: Adjustment Requirements in the Developing World: International IPRs Conventions

Developing Country WTO members that have signed the Paris, Berne, and Rome/Geneva Conventions, as of early 1998					
All Agreements	Paris and Berne Conventions	Berne and Rome/Geneva Conventions	Only Paris Convention	Only Berne Convention	No Agreement
Argentina, Barbados, Bolivia, Brazil, Bulgaria, Burkina Faso, Chile, *China*, Colombia, Congo, Costa Rica, Czech Republic, Dem. Rep. of Congo, Dominican Rep., Egypt, El Salvador, Guatemala, Honduras, Hungary, Kenya, *Latvia*, Lesotho, *Macedonia*, Mexico, Niger, Nigeria, Panama, Paraguay, Peru, Philippines, Poland, Rep. of Korea, *Moldova*, *Russia*, St. Lucia, Slovakia, Slovenia, Trinidad and Tobago, Uruguay, Venezuela	*Albania*, *Algeria*, Bahrain, *Belarus*, Benin, Botswana, Cameroon, Central African Rep., Chad, Côte d'Ivoire, *Croatia*, Cuba, *Estonia*, Gabon, Gambia, *Georgia*, Ghana, Guinea, Guinea-Bissau, Guyana, Haiti, Indonesia, *Lithuania*, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritania, Mauritius, Mongolia, Morocco, Romania, Rwanda, Senegal, St. Kitts & Nevis, St. Vincent & the Grenadines, South Africa, Sri Lanka, Surname, Togo, Tunisia, Turkey, Zambia, Zimbabwe	Ecuador, Fiji, Jamaica, Cape Verde, India	*Armenia*, *Azerbaijan*, Bangladesh, Burundi, *Cambodia*, Grenada, *Jordan*, *Kazakstan*, *Kyrgyzstan*, Mozambique, Nicaragua, Sierra Leone, *Sudan*, Swaziland, Uganda, *Ukraine*, Tanzania, *Uzbekistan*, *Vietnam*	Pakistan, Namibia, Thailand	Antigua & Barbuda, Angola, Belize, Brunei Darussalam, Djibouti, Dominica, Maldives, Myanmar, *Nepal*, *Oman*, Papua New Guinea, *Samoa*, *Saudi Arabia*, *Seychelles*, Solomon Islands, *(Chinese) Taipei*, *Tonga*, *Vanuatu*

Countries in italics are applicants to the WTO.

Note: The TRIPS Agreement makes reference to the Paris, Berne, and Rome Conventions as standards of protection for the respective types of intellectual property covered by these conventions. Because the Geneva Convention on the protection of producers of phonograms implies even stronger protection than the Rome Convention, the table treats the Geneva Convention as a substitute for the Rome Convention. It should be noted that statistics on membership in international IPRs conventions give only a tentative picture of the adjustment requirements in the developing world. The TRIPS Agreement has additional obligations for the types of IPRs covered by the Paris, Berne, and Rome/Geneva Conventions, provisions for other types of IPRs as well as requirements regarding the administration and enforcement of IPRs.

Source: Institute of Economic Research (1996), www.wipo.int, and www.wto.org.

ensure that administrative procedures permit the granting or registration of IPRs within a reasonable period of time.

In the area of patents, the most resource-intensive task is the examination process of patent applications. Patent examiners need to be up to date in the relevant fields of technology. They are likely to demand high salaries and require frequent training. For patent searches, examiners must have access to historical patent databases and libraries. There are substantial economies of scale in the examination of patent applications. Developing countries may not receive enough applications to justify a cadre of examiners covering every field of technology. As described in Box 7, this is true even for a large developing economy like Brazil. Moreover, there is potential for wasteful duplication of examinations if patents are filed in multiple countries.

Box 7: Economies of Scale in the Examination of Patent Applications: The Example of Brazil

Since 1970, industrial property rights in Brazil have been administered by the Instituto Nacional da Propriedade Industrial (INPI). INPI is the largest industrial property office in Latin America and is responsible for the examination and grant of patents (including utility models and industrial designs) and trademarks in Brazil. In recent years, it had a technical staff of about 100 people for the examination of patents. INPI's annual reports indicate that, in 1995 and 1996, it received respectively about 7,500 and 8,400 patent applications (although these figures differ somewhat from available WIPO statistics). This corresponds to an average workload of about 80 applications per examiner per year, which compares to a similar number of applications per examiner at the United States and British patent offices. But these offices employ about 2,300 (for the United States) and about 210 (for the UK) patent examiners handling respectively about 189,000 and 16,700 patent applications. To cover every field of technology, some analysts have proposed a cadre of at least 200 examiners—corresponding to the 200 discrete fields of science reflected in the international patent classification system. From this view, even a country as large as Brazil seems to have too few technical staff to conduct reliable examinations for every field of technology.

In May 1997, a new patent law became effective in Brazil that extends the grant of patents to five fields of technology previously excluded from protection. For this reason, and with a general increase in the global demand for patent protection, the number of patent applications filed at INPI is expected to rise over the coming years. To effectively manage the increasing number of application, INPI has several options, such as hiring of additional examiners, increased international cooperation for applications that are also filed abroad, "outsourcing" of examinations, or administrative and procedural changes increasing the number of applications each examiner can handle. Each option needs to be carefully evaluated in terms of its resource intensity, the quality of examinations, and the implications for the rights of patent holders as well as the wider social and economic implications.

Source: Sherwood, Scartezini, and Siemsen (1999) and www.inpi.gov.br.

Through international cooperation, developing countries can overcome the potentially wasteful duplication of examinations as well as problems to do with economies of scale. Membership in the Patent Cooperation Treaty (PCT) reduces the workload of national patent offices as certain stages of the processing of the application take place at the international level—performed by a major regional or national industrial property office.[55] A second option lies in regional cooperation and the establishment of regional industrial property offices. This option is especially suitable for countries that share the same language because it allows the development of common-language databases.

Finally, for all (non-PCT) applications that have already been examined by a specified foreign patent offices, countries can establish a system for automatically extending a foreign grant domestically. Only limited domestic resources would be needed for such an "extension system," mainly to administer the system and to ensure that extended patent grants are in full compliance with national laws.[56]

Governments in developing countries need to carefully decide how to most efficiently allocate scarce resources in administering patents. In doing so, they need to take into account that the number of domestic and foreign patent application is likely to increase in response to a strengthening of patent rights toward TRIPS compliance. One option would involve international cooperation through the PCT, regional agreements, or "patent extension systems"—combined with the development of domestic examination capabilities focusing on fields of technology in which local firms specialize

Another important consideration is the use of modern information and communication technologies (ICT) in the administration of patents. The possibility of submitting a patent application electronically and the use of electronic patent databases in the search process (e.g., through CD-ROMs or on-line access) are some of the main examples of such a use. Electronic links to foreign patent offices can greatly facilitate international cooperation and reduce the need for small countries to maintain their own comprehensive patent databases. Moreover, the use of ICT can broaden the service of patent offices to the general public and enhance the dissemination of information about new technologies. It should be kept in mind, however, that the diffusion of ICTs in developing countries is still limited and the capacity for electronic submission of patent applications and access to published patent databases is likely to be restricted to a small part of the population. This needs to be taken into account when formulating an ICT strategy for the national patent office.

The institutional status of national industrial property offices is also a relevant variable. In some countries the office is placed within a government ministry, whereas in other countries it has a more independent status. Through application and renewal fees, industrial property offices have a significant source of income. In fact, many patent and trademark offices generate operating surpluses. Consequently, there exists the danger that they are perceived as cash-generating machines for other government activities. By giving industrial property offices financial and planing autonomy, they are more likely to be flexible and responsive to the needs of intellectual property owners as well as to the general public.

Finally, it is important to keep in mind that application and renewal fees for patents can have an important effect on the behavior of innovators seeking protection. Although high patent fees can ensure adequate funding for the national patent office, they may discourage small entrepreneurs in developing countries from applying for protection and may thus bias the patent regime towards larger firms (often transnational corporations) with "deeper pockets."

Enforcement of IPRs

IPRs laws and administration are only the necessary preconditions for the protection of intellectual property. Without proper mechanisms for enforcing these rights, protection can be significantly weakened. Intellectual property owners depend on their ability to request court action to stop others

from unauthorized use of their assets. The TRIPS Agreement recognizes the importance of enforceability and incorporates basic measures designed to assure that legal remedies will be available to title holders to defend their rights. Many developing countries' judicial systems, however, lack the capacity to guarantee effective enforcement of IPRs.

The basis for guaranteeing the enforcement of IPRs is a capable and independent judicial system. Judges and courts should be free from political influence and free from corruption. They should be familiar with the legal aspects of IPRs protection and should have a basic understanding of science. Many countries have specialized courts dealing with intellectual property cases. At the least, judges need to be well-educated. Moreover, the legal system should establish tools such as preliminary injunctions or seizures to effectively stop infringements of IPRs.

Enforcement of rights can be a resource-intensive activity. In principle, courts have the option of levying fees for their services. However, this may discourage small firms from filing complaints and may bias the judicial system towards large firms, especially if one adds expenses for patent lawyers and related costs. In the extreme, the judicial system may be used by the largest firms and dominant players as a threat to competitors. These considerations need to be taken into account when designing judicial rules, procedures, and charges.[57]

New Technologies

The emergence of new technologies has led to the continuous adaptation of IPRs instruments over the last decade. Although new trends originate almost exclusively in the developed world, it is important for developing countries to participate in the ongoing international debate around IPRs and new technologies, and to take new technologies into account when reforming IPRs regimes. Many of these new technologies promise substantial social and economic benefits to developing countries in the form of new plant varieties suitable for tropical climates, new drugs against diseases prominent in the developing world, distance education via electronic networks, and so on. Again, in adapting IPRs instruments to new technologies, emphasis should be given on the wide dissemination of these new technologies and on facilitating entry of local entrepreneurs in markets for new technologies. Two areas of particular relevance to developing countries are biotechnology and the protection of digital information on the Internet.

The rapid evolution of biotechnology research presents the developing world with both opportunity and challenge. Opportunity exists in improving sustainable agricultural output with new plant varieties suitable to tropical and temperate zone climates, in developing new drugs against diseases prevailing in the developing world, and in using genetically-modified microorganisms for environmental cleanup. The challenge is that firms in developed countries are acquiring strong patent rights covering inventions related to genes and proteins, fundamental research tools, the human genome, transgenic plants, and even living organisms. Aside from ethical considerations, such strong patent rights may make it difficult for new firms and researchers from the developing world to enter the evolving biotechnology industry.

The advent of biotechnology is fundamentally shifting the institutional structure of innovation in pharmaceutical and agricultural research. Moreover, the reliance of research-based corporations in

the developed world on the "gene-rich" biodiversity of developing countries and the indigenous knowledge of local communities, as described in Section 5, has brought additional complexity in the process of creating and disseminating biotechnology products.

New forms of North-South and public-private partnerships are needed. Firms and public-sector research groups in developing countries will need to establish agreements with developed-nation firms—on the one hand to ensure that their nations' interests are taken into account, and on the other hand to obtain privately held technologies. Understanding how to make such agreements will become increasingly important for R&D managers in developing countries.

The Internet revolution poses another set of problems for IPRs regimes.[58] To some extent, it can be argued that the Internet is simply another chapter in the history of technological progress and that, as in the case of photocopying and audio- and videotape capabilities, the law will eventually adapt to face these new challenges. The expansion of legitimate videotape rental facilities around the world illustrates how the legal system can cope with decreasing costs of copying while enforcing the protection of IPRs. However, there are issues that are new and for which no definitive answers are yet available. With a few keystrokes, for example, one can anonymously download or copy copyrighted material from the a vast number of sites on the Worldwide Web. The frontiers between content carriers and content providers become fuzzy in the global information infrastructure. By prosecuting infringing carriers of digital information, one can discourage infringement, but this may inhibit the expansion of the very value-added services that make the Internet meaningful.

Some analysts are optimistic about the capacity of conventional IPRs laws to deal with these new issues, and history is a strong ally to the extent that it highlights the capacity of the system to adapt and address the needs of new technologies. Others believe that encryption (digital rights management technologies), rather than laws, provides the only effective way to protect intellectual property in "cyberspace."

In December 1996, WIPO convened a Diplomatic Conference to update the Berne Convention for the Protection of Literary and Artistic Works. The resulting WIPO Copyright Treaty and the WIPO Performance and Phonograms Treaty are expected to facilitate the use of cyberspace for commercial applications by clarifying the rights of authors in such an environment. The treaties allow the translation to the digital environment of exceptions to rights of authors under "fair use" considerations, while leaving the details of such exceptions to national laws. But some controversial issues—such as the creation of new liabilities in the treatment of "ephemeral" copies of copyrighted documents (digital copies generated in the process of browsing the World Wide Web)—were not settled. Moreover, the potential liability of communication carriers for transmitting infringing material, although clarified, remains a point of concern for the Internet industry.

Negotiations of multilateral agreements can help to advance the debate on how to reform IPRs laws to cope with the challenges of the digital age. The need to balance the interests of providers, carriers, and users of copyrighted material should be paramount in these debates. Special attention should be given to the danger of adopting extreme positions in this area to the extent that this may affect the availability of content in cyberspace and the prospects for expansion of digital networks in the developing world.

Building Consensus for IPRs Reform

The political economy of IPRs protection is complex. As described in Section 2, a major impetus for the move toward higher standards of protection in developing countries came from developed-world interest groups representing pharmaceutical, software, and musical recording companies as well as other IPRs-intensive firms. Many developing countries have opposed such stronger standards on the grounds that they would foster monopolistic behavior from multinational companies while promising few benefits to local entrepreneurs and consumers. Accordingly, one finds often a negative public attitude toward IPRs reform in the developing world. While concerns of higher prices and rent transfers are justified, the economic implications of stronger IPRs standards go beyond static market-structure considerations and involve many complex trade-offs.

A first step for a developing country reforming its IPRs regime should be to support initiatives that promote consensus. It is important to bring together all affected parties—local "pirates," research-based companies, universities, consumer groups, government agencies, industrial property offices, IPRs lawyers, and others—to discuss what IPRs "do" and "don't do," while attempting to evaluate the economic impact of IPRs reforms. Such an exercise can provide useful input for the formulation of new laws and help in identifying adversely affected groups and in the design of appropriate compensatory mechanisms.

Assistance from Developed Countries and Multilateral Institutions

The TRIPS Agreement obligates industrial countries to provide "technical and financial cooperation in favor of developing and least-developed country members."[59] In general, assistance to developing countries can be divided into four main areas:

- Supporting the IPRs reform process,
- Implementing reforms and building institutions,
- Enhancing the environment for IPRs, and
- Increasing the understanding of the social and economic effects of IPRs protection.

General *support for the IPRs reform process* would involve facilitating consensus-building in individual developing countries. In this context, multilateral organizations could serve as an "honest broker" in bringing together different interest groups, and educate policymakers and the public at large about the complex trade-offs surrounding IPRs protection and what TRIPS-related IPRs reforms will and will not do. In addition, bilateral and multilateral organizations could support the development of strategies for reforming IPRs laws and procedures, taking into account the "TRIPS standards of protection."

In *implementing reforms and building IPRs institutions*, bilateral and multilateral assistance could promote cost-saving measures for the administration of industrial property and plant breeders' rights as described above. Such assistance could advance international cooperation, develop and implement an ICT strategy for national and regional IPRs offices, train staff of these offices (e.g., patent examiners), develop foreign language patent databases, and so on. In the area of enforcement, assistance could be geared toward developing judicial institutions (e.g., courts and

customs authorities), training judges, and making judicial reform specialists available to developing countries.

To maximize the benefits of IPRs reforms, assistance from developed countries or international organizations could support the *enhancement of the environment under which IPRs operate*. This refers specifically to policies and regulations directly related to IPRs—such as competition-related policies, standards, and rights to biological resources and indigenous knowledge (see Section 5). One particular activity could be the development of reference material and (electronic) databases for technology transfer and material transfer agreements. In addition, assistance could sensitize researchers and small and medium-sized firms in the developing world on emerging opportunities related to IPRs protection and develop the skills necessary to negotiate international licensing contracts and material transfer agreements.

More generally, supporting developing countries' human resource bases and tertiary education and research institutions (with the goal of enhancing R&D capability) would increase the benefits of stronger IPRs—as would the promotion of better linkages between basic research institutions and private entrepreneurs. Finally, overall macroeconomic stability and open trade and investment regimes would reduce investment risks for local and foreign firms and could make the IPRs regime more effective in creating and diffusing information and knowledge.

A final area of assistance relates to the *understanding of the social and economic effects of IPRs protection*. As mentioned several times in this paper, much remains to be learned about the implications of IPRs protection. Bilateral and multilateral institutions could support more research on the role of IPRs in the economic development process. Such research should focus on specific types of intellectual property and should analyze the implications of IPRs under different country-specific and sector-specific circumstances. International organizations can play an important role in collecting more data and developing comprehensive databases on IPRs protection, and in monitoring reforms of national IPRs regimes.

7. Conclusion

As this paper has shown, IPRs protection is becoming increasingly relevant to policymakers in developing economies. This trend reflects not only international commitments made in the context of multilateral negotiations (e.g., the TRIPS Agreement), but also the growing reliance on private sector R&D in areas of particular interest to developing countries. In the case of agriculture, for example, IPRs policies may affect the lives of millions of low-income farmers in the developing world by influencing the pace and focus of advances in biotechnology.

The challenges these developments pose for developing countries are significant. Protection of IPRs influences how knowledge is created and diffused within and between economies. Besides the legal standards of protection, the foregoing discussion identified many other variables that determine the economic impact and net benefit of a particular IPRs regime: countries' endowments with factors and technologies, other business regulations, the efficiency of the judicial system, macroeconomic stability, and so on. Developing countries can enhance the benefits of TRIPS-motivated reforms by building national consensus on the desirability of IPRs protection and establishing efficient and credible institutions for administering and enforcing IPRs. Of particular importance is the adoption of a pro-competitive approach to IPRs, which requires close interaction between IPRs regulations and anti-trust rules. Assistance from industrialized countries and multilateral organizations in implementing these reforms can make a difference not only in accelerating the process, but also in paving the way for innovative approaches to IPRs protection in the developing world.

Endnotes

[1] With regard to biotechnology patents, the key step in the legal history was *Diamond v. Chakrabarty,* a 1980 case in which the United States Supreme Court decided that a novel living organism could itself be patented. Throughout the developed nations, this case was the beginning of a broad sweep of patent protection into a variety of forms of biological discoveries and inventions. For a discussion of the use of patents for soft-ware protection see Barton (1997).

[2] In many countries, industrial designs do not belong to the family of patent rights, but are established in separate laws.

[3] In a few areas, the IPRs regime of the United States does not provide the "highest standards" of protection. For example, the United States does not yet grant protection for electronic databases. Moreover, because litigation is highly expensive, the enforcement of rights has been characterized as being biased toward those with "deep pockets."

[4] This view was widely accepted among policymakers in the 1970s and led many developing countries to weaken their IPRs regimes. Some developing countries also supported attempts to reform international agreements, such as the Paris Convention, with a view to weaken existing international obligations concerning IPRs protection. Moreover, this view influenced the North-South debate on the so-called "New International Economic Order," with developing countries seeking the establishment of an "International Code of Conduct on the Transfer of Technology" (Primo Braga 1990).

[5] As of early 1999, there were 32 applicants for accession to the WTO, including China and Russia.

[6] It should be noted, however, that reforms in some countries were also driven by the belief that a higher standard of IPRs would bring net benefits to the economy.

[7] All dollar amounts are U.S. dollars.

[8] According to OECD data, the share of R&D expenditure in GDP for all OECD countries decreased from 2.38 percent in 1990 to 2.16 percent in 1995.

[9] Only in a few developing countries—including Korea, Singapore, and Taiwan—has private R&D become significant. Korea tops this list, with private R&D accounting for 2.3 percent of GDP, one of the highest rates in the world. (The World Bank, 1998)

[10] Especially in Sub-Saharan Africa, it would be fair to say that proprietary agricultural technologies are of secondary relevance to local farmers. For example, among the most urgent needs for agricultural development in many Sub-Saharan countries are the provision of wells on farmers' field for irrigation, improvements in crop physiology and agronomic practices, and the preservation of food crops and fruits to remove seasonality and ensure fruit-derived vitamins. See John Afele's contribution to the TechNet Think Tank (www.vita.org/technet/iprs).

[11] As mentioned in Section 2, a weaker form of protection (plant breeders' rights), however, was provided in most developed countries. In the 1990s, developing countries began to adopt plant breeders' rights and this trend is expected to accelerate as the TRIPS agreement requires WTO members to provide protection for plant varieties.

[12] See Alston, Pardey, and Smith (1998).

[13] These estimates rely on data from the Business Software Alliance and the U.S. Bureau of Economic Analysis.

[14] These figures are the authors' estimates based on Network Wizard (www.nw.com) and World Bank data. Similarly, in 1996, there were only 9 personal computers and 52 telephone lines per 1000 inhabitants in developing countries compared to respectively 224 and 540 in developed countries (also based on World Bank data).

[15] It should be noted that high technology trade does not include trade in agricultural products, which are based on proprietary seeds and agricultural processes.

[16] For example, in the late 1980s, developing economies accounted only for 16 percent of global high technology imports.

[17] The growing share of services in international trade was most pronounced in middle -income countries, where it doubled from 8 percent in 1980 to 16 percent in 1995. These estimates rely on balance -of-payments data from the International Monetary Fund.

[18] These estimates are based on data from the U.S. Bureau of Economic Analysis.

[19] Some data is also available for Germany. Total receipts of royalties and license fees increased from an average of $571.8 million in 1980-82 to $2.3 billion in 1993-95. The share of royalties and license fees in total services exports grew from an average of 1.8 percent in 1980-82 to an average of 3.1 percent in 1993-95. However, royalties and license fees represent less than 0.5 percent of all exports in goods and services. In 1993, total receipts for patents and licenses were $2.0 billion, of which $158 million (7.9 percent) came from developing countries. Note that this includes receipts from both unaffiliated and affiliated foreign parties. These estimates rely on data from the Deutsche Bundesbank.

[20] These estimates are based on World Bank data.

[21] These estimates are based on data from the U.S. Bureau of Economic Analysis. Unfortunately, only limited data are available regarding the sectoral distribution of FDI flows in developing countries.

[22] See The World Bank (1998).

[23] For industrial designs and utility models, this "globalization effect" is not as pronounced as for trademarks and patents because industrial designs and utility models typically relate to domestic activities, with limited transferability to other countries.

[24] The figures mentioned in this sections are the authors' estimates based on WIPO data (www.wipo.org).

[25] For patents, this excludes the countries of the former Soviet Union.

[26] For formal models see, for example, Chin and Grossman (1988), Deardorff (1992), and Helpman (1993).

[27] In practice, the uniformity of protection across sectors as well as the many uncertainties related to the innovation process are likely to cause a given patent regime to lead to both "underinvestment" and "overinvestment" in private R&D across economic sectors.

[28] See Mazzoleni and Nelson (1998).

[29] See Barton (1998).

[30] See the studies cited in Lesser (1990).

[31] See Gould and Gruben (1996).

[32] See Diwan and Rodrik (1991) for a theoretical treatment of this possibility.

[33] There are interesting exceptions to this trade-off. In the presence of network externalities or "de facto standards" — as frequently observed in the software industry—a certain degree of "piracy" can over time expand the market for intellectual property owners.

[34] For a historical discussion of the role of IPRs in the process of knowledge diffusion, see David (1993).

[35] It should be noted, however, that patent systems have been criticized to the extent that the actual information provided in the patent title is often insufficient to reproduce the knowledge related to the patent grant. This can be the case either because some knowledge is explicitly kept secret or some knowledge is tacit, i.e. difficult to codify, such as experience gained over time.

[36] For a literature survey on the effects of intellectual property rights on international transactions, see Primo Braga and Fink (1999).

[37] See Gould and Gruben (1996).

[38] See Maskus and Penubarti (1996) and Fink and Primo Braga (1999).

[39] The survey evidence quoted in the context of foreign direct investment and technology transfer refers to Mansfield (1994) and (1995).

[40] Theoretically, it is also possible that a weak IPRs regime attracts more FDI than a strong regime. A multinational company may prefer a local presence in a market with weak IPRs in order to defend and increase its market share, if it cannot rely on the IPRs system as the primary source of market power. Anecdotal evidence from pharmaceutical multinationals in Argentina, Brazil, and Turkey points to such behavior, but systematic evidence in this context is missing.

[41] This subsection relies heavily on Maskus (1998).

[42] See, for example, Lanjouw (1997).

[43] See Redwood (1994).

[44] In another simulation study of two therapeutic groups of the Indian pharmacy market, Fink (1998) demonstrates the effectiveness of therapeutic substitutes in restraining excessive price hikes and consumer welfare losses.

[45] The study is quoted in Maskus (1998).

[46] Some analysts have pointed out that the language of the TRIPS Agreement in this area is ambiguous and that the scope of TRIPS-consistent compulsory licenses is still not clear. See, for example, Watal (1998b).

[47] Parallel trading should not be confused with trade in counterfeit goods, which refers to trade in goods produced by a foreign firm infringing on somebody's intellectual property.

[48] Specifically, Article 6 of TRIPS states that "nothing in this Agreement shall be used to address the issue of the exhaustion of intellectual property rights." Notwithstanding Article 6, some observers have argued that the substantive provisions on TRIPS with regard to specific IPRs and certain provisions in the General Agreement on Trade and Tariffs (GATT) regulate parallel imports. See Watal (1998b).

[49] For a more comprehensive review on the legal and economic aspects of parallel trading see Yusuf and von Hase (1992), Malueg and Schwartz (1994), Abbott (1998), and Fink (1999).

[50] This subsection relies heavily on Watal (1997b).

[51] "Farmers' rights" should not be confused with the "farmers' privilege," which gives farmers the right to re-use seeds obtained from their own harvests (see Section 2).

[52] For a more comprehensive discussion of the legal, administrative, and judicial elements of IPRs regimes and an evaluation of IPRs systems of 18 developing countries in this respect, see Sherwood (1997).

[53] It should be noted that the TRIPS Agreement leaves its members the options to provide protection for plant varieties either by patents or by an effective *sui generis* system, such as plant breeders' rights. Most developing countries are likely, however, to adopt the *sui generis* approach as it gives more flexibility in ensuring adequate dissemination of protected varieties.

[54] Such information services consist of the maintenance of public libraries, assistance in patent searches, awareness - raising about technological opportunities, facilitation of technology transfer agreements, and participation in national and international events on industrial property matters.

[55] As of early 1998, 96 countries were signatories of the Patent Cooperation treaty. The international examining authorities of the PCT are the patent offices of Australia, Austria, China, Japan, the Russian Federation, Sweden, and the United States, as well as the European Patent Office. For more information, see www.wipo.int.

[56] For example, Ecuador and Singapore have adopted an extension type of system. See Sherwood, Scartezini, and Siemsen (1999).

[57] Another option in countries with particularly weak judicial systems is to create administrative conflict resolution mechanisms. This option has been implemented in Peru, where most disputes on IPRs are resolved by the tribunal of the *National Institute for the Defense of Competition and for the Protection of Intellectual Property* (INDECOPI). It should be noted, however, that administrative dispute settlement cannot function independently from the judicial system and, in the long term, the development of a strong judiciary is a prerequisite for adequate enforcement of IPRs.

[58] For further details on the protection of IPRs in a digital environment see Primo Braga and Fink (1997) and Shapiro and Varian (1999).

[59] An example of such assistance is the *Regional Industrial Property Programme* (RIPP) for transition economies, which is coordinated and implemented by the European Patent Office and financed by the European Union. The beneficiary countries of this program are Albania, Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

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