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THE IMPACT OF TRADE-RELATED INTELLECTUAL PROPERTY RIGHTS ON TRADE AND FOREIGN DIRECT INVESTMENT IN DEVELOPING COUNTRIES

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THE IMPACT OF TRADE-RELATED INTELLECTUAL PROPERTY RIGHTS ON TRADE AND FOREIGN DIRECT INVESTMENT IN DEVELOPING COUNTRIES

Executive Summary

This paper examines the relationship of certain types of intellectual property rights (IPRs) to foreign direct investment (FDI) and trade flows with respect to developing countries. The first sections of the paper provide an introduction and stocktaking that includes: 1) a brief review of the context, including references to the key treaties administered by the World Intellectual Property Organisation (WIPO) and the *Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)* of the World Trade Organization (WTO); 2) a summary of evidence from existing literature on the nature of the relationship between IPRs, FDI and trade; and 3) an overview of trends in FDI and trade. There follows an analysis focused on the association of the strength of patent rights with trade and FDI flows controlling for other factors.

For developing countries, trade and FDI are key sources of new technology, particularly in regions where the domestic research and development (R&D) sectors are underdeveloped or non-existent. There are controversies, however, surrounding the importance of IPRs to trade and FDI. From the rather limited empirical evidence thus far, it is difficult to assess the economic impacts to-date of strengthened IPRs resulting from increased adherence to key WIPO-administered treaties and the WTO TRIPS Agreement. Thus, a main objective of this paper is to contribute new empirical evidence on the role that strengthened adherence to the international arrangements concerning selected types of IPRs plays in attracting foreign trade and FDI in developing countries as well as fostering these countries' potential to export and invest abroad. A second purpose is to consider the economic payoffs to intellectual property reform with respect to access to new technologies.

At the heart of the study is a regression analysis whereby trends in FDI and trade are related to an index of patent rights (controlling for other factors that influence FDI and trade). This index was found to correlate well with survey measures of intellectual property laws in practice. The empirical study investigates national data as well as data disaggregated by industry. The period covered is from 1990 to 2000.

Overall, the study finds that the patent rights as described by the index are associated positively with FDI and moderately with trade. The results indicate that variation in FDI in relation to strengthened patent rights is largest for the least developed nations (where IPR regimes are weakest), and second largest for the developing nations (where IPR regimes are next weakest). Thus, patent rights appear to have a positive but diminishing association with increased FDI as the strength of those rights increases. This would seem consistent with the point that as IPRs increase in strength, they approach levels where the effects of market power prevail. The results do not imply that stronger patent protection (or correlated IPRs) will always raise FDI and trade. There may come a point where these types of IPRs are too strong – in the sense that they grant producers of intellectual products excessive market power – in which case IPRs may negatively influence FDI and trade. Thus, the empirical finding is conditional on intellectual property systems not reaching excessive levels of strength.

The evidence indicates that the relationship of patent rights to FDI and trade vary by industry (as well as by a country's level of economic development). This should be expected given the nature and functions of intellectual property rights. IPRs better enable the rights holders to appropriate the returns to their investments. Unlike tangible products, intellectual ones have the characteristics of a public good, which make it difficult to exclude others from producing and distributing the same good. Thus the effects of IPRs centre on the 'ability to appropriate'. For instance, in some industries, firms have alternative means to appropriate the returns to their investments. They may have lead-time advantages or brand name reputation. Or their technologies may be difficult to imitate or reverse engineer. In these cases, given the costs of acquiring intellectual property rights, firms may forgo seeking IPRs and rely on 'natural' protections. This might explain why the FDI in certain industries (such as metals, machinery, and transportation) is found to be insignificantly affected by the types of IPRs covered in this study. On the other hand, the selected IPRs appear to matter to FDI in computer services, finance, and chemicals (including pharmaceuticals), as the technologies in these industries are relatively easy to imitate.

Appropriability also varies by type of investment. For example, the returns to direct investment in production and R&D facilities are more difficult to appropriate than the returns to FDI in sales and distribution outlets, due to the greater risk of technology theft in the former. This could explain why the selected types of IPRs are found not to matter to FDI in wholesale trade. Likewise, countries differ in their capacity to imitate, particularly between developed and developing countries. The imitative capacities of the latter are on average lower, judging by their comparatively low R&D and skilled resources.

Compared to the relationship of the selected IPRs to FDI, their relationship to trade is generally positive but not as significant. One major reason is that changes in the intellectual property regime can affect the scale and distribution of foreign modes of entry. That is, both trade and FDI may increase in response to stronger IPRs, but firms may also switch from exporting to engaging in FDI. Thus, some firms expand their exports while others establish affiliates abroad so that, on balance, total trade expands less. (It may be that such affiliates will also subsequently contribute to trade flows, a potential long-run effect that might be investigated in the future).

This study also stresses that the state of IPRs in a country is but one of several factors that influence trade and FDI, albeit a very significant factor in certain industries and regions. Other important factors include market size, input costs and resource abundance, among others. In some situations, these factors have compensated for weak IPRs. For example, FDI and trade are drawn to regions in Latin America and China where markets are fairly large, to Southeast Asia where labour costs are low, and to the Middle East where petroleum is abundant. In addition, the implementation of IPR regimes depends on complementary factors such as the quality of legal institutions, markets, infrastructure, and so forth. Thus, the efficacy of intellectual property reform on trade and FDI is ultimately subject to the environment in which IPRs operate. It should be noted that the scope of the present study did not extend to cover assessment of the administrative (and related) costs of implementing enhanced IPR systems.

Overall, the paper provides evidence from different perspectives: from developed, developing, and least developed country data, and from economy-wide and industry data. While the full ramifications of the increase in developing country adherence to key WIPO treaties and the TRIPS agreement during the 1990s are yet to be felt, the evidence in the paper is supportive of the proposition that intellectual property rights, particularly patent rights, are an important influence on FDI and trade, depending on the type of industry and region of the world.

I. Introduction

1. This paper examines the relationship of certain types intellectual property rights (IPRs) to foreign direct investment (FDI) and trade flows with respect to developing countries. The first sections of the paper provide an introduction and stocktaking that includes: 1) a brief review of the context, including references to the key treaties administered by the World Intellectual Property Organisation (WIPO) and the *Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)* of the World Trade Organization (WTO); 2) a summary of evidence from existing literature on the nature of the relationship between IPRs, FDI and trade; and 3) an overview of trends in FDI and trade. There follows an analysis focused on the association of the strength of patent rights with trade and FDI flows, while controlling for other factors.

2. It is useful to review why IPRs might matter to FDI and trade. IPRs are often discussed in the context of innovation and creative activity. Intellectual outputs have the characteristics of a public good: once produced, they are available on a nonexclusive basis. They are also nonrivalrous in use - additional parties can benefit from them at zero additional cost. These factors make it difficult for producers of intellectual outputs to appropriate the returns to their investments and recoup costs. In the absence of property rights, the market for intellectual outputs would fail or yield an inefficient supply of output. As to the connection to FDI and trade, many producers of intellectual output are engaged in both domestic and foreign markets. Risks of unauthorised copying and imitation exist at home and abroad. Thus, in regions where IPRs are weak, incentives to market (via trade or FDI) might also be weak. Moreover, weak IPRs (and smaller markets as a consequence) may adversely affect incentives to innovate and produce, and thereby affect the potential to export and invest abroad.

3. Thus far, relatively limited evidence exists as to the impact of intellectual property regimes on FDI and trade flows to and from developing nations. This paper reviews the existing evidence and contributes new empirical work. The purpose of this paper is two-fold. A first purpose is to examine the role IPRs play in attracting foreign trade and FDI as well as fostering a country's potential to export and invest abroad. Economic development requires technology and resources, among other things. For many developing economies, imports and inward FDI are the key vehicles for technology inflow and resource accumulation.¹ Moreover, a developing economy's exports and outward FDI are measures of its productive capacity. A nation's exports are the difference between its output and *consumption* (by consumers, businesses and government). Residual output is sold to foreign markets. The more productive a country is the more 'residual output' there will be, holding domestic absorption constant. A nation's establishment of affiliates abroad is a channel by which to serve foreign markets (by producing and distributing goods and services in those markets). Outward FDI to establish these channels requires sufficient national savings and capital. To the extent that IPRs can have an impact on these inward and outward flows, it is important to consider the nature of this relationship.

4. A second purpose is to consider the economic payoffs to intellectual property reform, particularly with respect to access to new technologies (see Box 1). A number of international agreements address IPRs, some having been in place for decades. Key aspects of existing IPR protection under these agreements was reinforced and extended through the far-reaching TRIPS Agreement that came into effect in 1995. A main issue of interest is the gain that developing economies derive in return for strengthening their IPR regimes. IPRs have always involved "exchanges" of some sort. In exchange for property rights protection, the innovator discloses the underlying technology to society. That is, in exchange for the temporary monopoly, the innovator or creator eventually puts the technologies or creations into the public domain. Developing countries, for example, might see the TRIPS agreement as representing a bargain

¹ See, for example, Maskus (2000), chapter 5, and United Nations (1995).

whereby in exchange for granting technology owners stronger protection against imitation (and, consequently, increased profits), these countries can obtain increased access to the latest technologies (whether foreign originated or domestically generated). The empirical evidence in this paper touches on the extent to which IPR reform has affected technological exchanges between nations via changes in trade and FDI patterns.²

5. This paper is organised as follows. Section II provides a brief review of developments in international intellectual property reform. Section III reviews available evidence on the impact of IPRs on FDI and trade. Section IV reviews recent trends in world FDI and trade. Section V discusses the methodology used in this paper for studying the relationship of the selected IPRs to FDI and trade. Section VI discusses the results of the analysis. Finally, section VII concludes with a summary of the evidence and policy implications.

6. Overall, the paper provides evidence from different perspectives: from developed, developing, and least developed country data, and from economy-wide and industry data. While the full ramifications of the increase in developing country adherence to key WIPO treaties and the TRIPS agreement are yet to be felt, the evidence in the paper is supportive of the proposition that intellectual property rights, particularly patent rights, are an important influence on FDI and trade, depending on the type of industry and region of the world. The evidence also indicates that IPRs are relatively more significant to FDI than to trade.

Box 1. Trade-Related Intellectual Property Rights and Transfer of Technology

Technology is fundamental to economic development.³ Countries can acquire technology from domestic and foreign sources. The principal sources are domestic R&D and international trade, investment and licensing. International transfer of technology can be quite important for promoting development. Maskus (2000, p. 136) describes transfer of technology, at its most basic level, as the “successful learning of information and the know-how to use it by one party from another party”.

For developing countries, domestic technology sources tend to be rather limited. Often, the domestic R&D sector is underdeveloped. The causes of this are debated, but include the effects of weak intellectual property systems. Nevertheless, even if these countries undergo reform to stimulate domestic R&D, foreign sources will remain important while the domestic R&D sector develops. It takes time, for instance, to train scientists and engineers, build laboratories and create funding mechanisms.

A key issue is to identify how developing countries can attract foreign technologies, particularly by stimulating foreign trade and FDI. Clearly intellectual property laws and regimes play a role, but the nature of this role is still not fully understood. Proponents argue that strengthening IPRs in developing countries will raise the incentives for foreign firms to bring their technologies to these countries. Critics, on the other hand, argue that stronger IPRs could limit the local imitation of new technologies, reduce the supplies of new technologies (to the monopoly level), and increase the prices of new technological goods. Hence, it is an empirical question as to whether global IPR reform narrows or widens the technology gap between the *North* (developed world) and the *South* (less developed world).

² FDI and trade are two of the most important channels of technology transfer, but there are others. For example, technologies can also be transferred via contractual licensing [World Bank (2002)]. Licensing is beyond the scope of this paper.

³ See, for example, Jones (1998) and Maddison (1991).

(Box 1. Continued)

Maskus (2000) reviews a range of studies on technology transfer and concludes that weak IPRs can be a constraint on trade flows into large developing economies with significant capacities for imitation. Enhancement of IPRs in such economies (*e.g.* to the levels embodied in the TRIPS Agreement) could potentially lead to a substantial increase in imports of technology-intensive goods. The literature cited in the main body of the present paper indicates the importance of IPRs for investment in production and R&D facilities. Moreover, increased inflows of trade and FDI can have significant technological spill-over effects on the local economy, provided there is a conducive business environment in place. Elements of such an environment include openness to trade, an appropriate framework for competition, and adequate availability of human capital, among other complementary factors.

Internationally, a number of channels are being utilised to encourage more effective transfer of technology. WTO members have emphasised the importance for economic development of the interrelationship between trade, technology transfer and IPRs. The TRIPS Agreement made special reference to the promotion of technology transfer to least developed countries (Article 66, paragraph 2). It stated that developed country WTO members “shall provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least-developed country members in order to enable them to create a sound and viable technological base.” In Doha at the 4th session of the WTO’s Ministerial Conference, ministers agreed “to an examination, in a Working Group under the auspices of the General Council, of the relationship between trade and transfer of technology, and of any possible recommendations on steps that might be taken within the mandate of the WTO to increase flows of technology to developing countries.” The General Council will report on progress in the examination at the 5th session of the WTO Ministerial Conference to be held in September 2003 in Cancun, Mexico.⁴

WIPO is actively engaged in the issue of technology transfer. For example, it has sponsored a conference on technology transfer and for small and medium size enterprises, supported research and training, and facilitated information exchange on the issue.

Transfer of technology is also referenced in *The OECD Guidelines for Multilateral Enterprises* [OECD (2000)]. The science and technology section of the Guidelines calls for enterprises to adopt practices that permit the transfer and rapid diffusion of technologies and know-how, with due regard to the protection of intellectual property rights. The Guidelines state that, when appropriate, enterprises should perform science and technology development work in host countries, engaging local resources, granting licenses on reasonable terms and conditions, and ensuring that their activities are compatible with the science and technology policies of the host countries.

⁴ Recently, the Commission on Intellectual Property Rights (CIPR), an international panel sponsored by the U.K. Department for International Development, issued a report calling for an agenda to support technology transfer that goes well beyond the WTO framework [CIPR(2002)]. The CIPR recommendations call for the institution of: 1) appropriate incentive policies in developed countries to promote technology transfer (*e.g.* tax breaks for companies that license technology to developing countries), 2) effective competition policies in developing countries, 3) increased public funding to promote indigenous scientific and technological capability in developing countries through scientific and technological co-operation, 4) commitments to ensure that the benefits of publicly funded research are available to all and 5) commitments to ensure open access to scientific databases.

II. Recent Developments in Intellectual Property Rights

7. National laws and international treaties govern IPRs. The *World Intellectual Property Organization (WIPO)* administers a series of international IPR agreements that has been developed over a number of decades. Building on this framework, the TRIPS Agreement was negotiated within the GATT/WTO and came into effect on 1 January 1995. Member states of the WTO accept the multilateral agreements under the system as a single undertaking, including the TRIPS Agreement (Table 1).⁵ Currently, there are 146 member states (with the European Community counted as a single unit).

8. The TRIPS Agreement is relatively comprehensive in the areas of intellectual property rights it covers and includes mechanisms for enforcement, dispute resolution and remedies. It encompasses a broad range of intellectual property including copyrights and related rights, trademarks, geographical indications (which identify the geographical origins of products), industrial designs, patents and layout-designs (topographies) of integrated circuits. The TRIPS Agreement creates additional obligations while affirming the *substantive provisions* of key prior-existing WIPO-administered conventions including the *Paris Convention for the Protection of Industrial Property* (1967), the *Berne Convention for the Protection of Literary and Artistic Works* (1971), the *Washington Treaty on Intellectual Property in Respect of Integrated Circuits* (1989), and the *Rome Convention for the Protection of Performers, Producers of Phonograms, and Broadcasting Organizations* (1961) - with some exceptions. The TRIPS Agreement does not generally require compliance with the substantive provisions of the Rome Convention nor does it incorporate the Berne Convention's provision on moral rights (which protects authors against acts that may harm their reputation). For many developing countries, the TRIPS Agreement is associated with a major strengthening in intellectual property regime.⁶

9. The TRIPS Agreement establishes *minimum standards* for protection. Countries are free to adopt stronger laws if they so wish and are free to decide on how to implement the agreement using their own systems of law and practice. TRIPS also provides for *enforcement mechanisms*, enabling intellectual property disputes to be heard through the WTO's dispute settlement system and it provides for different *transitional arrangements* for countries at different stages of economic development. For example, developed countries were given one year to ensure that their laws conformed with TRIPS. Developing countries (and former socialist economies) were given five years and the least developed economies were given eleven years.⁷ Developing countries were also given ten years to extend product patent protection to areas of technology for which they did not previously grant patents.⁸ These transitional arrangements

⁵ There are also four plurilateral (as opposed to multilateral) agreements within the WTO framework. Two remain in force: *the Agreement on Trade in Civil Aircraft* and *the Agreement on Government Procurement*. The other two relate to bovine meat and dairy products; they were terminated in December 1997.

⁶ For more details on the origins of TRIPS and the obligations of member states, see Safadi (1999), chapter 1.

⁷ Table 1 lists the 49 least developed economies, as classified by the United Nations.

⁸ Technically, in the case of a developing country obliged by the TRIPS Agreement to extend product patent protection to areas of technology not so protectable at the time the agreement becomes applicable to that WTO member, the agreement provides for a delay in the application of the product patent provisions to such areas for an *additional* transition period of 5 years in addition to the basic 5 year transition period for all developing countries (*e.g.* this was the case for product patents on pharmaceutical products in India).

apply to the original signatory nations from 1995.⁹ Generally, newcomers are expected to conform with the requirements of the agreement at the time of entry, without any transition period.

10. In the special case of pharmaceutical and agricultural chemical products, under the original TRIPS Agreement, developing countries (other than LDCs) must accept patent applications (*i.e.* the “mailbox provision”) and can decide on patent grants at the end of the transition period. If a pharmaceutical and agricultural chemical product is allowed to be marketed, the marketing right must be exclusive for five years (or until a patent is issued, whichever comes sooner). These two sectors are singled out in these provisions because several countries have not historically recognised intellectual property protection for pharmaceutical and agricultural chemical products.

11. At the Fourth WTO Ministerial Conference (held in Doha, Qatar, in November 2001), Ministers provided further elaboration of the TRIPS Agreement. The Ministerial Declaration from Doha stresses the importance of interpreting the TRIPS Agreement in a way that supports public health by promoting access to existing medicines and development of new medicines; provides for negotiations on the establishment of a multilateral system of notification and registration of geographical indications for wines and spirits; and gives guidance for the on-going WTO review of TRIPS implementation issues. At Doha, Ministers also issued a separate *Declaration on the TRIPS Agreement and public health* that clarifies some forms of flexibility available with respect to pharmaceuticals, including the right of each WTO member to grant compulsory licenses (based on grounds determined by the individual members) and to use patented inventions in the case of national emergencies without the authorisation of the rights holder (particularly in the case of public health crises related to HIV/AIDS, tuberculosis, malaria, and other epidemics).¹⁰ The separate declaration exempts least developed countries from the obligation to provide patent protection for pharmaceuticals until January 2016 and waived the requirement to provide exclusive marketing rights for any new drugs in the period when they do not provide patent protection.

12. While the TRIPS Agreement represents a strengthening of the IPR regimes of WTO member countries, the transitional arrangements discussed above suggest that many developing economies might not have had TRIPS compliant laws during the late 1990s. (TRIPS implementation reviews are still underway, examining conformity of national laws to TRIPS Agreement requirements.) In this sense, it may appear early to investigate the effects of recent IPR reform on FDI or trade. Nevertheless, the transition periods exist not so much to postpone the adoption of laws but to phase in the changes in laws gradually. Thus, although the transition periods might not have expired for some countries, this does not imply that no legal changes have been made in these countries. Indeed, the core TRIPS provisions are already working to increase the degree of predictability in the current and future level of protection for IPRs.

13. Moreover, during the 1990s many developing countries moved to strengthen their IPR regimes through adherence to existing WIPO agreements. Adherence to these agreements and the TRIPS Agreement could affect FDI and trade decisions via expectations and signalling effects even prior to full implementation. Expectations of a future shift in IPR regime can influence firms’ current plans to trade and invest abroad. Signing on to an international IPR accord helps to send a signal of a country’s willingness to change its IPR regime. Hence, while a full exploratory study of the TRIPS Agreement may be

⁹ Indeed the vast majority of signatories joined the WTO at inception (January 1995) or within two years (*i.e.* by December 1996). Those that have joined since include Albania, Armenia, Bulgaria, China, Croatia, Ecuador, Estonia, Former Yugoslav Republic of Macedonia, Georgia, Jordan, the Kyrgyz Republic, Latvia, Lithuania, Moldova, Mongolia, Oman, Panama and Chinese Taipei.

¹⁰ The separate declaration also mandates the TRIPS Council to report by the end of 2002 on ways for countries with limited pharmaceutical manufacturing capacity to make use of the compulsory licensing provisions.

premature, the short-to-medium term economic effects of the agreement and the increase in adherence during the 1990s to WIPO-administered agreements should be discernible, especially the developments associated with changed investor expectations and already-implemented provisions for improved protection of IPRs in a trading context.

III. Literature

14. This section surveys some of the existing empirical work in order to provide context for the analysis that follows in subsequent sections of this paper. While the empirical evidence on the relationship between IPRs, trade and FDI to date is mixed, it is important to examine the evidence because theory does not necessarily provide clear insights. As Maskus (2000, p. 113) notes in the case of patents and trade,

“theoretical models do not clearly predict the impacts of variable patent rights on trade volumes. Much depends on local market demand, the efficiency of imitative production, and the structure of trade barriers. Also important are the reactions of imperfectly competitive firms. Thus, a clear picture can emerge only from empirical studies.”

15. Though separate studies exist on the relationship of intellectual property rights to trade and FDI, it should be recognised that trade and FDI are not independent events. First, from a *mode of entry* perspective, trade and FDI are substitutes. That is, a producer can choose to export its goods, establish a plant abroad, or license its technology to an unaffiliated firm abroad. Changes in IPRs may motivate the producer to switch among these different modes of serving foreign markets. Secondly, from a *balance of payments* perspective, countries running a current account deficit (*e.g.* due to a rise in trade deficits) in a particular period must finance this deficit. As a result, foreigners (the lenders) acquire domestic assets (including domestic bonds, land or capital stock). Thus, trade deficits can be associated with some amount of FDI inflows.¹¹ Thirdly, from a *strategic sequencing* perspective, firms typically trade with foreign agents before undertaking FDI.¹² The latter involves some degree of sunk costs and irreversible investments. Given this, trade is a means to testing out foreign markets. The point of these different perspectives is that IPRs (and other policies or events) can affect the *volume* of FDI and trade as well as the *distribution* between them as modes of entry.

16. Another important point is that IPRs constitute but one of a number of factors that determine trade and FDI activity. A United Nations (1993) report documents how weak IPRs in Argentina, Brazil, and Turkey did not deter inward pharmaceutical FDI, and how strong IPRs in Nigeria did not attract FDI. Other factors might have offset the effects of IPRs, such as the size of the market, the stability of the political regime, the quality of the labour force and infrastructure, among other possibilities. Hence, it is important to control for other factors influencing trade and FDI.

17. Turning first to empirical studies on IPRs and trade, a seminal work is by Maskus and Penubarti (1995). This study identifies two opposing effects of IPRs on trade. On the one hand, IPRs better enable the producer to exercise market power; that is, to reduce output and charge higher prices. The exporter can also better segment its foreign markets. On the other hand, IPRs help deter infringement, imitation, and competition from rivals, and thus help expand the size of the exporter's market. Using 1984 data, the study finds that for manufacturing exports from OECD member countries (as of 1984) to developing nations, the market expansion effect tends to dominate the market power effect, so that stronger IPRs -- on net -- expand trade. Smith (1999) qualifies these results by showing that the market expansion effect of IPRs

¹¹ For example, during the 1980s, the U.S. ran current account deficits while foreigners (from Japan, Netherlands, Saudi Arabia, and so forth) acquired U.S. assets.

¹² See United Nations (1996), pp. 75-76.

hinges on whether local firms are capable of imitating the exporter's technology. This affects whether local firms can pose a credible threat of competition. If not, stronger IPRs will merely reinforce the market power of exporters and restrict trade. Smith's evidence is based on U.S. state level exports for various manufacturing sectors in 1992.

18. Fink and Primo Braga (1999), using a sample of 89 countries in 1989, find a positive link between IPRs and trade flows for total non-fuel trade, but a weak link between IPRs and high technology trade (such as trade in chemicals, electrical and office machinery, telecommunications apparatus, and so forth). Some explanations they offer are that the market power effect of IPRs could very well dominate in high-technology sectors, that stronger IPRs lead to a switch from exporting to FDI, or that technology exports depend on alternative means for appropriation (such as first-mover advantages or reputation).

19. Turning next to empirical studies on FDI and IPRs, it is useful to distinguish between two types of studies. One type examines the *operations* of multinational firms (*e.g.* the sales of their affiliates); another type examines the *direct investments* made by parent firms in their affiliates. First, on operations, early work by Ferrantino (1993) finds no statistically significant relationship between membership in intellectual property treaties (Berne, Paris, and Union for the Protection of Plant Varieties (UPOV)) and U.S. affiliate sales. Such sales are no higher or lower in member countries than in non-member countries. However, the location of production appears to be sensitive to treaty membership. The intuition is that firms are more willing to produce in regions that better protect production processes and know-how. Likewise, Primo Braga and Fink (1998) find negative or weakly significant effects of IPRs on sales of U.S. affiliates. However, these studies do not control for the threat of imitation by local firms. Indeed, Nair-Reichert and Duncan (2002) find that in regions which pose a strong threat of imitation, the market expansion effect of IPRs dominates so as to stimulate the sales of U.S. affiliates.

20. Smarzynska (2002) uses firm level data from a world-wide survey of companies conducted by the EBRD in 1995 concerning FDI undertaken in Eastern Europe and the republics of the former Soviet Union. She finds that one of the consequences of a weak IPR regime is that it deters foreign investors in technology-intensive sectors that rely heavily on intellectual property rights. Moreover, in all sectors, weak IPR regimes were found to deter investors from undertaking local production and rather focus on distribution of imported products. In addition, she notes that there is some evidence that weak IPR protection may discourage investors generally (*i.e.* not just those in sensitive sectors).

21. Among studies focusing on direct investment activity as the variable of interest, one by Kondo (1995) finds that the stock of U.S. outward FDI is insignificantly affected by the patent regimes of destination countries. Kondo's sample consists of thirty countries (from Europe, Asia, and Latin America) for the period 1979-1987. Maskus (1998) uses a different sample of 46 countries, a different measure of patent rights, and controls for other modes of entry (such as trade and licensing), and finds that IPRs positively affect the stock of U.S. outward FDI. Seyoum (1996) focuses on "flows" of FDI and measures the strength of IPRs based upon a questionnaire given to intellectual property attorneys and consultants in different countries. Seyoum finds for a sample of 27 countries over the period 1975-1990 that IPRs have a positive effect on FDI flows overall, but no significant effect on FDI flows to developing countries. One reason might be that FDI in less developed countries tends to be distribution oriented, as Smarzynska (2002) pointed out in the case of less developed transition countries (*i.e.* those that are less stable and whose reform processes are less advanced). Another possible reason is that FDI flows are cyclical over time so that the effects of IPRs on long run FDI could not be captured.

22. The above studies on direct investment drew on aggregate FDI data rather than data disaggregated by industry. An industry level study is presented in Mansfield (1994) and Lee and Mansfield (1996). Intellectual property managers from 100 major U.S. firms from six different industries were asked to rate the intellectual property regimes in 16 countries, and to indicate the importance of IPRs

to their FDI and licensing decisions. The empirical analysis reveals that IPRs matter little for protecting sales and distribution outlets, but matter importantly for protecting production and R&D facilities. The proportion of FDI invested in production and R&D facilities was positively and significantly related to the perceived strength of IPRs.

23. The empirical analysis in this paper differs from these previous studies in several respects. First, more recent data are used. The previous studies were largely based on data predating the TRIPS Agreement. Secondly, more industries are covered (including the pharmaceutical and computer sectors). Thirdly, U.S. and non-U.S. trade and FDI data are examined. Fourthly, a different measure of IPRs is used (one that varies over time and incorporates new information up to the year 2000).

IV. Trends in FDI and Trade

24. Before proceeding to the empirical analysis, it will be useful to discuss some conceptual and measurement issues, and to review some recent trends in FDI and trade. Foreign direct investment is defined as “investment in which a resident of one country obtains a lasting interest in, and a degree of influence over the management of, a business enterprise in another country.”¹³ In practice, certain countries apply the definition differently, making international FDI data less than perfectly comparable. For instance, under U.S. practice, the resident must own at least 10% of a foreign business enterprise; under German and U.K. practice, at least 20%. Secondly, some countries include reinvested earnings as part of FDI, others do not.

25. An important measurement issue concerns the fact that FDI data are attributed to the first country of destination. It may well be that the funds are (ultimately) transferred elsewhere. Some multinationals have established entities such as “offshore holding companies” for this purpose – to channel funds from the parent to its various affiliates around the world. Consequently, reported FDI data may not accurately reflect the countries or industries into which funds were invested, nor the countries or sectors in which affiliate operations (such as production) occur. The number of countries that serve as offshore financial centres is not many. However, Borga and Mataloni (2001) note a growing trend concerning U.S. affiliates: in 1982, foreign affiliates classified as holding companies accounted for 9% of U.S. outward FDI stock; by 2000, they accounted for nearly one-quarter.

26. A related phenomenon of interest is the role of tax haven countries (such as Bermuda, the Bahamas and Barbados). To avail themselves of tax advantages, a number of corporations have moved their legal base – their headquarters – abroad without changing their real bases of operations. This may potentially confuse the nationality of the firm. For example, is a foreign-owned and operated corporation registered in Bermuda really a Bermudan company or, say, American or British?

27. These conceptual and measurement issues should be considered carefully when interpreting and applying FDI data. To help minimise, but not solve, the data problems posed by offshore holding companies and tax haven nations, the empirical analysis eliminates from the sample certain familiar countries that have acted in these capacities, such as Bermuda, the Bahamas, Netherlands Antilles, and so forth. For some idea of the distortions in reported FDI data, Lipsey (2001) examines the extent to which FDI stocks relate to FDI operations. In the case of the U.S., at particular points in time, these measures correlate strongly; however, *changes* in the country distribution of U.S. outward FDI are poorly related to the *changes* in the location of sales and employment over time (namely 1982-1998).

¹³ Mataloni Jr. (1995), p. 38.

28. The reported FDI trends will now be discussed. Significant developments in world FDI occurred between 1990 and 2000. Table 2 provides a summary of the value of the stocks of inward and outward FDI in real 1995 U.S. dollars.¹⁴ The top section focuses on the stocks of FDI for the world as a whole (based on countries listed in Table 1 for which data are available), while the rest of the table focuses on the stocks of FDI by groups of countries.¹⁵ Five groups of countries are considered: 1) twenty-five OECD nations¹⁶; 2) developing nations (self-elected) that are members of the WTO; 3) developing nations that are not members of the WTO; 4) least developed nations that are members of the WTO; and 5) least developed nations that are not members of the WTO.

29. While the focus of this study is on developing nations, the group of OECD nations is included as a reference point. Developing countries and least developed countries are treated in separate groups given the sharp differences between them in terms of level of income and institutional development. Finally, developing (and least developed) nations are differentiated according to whether they are WTO member states. This helps to identify any differences attributable to WTO membership. It should be noted, however, that WTO membership signifies many things, including TRIPS-minimum protection of IPRs, market access (*e.g.* secure access to trade partners), access to dispute resolution mechanisms, and improved predictability in trade-related matters. At the same time, it should be recognised that some non-WTO countries (but not many) adhere to the Berne and Paris conventions (see Table 1). Thus, such countries still have protection for core aspects of patents and copyrights.

30. Between 1990 and 2000, the world average national inward FDI stock increased from US\$13.7 billion to US\$32.6 billion, representing a 138% increase. Outward FDI increased over the same period by 110%. In terms of gross domestic product (GDP), inward FDI stock was on average about a fifth of (destination country) GDP in 1990 and one-third in 2000. Outward FDI was 6.4% of (source country) GDP in 1990, and 10.5% in 2000. The outward stock to GDP ratio is typically lower than the inward stock to GDP ratio as many countries do not have much, if any, outward FDI stock, particularly the smaller, poorer economies.

31. In terms of groups of countries, the OECD has a disproportionately large share of world FDI. Moreover, for OECD countries, the outward stocks of FDI are larger than the inward stocks of FDI, reflecting the greater presence of their multinational firms in non-OECD countries than that of firms from non-OECD countries investing and operating in the OECD. The fastest growth in inward FDI activity, however, occurs in developing countries that are members of the WTO. Inward FDI stock in this group increased nearly four-fold during the 1990-2000 period, albeit from a relatively modest base. The outward FDI stock of this group has also more than doubled. In contrast, the inward and outward FDI stocks of non-WTO developing nations have not increased nearly at this pace. Even in relative terms (as a percentage of GDP), the developing WTO member nations have higher rates of inward and outward FDI than their non-member counterparts. Indeed for non-member developing nations, the average outward FDI stock to GDP has declined over the 1990-2000 period. Between WTO member and non-member least developed nations, the differences in stocks are not that wide; however, the WTO member least developed

¹⁴ FDI stock data are only approximate: 1) except for the United States, they are generally estimated based upon accumulated flow data and 2) they are based on historical cost (*i.e.* book value), not market value. In practice, the real value of the stock is obtained by deflating the historical cost figures with a price index. The technically correct way, however, would be to convert historical figures into current cost and then deflate them. This is a very involved process, and a work in progress for statistical agencies.

¹⁵ The data sources are listed in the Appendix.

¹⁶ The OECD group referenced in this study includes Korea, but not the other new members of the OECD (the Czech Republic, Hungary, Mexico, Poland and the Slovak Republic). Table 1 indicates the countries included in the OECD group.

nations have acquired greater inward FDI capital. They have also experienced a three-fold increase in their outward FDI stocks. In absolute terms, however, the non-member least developed nations have greater stocks of outward FDI, or at least started out with larger initial stocks. As a percentage of GDP, however, the WTO members of the least developed nations have devoted a greater share of resources to outward FDI.

32. Table 3 reports on trends in the stock of U.S. outward FDI. An advantage of U.S. data is that industry level data are available.¹⁷ For industries as a whole, outward FDI from the U.S. has increased between 1990 and 2000, except in the least developed countries that are not members of the WTO. The total stock of U.S. outward FDI in the OECD has more than doubled from US\$370.5 billion in 1990 to US\$813.4 billion in 2000. The same stock in developing WTO countries has increased about 3 times, and in developing non-WTO countries 5.76 times. The latter consists of oil producing countries like Saudi Arabia, Azerbaijan and Russia.

33. By sectoral breakdown, U.S. outward FDI stock is largest in finance, wholesale trade, and petroleum. This is generally the case for both 1990 and 2000. Chemicals also account for an important share of outward U.S. FDI particularly in the OECD and in developing WTO countries. By 2000, services FDI has also increased in prominence, while the share of FDI in transportation equipment (such as automobiles) has fallen. This diversity of outward U.S. FDI appears to exist only in the OECD and developing country WTO-member areas. Outside these countries, the U.S. commits its FDI predominantly in the petroleum industry. The negative figures in Table 3 indicate a net debtor position on the part of U.S. companies abroad.

34. Table 4 presents summary statistics of world trade for the same country groupings. The table shows the total exports and imports of each country group and a percentage breakdown for five sectors. Only those few sectors (as mentioned in the literature cited above) that are argued to be sensitive to IPRs are considered. For example, in the textiles industry, protection of trademarks (name and reputation) may be important in foreign trade (particularly against “knock-offs”). Patents are likely to be important for goods and services produced in the chemical, pharmaceutical (drug) and computer industries, which embody a high degree of knowledge capital.

35. As the table shows, world export and import flows are concentrated in the OECD region. Exports and imports each account for about a quarter of GDP in the OECD. The ratio of trade to GDP is higher in the developing countries. The fastest growth in trade between 1990 and 2000 occurs (as in the case of FDI) in developing WTO countries. The volume of exports and imports (in real 1995 U.S. dollars) has doubled for this group. Interestingly, in 1990, developing WTO countries had a lower volume of trade than their non-WTO counterparts. This situation is reversed in 2000. For the least developed countries, the volume of trade (in real terms) has fallen. This is partly due to a combination of cyclical (business cycle) disturbances and weak structural growth in incomes and productivity. For the least developed, non-WTO member states, it may also be due to the presence of trade barriers. Imports in 1990 are 82.6% of GDP, but are 12.2% of GDP in 2000.

36. As for sectoral developments, in the OECD the share of textile exports has declined over the period 1990-2000, while the shares of drugs, industrial chemicals, and computer and office equipment exports have increased.¹⁸ The trade shares and volumes of drugs, chemicals and computers are fairly small outside the OECD. While the share of drug imports in WTO developing nations has remained steady at

¹⁷ Sectoral detail is also available for inward U.S. FDI, but the country detail does not include a full coverage of developing and least developed economies.

¹⁸ As trade data for computer services were not available, data for computer and office equipment trade are reported instead.

1.9%, the volume of total imports has increased so that this group has been importing more drugs (in real U.S. dollar terms). It has also been importing more computer equipment. In contrast, the least developed countries and non-WTO developing countries have faced declines in drug and computer imports over the same period. Their total imports have fallen in real value and the percentage shares of their drug and computer imports have not changed remarkably to compensate. These reductions in imports are likely to have reduced these countries' access to new technologies in computers and pharmaceuticals.

V. Methodology

37. The remainder of this paper is devoted to the empirical analysis of the relationship between the trends in FDI and trade and developments in intellectual property rights. The central issue in this study is the extent to which intellectual property reform affects a country's ability to attract imports and inward FDI as well as its ability to export and engage in outward FDI. The study employs *regression analysis* to test the hypothesis that FDI and trade flows vary positively with changes in the stringency of patent regimes. That is, the regression analysis measures the extent to which variations in the strength of patent regimes are associated with variations in FDI or trade, holding other factors being constant. An equation of the following type was fitted to the data:

$$y_{it} = \alpha + \beta x_{it} + \gamma z_{it} + \eta_i + \varepsilon_{it}$$

where y is the variable to be explained (*i.e.* the FDI or trade indicators), and x and z are the variables to explain y . In this case, x is an index of the strength of patent rights and z the control variables (*e.g.* country risk, tariff rate, incomes per capita). In the above equation, η represents the individual country effects. The latter refers to some unobservable, but relevant country-specific factor (such as culture, environment, or quality of institutions). In this study, it was found that η should be treated as a "fixed" effect, rather than random. The error term is represented by ε . Additional technical explanations and a description of the data sources are provided in the Appendix.

VI. Regression Analysis of FDI and Trade Flows

38. Intellectual property reform is not an either-or event but a process involving different phases of change. For example, countries may move from being non-adherents to the WIPO patent-related agreements or the WTO's TRIPS Agreement, to adhering to one or more of these agreements, to implementing them or even going beyond.¹⁹ These variations in the strength of IPRs can be quantified by an index, such as that developed for patent rights in Ginarte and Park (1997) and Park (2001), and which is employed in this study.

39. The index of patent rights in the following analysis rates the strength of each country's patent system *at particular points in time*. The Appendix summarises the index methodology for rating patent systems. The value of the index ranges from zero (no system) to five (strongest system), and is obtained by aggregating five sub-indices: extent of coverage (that is, the fields of technology that can be protected), membership in international treaties, enforcement mechanisms, duration of protection, and provisions against loss of protection (against, for example, compulsory licensing). The numerical value of each of these sub-indices (which ranges from zero to one) indicates the fraction of legal features in that sub-index available in a particular country. For example, a value of 1/3 for *enforcement* indicates that a country has one-third of the possible enforcement mechanisms listed under that sub-index. A value of 1/2 for duration

¹⁹ For example, Lippoldt (2002) finds that regional trade agreements (RTAs) sometimes engage their signatories go beyond the minimum IPR requirements as laid out in the TRIPS Agreement.

implies that a country grants protection for half the international standard time (of 20 years from the date of application or 17 years from the date of grant). The value for *membership in international treaties* indicates the fraction of available treaties to which the nation is a signatory. The value for *coverage* indicates the fraction of invention classes the country allows as patentable subject matter. Finally, there are several conditions or regulations under which legal authorities can revoke or reduce patent rights. The value for *provisions against loss of protection* indicates the fraction of those conditions or regulations that are not exercised in the country.

40. Part A of Table 5 presents a summary of the index of patent rights across country groups. According to the index, the patent regimes are substantially stronger in OECD nations (with the U.S. having the strongest system) than in either developing or least developed nations.²⁰ The least developed nations have the weakest scores and the widest variation in strength of patent rights (as measured by their standard deviation to mean). Broadly speaking, the strength of patent regimes varies positively with the level of economic development; however, there is much *within-group* variation in the strength of patent rights.

41. The patent rights index is based on laws on the books. An alternative approach is sometimes used drawing on surveys of firms' experiences and perceptions. One advantage of surveys is that deviations from statutory laws can be brought to light and the actual execution of laws rated. A disadvantage is that survey findings are subjectively based and sometimes difficult to compare (since different executives of firms may mean different things even when they assign the same numerical score). A comparison of the patent rights index scores with survey results provides a useful confirmation of the index. Two surveys are considered in this comparison. One is presented in the World Economic Forum's *Global Competitiveness Report*. The other is based on the United States Trade Representative (USTR) reports on national trade barriers. Park (2001) derives a quantitative index based on the USTR reports. Part B of Table 5 shows that the survey measures and the patent rights index are highly correlated, suggesting that countries with strong patent rights regimes tend generally to carry out the laws.

42. Next, the patent rights index is compared with indicators for the strength of IPR regimes with respect to two other types of IPRs: copyrights and trademarks. Thus far, the academic literature has largely focused on the role of patent protection since this may be the most relevant type of IPR for technology creation and diffusion. Using the same type of methodology as for the index of patent rights, Park (2001) developed indices for copyrights and for trademark rights. Each index covers one type of IPR, aggregating scores for coverage, duration, membership in international treaties, enforcement provisions and restrictions. As Part C of Table 5 shows, these three indices exhibit a fairly high correlation in a statistical sense.²¹ However, while there is a tendency for countries that strongly protect one of the three types IPR covered here (patents, copyrights and trademarks) to also protect strongly the other two types, it should be noted there are a number of significant exceptions.²²

43. The regression analysis uses control variables to account for factors that influence FDI and trade other than those associated with the index of patent rights. Without the control variables, the index of patent rights might pick up the effects of other policies or economic events on FDI and trade. Several different control variables have been examined, and the important ones appear to be GDP per capita (which proxies for purchasing power on the demand side and for productivity on the supply side), mean tariff rate,

²⁰ A breakdown between WTO and non-WTO developing (and least developed) nations is not provided as there is not enough data on the index of patent rights to make a meaningful comparison.

²¹ The correlation coefficient in each case is 0.72 (relating the patent index to each of the other two indices).

²² India, for example, has relatively strong copyright protection but weak patent protection in some areas (*e.g.* there has been a lack of patent protection for pharmaceutical products in India).

and country risk. Country risk is measured based on ratings from the *International Country Risk Guide* taking into account financial, political and economic risk (described in the Appendix). Corporate tax rates were also tried as a control variable, but were found not to be statistically significant. This may be partly due to the removal of major tax haven nations from the sample.

44. Table 6 presents the regression results for FDI. The equation described in section V was estimated for different panels of countries over the period 1990, 1995, and 2000. The different panels correspond to different country groupings, as indicated below. The variable to be explained is the ratio of FDI stock to GDP. The reason for using this ratio is that one dimension of the significance of a given unit of FDI for a country is its size relative to income level (or market size). The variables in the equation are all expressed in logarithms so that the coefficient estimates represent percentage impacts (as explained in the Appendix).²³

45. Part A of Table 6 shows that, for countries as a whole, GDP per capita has positive effects on inward and outward FDI stocks to GDP. Higher per capita incomes may reflect stronger market demand and thus attract inward FDI. They may also reflect increased productivity and thus stimulate a country's capacity to engage in outward FDI. Country risk has a negative effect (as expected) on inward FDI but a negligible effect on outward FDI. The latter is sensitive to country risk levels abroad, not at home. Tariff rates have a negative effect on inward FDI but an insignificant effect on outward FDI. A priori, tariffs have an ambiguous relationship to FDI. Under the tariff-jumping hypothesis, a rise in trade restrictions should motivate foreign firms to avoid trade barriers by establishing affiliates within countries that erect those barriers. On the other hand, those same trade barriers make it more difficult for foreign affiliates to import essential inputs into production and to export their output to other markets.

46. As for the variable of interest, patent rights have positive effects on both inward and outward FDI to GDP. A 1% increase in the patent rights index would tend to increase the stock of inward FDI (holding other factors constant) by 0.49%. This estimate is very similar to Maskus's (1998) finding of 0.45%. The same increase in patent rights would tend to raise outward FDI by 1.69%. Overall, the model explains about 34% to 47% of the variation in the data. Thus, some non-observable country factors (such as culture, environment, firm strategies, and so forth) also play an important role in shaping world FDI activity.

47. Parts B and C of Table 6 show the results of re-estimating the model for developing nations and least developed nations separately. To avoid cluttering up the table, only the coefficient estimate for patent rights is reported (though the other variables were controlled for).²⁴ The results again show that patent rights are significant determinants of inward and outward FDI. The main difference is that the estimated impacts are larger, indicating that for poorer economies (with weaker patent regimes), a given package of IPR reforms tends to have a bigger impact on FDI activity ("bigger bang per change in patent regime"). As nations develop and have stronger patent regimes, a given reform in patent laws has a positive but smaller impact on FDI.

48. Table 7 reports on the sectoral impacts, using U.S. outward FDI position data. To keep the presentation compact, the table shows the effects of patent rights only (though in the background other determinants of FDI were controlled for). The table does not include results for U.S. FDI in the least developed countries due to an insufficient number of observations for regression analysis. The table shows that for industries as a whole, the stock of U.S. outward FDI is *modestly* affected by the strength of foreign patent regimes. Apparently, U.S. outward FDI is influenced significantly by other considerations. For

²³ Thus the observations are limited to cases where $y > 0$; that is, where FDI stocks are positive. Few countries had negative stocks (or debts). The model better explains positive FDI stocks.

²⁴ For the least developed nation sample, the tariff rate and country risk variables were dropped due to limited data. Including them would reduce the sample size considerably.

example, the markets of certain countries may be large while their patent laws are weak (as in China). It is also possible that stronger patent rights permit some U.S. multinationals to enjoy enhanced market power rather than expanded markets, particularly in developing nations where the capacity to imitate U.S. technologies is not especially high.

49. Nevertheless, the importance of patent rights to U.S. outward FDI varies by industry. For example, the strength of foreign patent regimes insignificantly influences U.S. outward FDI in metals, machinery, electronics, transportation, and wholesale trade. One possible reason is that the goods and technologies in these sectors are harder to imitate (creating some natural protections against the misappropriation of new ideas). Another possible reason is that “vertical FDI” motives govern foreign investment in these sectors, with availability of cheaper foreign inputs driving the investment decisions. For example, outsourcing is common in the transportation and electronics industries. A third possible reason is that there are non-manufacturing motives for FDI, such as distribution and marketing which comprise activities in wholesale trade. This is consistent with previous research by Mansfield (1994) and Lee and Mansfield (1996) who find that IPRs matter more to affiliate production than to affiliate sales and distribution activities. Another industry in which U.S. FDI is not significantly affected by patent rights is the food and kindred industry, except in developing nations (due perhaps to agricultural research factors).

50. In contrast, patent rights significantly affect U.S. outward FDI in the petroleum, finance, and services (including computer-related services) industries of all countries. Patent rights moderately affect U.S. FDI in these same sectors in developing nations (except in the computer-related services industry, where U.S. FDI is strongly dependent on patent rights). FDI in services may be sensitive to patent protection as the service sector has progressively become centred around knowledge-based assets; this is particularly so with computer-related services. The petroleum sector has also experienced increases in new energy-related technologies. FDI in finance may be sensitive to patent protection because of the complementarity between finance and technology. The success of one is often tied to the success of the other. FDI in these same sectors may be moderately dependent on patent protection in developing nations because of other incentives for FDI, such as resource costs and supplies (such as oil), or because of low risks of imitation.

51. Patent rights are found only moderately to affect U.S. outward FDI in chemicals and pharmaceuticals.²⁵ This result is somewhat surprising in light of previous assertions that strong global patent protection is important to the chemical industry (which includes the pharmaceutical industry). One way to reconcile the results with previous views is that there may be differentiation in sensitivity to IPR strength according to the type of FDI. For example, overall FDI in chemicals may exhibit only moderate sensitivity to the strength of patent protection, whereas FDI *related to R&D* in chemicals may be relatively highly sensitive to IPR strength. Indeed, Park (2001) finds that pharmaceutical and non-pharmaceutical chemical R&D are significantly related to the strength of IPR as measured by the index of patent rights. Thus, the evidence in the present study would be consistent with such differentiation if the strategy of U.S. firms is to conduct chemical (and pharmaceutical) R&D largely in the home market.

52. Historically, R&D has been largely carried out in home countries; the R&D that is undertaken abroad is usually in affiliates in developed countries [see United Nations (1998), p. 116]. The chemical industry may be particularly selective as to where it conducts its R&D. As Mansfield (1994, p. 10) points out, “chemical firms are reluctant to transfer relatively new or advanced technology to other than wholly owned subsidiaries.” Also, historically, few countries recognised chemical and pharmaceutical patent rights. Thus, outward FDI in the chemical (and pharmaceutical) industry tends not to have been in R&D

²⁵ This result is obtained after dropping country risk and tariffs as control variables. They were statistically insignificant at explaining U.S. chemical (and pharmaceutical) FDI. If both of these variables are included, then patent rights insignificantly explains chemical and pharmaceutical FDI.

facilities but in other types of affiliates, such as sales and distribution outlets. This situation is not likely to change much given the transition provisions of the TRIPS Agreement, which permitted developing countries to delay protection for pharmaceuticals through 2000 (or beyond) and permit least developed countries to delay protection through 2016.

53. Finally, Table 8 presents the results on the effects of patent rights on trade. Part A focuses on the impact on exports and Part B on imports. Again, the effects of control variables are not reported to keep the presentation compact. The variable to be explained is the ratio of either exports or imports to GDP. The significance to a country of a given volume of trade flows depends on its income level or market size (as measured by its GDP). According to the results, patent rights tend to modestly influence total (aggregate industry) exports, while insignificantly affecting developing and least developed country total exports. The reason is likely due to the fact that patent rights indirectly at best affect a nation's exports. Typically, strong patent rights are expected to affect innovative activity, which will ultimately affect production, domestic sales and exports. Thus the connection between patent rights and exports is not a direct one. Consequently, patent rights may affect exports with varying lags, if at all, depending on the type of innovation, market demand, and other factors. However, two industries in which exports are moderately affected by patent rights are the drug industry and the computer and office equipment industry; this is the case in developed and developing countries. In the case of least developed countries, their exports are negatively and significantly affected by patent rights. One reason is that domestic patent reform will reduce its ability to make and export infringing copies.

54. As for imports, patent rights play a significant role in attracting total (aggregate industry) imports on average across the pooled sample of countries. But, this effect is not evenly distributed. Patent rights tend to play a modest role in attracting total imports to developing nations, and an insignificant role in bringing imports to least developed nations. Patent rights are especially important to imports of textiles, drugs, and industrial chemicals, for countries as a whole. The stronger protection enables, among other things, firms to enjoy larger markets and to better appropriate the benefits of their technological investments. Patent rights are also strongly important to the textile imports of least developed countries, where the threat of imitation of fabric patterns and other designs is fairly high and could discourage foreign producers from selling in these markets. Computer and office equipment imports are modestly affected by patent rights, and insignificantly so in the case of imports by developing and least developed nations. These types of goods may be harder to imitate and reproduce in less developed countries. Developing country imports of drugs and industrial chemicals are modestly affected by patent rights and least developed country imports (other than textile imports) are insignificantly affected by patent rights. These findings may be explained by the fact that developing and least developed countries have smaller markets, higher country risk, and remaining trade barriers which partially offset the effects of patent rights. But to the extent that developing and least developed countries have production cost advantages, it bears repeating that as patent rights increase in those regions, foreign firms may shift from exporting to engaging in FDI in order to serve those markets. Thus imports of those regions may decrease, but this may be compensated by a rise in local affiliate production.

55. Other studies may find somewhat different effects of IPRs on trade depending on the sample of countries and industries covered, the sample period, and the empirical methodology. The findings here, however, are fairly consistent with previous work (as discussed in section III). Previous studies find that the effects of IPRs on trade can be weak or strong depending on the relative contributions of the market expansion effects and market power effects of IPRs, on the threat of imitation, and on the relative attractiveness of FDI versus exporting. This study finds that intellectual property protection is relatively more significant to FDI than to trade. This is attributable to the strengths of other factors on trade (such as market size and comparative advantage) and to the substitutability between trade and FDI as modes of foreign entry (such that, at the margin, stronger IPRs expand FDI relative to trade).

VII. Concluding Remarks

56. IPRs create both social benefits and costs. Intellectual property systems must balance the interests of producers and users of intellectual property. It is conceivable, in this context, for IPRs to be too strong in the sense that producers are granted excessive market power. If this were the case, a negative relationship should generally have been expected between IPRs and trade or FDI, rather than the positive relationships that were found. As of 2000, the intellectual property regimes of many developing countries did not yet reflect full application of the minimum standards that will be applicable once the various transitional arrangements under the TRIPS agreement have ended. Thus, the empirical evidence presented in this paper – and implications for policy reform – must be interpreted in the context of the then existing intellectual property regimes or levels of IPR strength.

57. The evidence in this study, on the whole, finds that intellectual property rights matter importantly to FDI and modestly to trade. However, the effects of IPRs on FDI and trade tend to vary by a country's level of economic development and by industry. For instance, developing nations that are members of the WTO generally have greater inward and outward stocks of FDI than developing nations that are not members. But among least developed nations, WTO members do not have significantly more FDI than non-members. The regression results suggest, though, that an increase in the strength of patent rights will (over time) tend to have a significant positive effect on the inward and outward FDI of developing *and* least developed countries. As for trade flows, the results suggest that a strengthening of patent rights will tend to increase the imports of developing nations but insignificantly increase those of the least developed nations. This suggests that for the least developed regions, additional measures may be needed to help stimulate trade. The most likely explanation for why the impact of IPRs is relatively greater for FDI than for trade is that stronger IPR regimes induce firms to switch from exporting to establishing foreign affiliates.

58. Thus, a key policy implication from this study is that intellectual property reform in developing countries does tend to benefit them in terms of increased FDI and trade, albeit with some variation by sector and by level of development. FDI and trade may embody new technologies and may facilitate technological transfer to developing countries. However, intellectual property reform alone will not suffice to close the technology gap between developed and developing nations. Trade and FDI are influenced by a variety of factors, as is the ability to absorb new technologies. In order to reap the full benefits from IPR reform, developing countries must move to ensure an appropriate framework that provides an environment conducive to enterprise, appropriate regulation, essential physical infrastructure (*e.g.* for communications), educational systems, as well as the 'infrastructure' for enforcing the new intellectual property laws, among other elements. (It should be noted that the scope of the present study did not extend to cover assessment of the administrative and related costs of implementing enhanced IPR systems.²⁶)

59. The 1990s were a period of change in the international environment for IPRs. Additional developing countries moved to adhere to key IPR treaties administered by the World Intellectual Property Organisation. The TRIPS Agreement was agreed in the context of the WTO, with its full application to be rolled out according to certain transitional arrangements. In addition, many developing countries reformed their corresponding national legislation. Implementation of all of these changes will be carried out over a period of years. At the same time, these changes have already begun having a significant impact, in part due to actual changes in practice and in part due to the responses from various economic stakeholders to the signalling effects of the changes being implemented, among other reasons. Given this, the evidence

²⁶

Finger and Schuler (2001) provide an overview of costs related to the implementation of WTO Uruguay Round commitments with respect to IPR reform, customs valuation and sanitary and phytosanitary standards.

presented here may be considered short-to-medium run. As the implementation of the TRIPS agreement progresses, the longer run changes in intellectual property regimes and impacts on FDI and trade can be better assessed.

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APPENDIX: NOTES ON THE METHODOLOGY, DATA SOURCES, AND INDEX OF PATENT RIGHTS

A. Regression Analysis

Consider the following equation or model:

$$y_{it} = \alpha + \beta x_{it} + \gamma z_{it} + \eta_i + \varepsilon_{it}$$

where y is the variable to be explained (*e.g.* FDI or trade), and x and z the variables to explain y . Let x be the level of IPRs, and z the control variables. The subscripts refer to the values of y , x , and z for country i at time t , where $i = 1 \dots n$ and $t = 1, \dots, T$. In other words, the data set consists of n countries for T years, giving a total of nT observations. In the above equation, ε represents the error term and η the individual country effect. The latter refers to some unobservable, but relevant country-specific factor (such as culture, environment, or quality of institutions). In this study, it was found that η should be treated as a “fixed” effect, rather than random.

The objective of the regression analysis is to choose the values of α , β , and γ (called coefficients) that best fit the data. The estimated model is unlikely to capture the data perfectly – hence the presence of errors, ε . Fitting the data well requires essentially choosing the coefficient values to minimise the sum of the squared errors.

The estimated coefficient values indicate the nature of the relationship between y , x , and z . A positive coefficient on x indicates that y responds positively to IPRs. If y , x , and z are expressed in logarithms, the coefficient indicates the “elasticity” of response. For example, if y is the log of textile exports and x the log of IPRs, a 1% increase in IPRs results in a $\beta\%$ increase in textile exports, holding other factors constant. The regression analysis also provides the level of statistical significance of a coefficient estimate (again, a p -value). The issue is whether the coefficient estimate is significantly different from zero. The p -value indicates the probability of incorrectly rejecting the assumption of a zero coefficient value (or of a zero effect). For instance, if β is estimated to be 3 but the p -value is 80%, one cannot be confident that a 1% change in IPRs would lead to a 3% change in trade or FDI. The high p -value suggests that there is a strong probability that β is statistically insignificantly different from zero. The reason would be that the underlying variance (or standard deviation) of the estimate of β is wide. Thus, the lower the p -value, the more confidence one has that the explanatory variable in question (x or z) can account for y .

B. Data Sources

- Global inward and outward FDI stocks are available online from the United Nations Conference on Trade and Development (UNCTAD) at:
<http://www.unctad.org/Templates/Page.asp?intItemID=1923&lang=1>
- Data on U.S. outward FDI by industry are available online from the U.S. Department of Commerce, Bureau of Economic Analysis, at: http://www.bea.gov/bea/uguide.htm#_1_23.
- Trade data are from Statistics Canada's World Trade Analyzer 1980-1997 (available on CD-ROM from the Institute of Governmental Affairs, University of California, Davis, CA 95616) and from the United Nations Comtrade database 1996-2000 (further information is available at <http://unstats.un.org/unsd/comtrade>). Trade data by industry in the World Trade Analyzer are classified according to the Standard International Trade Classification (SITC), and concoded to the BEA 34-industry classification. The BEA-classified data were used in this study.
- Data on gross domestic product and price indexes are from the World Bank's World Development Indicators 2001 CD-ROM.
- Data on patent rights are from Ginarte and Park (1997) and Park (2001). Data on trademark rights, copyrights, and USTR ratings are also in Park (2001).
- Survey ratings of intellectual property regimes are from the World Economic Forum (2000).
- Data on country risk are from the international country risk guide, which can be purchased online at <http://www.countrydata.com>. See Appendix D.
- Data on tariff rates are from Gwartney and Lawson (2001).
- Data on corporate tax rates are from Price Waterhouse Coopers (2001).

C. Construction of the Index of Patent Rights

The following is an outline of how the strength of national patent regimes is scored. A country receives points for having various legal features (as indicated in the last two columns). The total points will range from zero to five.

(1) Membership in International Treaties	<u>Signatory</u>	<u>Not Signatory</u>
-- Paris Convention and Revisions	1/3	0
-- Patent Cooperation Treaty	1/3	0
-- Protection of New Plant Varieties (UPOV)	1/3	0
(2) Coverage	<u>Available</u>	<u>Not Available</u>
-- Patentability of pharmaceuticals	1/7	0
-- Patentability of chemicals	1/7	0
-- Patentability of food	1/7	0
-- Patentability of plant and animal varieties	1/7	0
-- Patentability of surgical products	1/7	0
-- Patentability of microorganisms	1/7	0
-- Patentability of utility models	1/7	0
(3) Restrictions on Patent Rights	<u>Does Not Exist</u>	<u>Exists</u>
-- "Working" Requirements	1/3	0
-- Compulsory Licensing	1/3	0
-- Revocation of Patents	1/3	0
(4) Enforcement	<u>Available</u>	<u>Not Available</u>
-- Preliminary Injunctions	1/3	0
-- Contributory Infringement	1/3	0
-- Burden-of-Proof Reversal	1/3	0
(5) Duration of Protection	<u>Full</u>	<u>Partial</u>
	1	$0 < f < 1$

-- where f equals the duration of protection as a *fraction* of the full (potential) duration. FULL duration is either 20 years from the date of application or 17 years from the date of grant (for grant-based patent systems).

Source: Ginarte and Park (1997).

D. International Country Risk Guide -- Risk Rating Components

Country risk ratings were utilised as a control variable in the regression analysis for this paper. The risk ratings were based on those published by the PRS Group in the *International Country Risk Guide*. The country risk ratings are a composite of political, financial and economic risk ratings. The original data are such that higher values indicate lower risk. This study uses the inverse of this measure so that higher values indicate greater country risk. The broad categories, their weighting in the composite rating and their components are shown below.

Political Risk Components (50% weighting)

Government Stability
Socio-economic Conditions
Investment Profile
Internal Conflict
External Conflict
Corruption
Military in Politics
Religious Tensions
Law and Order
Ethnic Tensions
Democratic Accountability
Bureaucracy Quality

Financial Risk Components (25% weighting)

Foreign Debt as a Percentage of GDP
Foreign Debt Service as a Percentage of Exports of Goods and Services
Current Account as a Percentage of Exports of Goods and Services
Net Liquidity as Months of Import Cover
Exchange Rate Stability

Economic Risk Components (25% weighting)

GDP per Head of Population
Real Annual GDP Growth
Annual Inflation Rate
Budget Balance as a Percentage of GDP
Current Account Balance as a Percentage of GDP

Further information on the rating system and method of aggregation is available at:
<http://www.prsgroup.com/commonhtml/methods.html>.

Table 1. Membership in Key International Intellectual Property Rights Treaties, as of 2001***A. Developed and (non-LDC) developing countries**

<u>Signatories to:</u>	<u>TRIPS</u>	<u>BERNE</u>	<u>PARIS</u>	<u>Memo item:</u>	<u>Signatories to:</u>	<u>TRIPS</u>	<u>BERNE</u>	<u>PARIS</u>	<u>Memo item:</u>
				<u>OECD</u>					<u>OECD</u>
Albania	x	x	x		Iran			x	
Algeria		x	x		Iraq			x	
Andorra					Ireland	x	x	x	x
Anguilla					Israel	x	x	x	
Antigua and Barbuda	x	x	x		Italy	x	x	x	x
Argentina	x	x	x		Ivory Coast	x	x	x	
Armenia		x	x		Jamaica	x	x	x	
Aruba		x	x		Japan	x	x	x	x
Australia	x	x	x	x	Jordan	x	x	x	
Austria	x	x	x	x	Kazakhstan		x	x	
Azerbaijan		x	x		Kenya	x	x	x	
Bahamas		x	x		Korea, Republic of	x	x	x	x
Bahrain	x	x	x		Kuwait	x			
Barbados	x	x	x		Kyrgyzstan	x	x	x	
Belarus		x	x		Latvia	x	x	x	
Belgium	x	x	x	x	Lebanon		x	x	
Belize	x	x	x		Libya		x	x	
Bermuda					Liechtenstein	x	x	x	
Bolivia	x	x	x		Lithuania	x	x	x	
Bosnia and Herzeg.		x	x		Luxembourg	x	x	x	x
Botswana	x	x	x		Macau	x	x	x	
Brazil	x	x	x		Macedonia				
Brunei	x				Malaysia	x	x	x	
Bulgaria	x	x	x		Malta	x	x	x	
Cameroon	x	x	x		Marshall Islands				
Canada	x	x	x	x	Mauritius	x	x	x	
Chile	x	x	x		Mexico	x	x	x	**
China	x	x	x		Micronesia				
Colombia	x	x	x		Moldova	x			
Congo	x	x	x		Monaco		x	x	
Costa Rica	x	x	x		Morocco	x	x	x	
Croatia	x	x	x		Namibia	x	x		
Cuba	x	x	x		Netherlands	x	x	x	x
Cyprus	x	x	x		Netherlands Antilles	x	x	x	
Czech Republic	x	x	x	**	New Zealand	x	x	x	x
Denmark	x	x	x	x	Nicaragua	x	x	x	
Dominica	x	x	x		Nigeria	x	x	x	
Dominican Republic	x	x	x		Norway	x	x	x	x
Ecuador	x	x	x		Oman	x	x	x	
Egypt	x	x	x		Pakistan	x	x		
El Salvador	x	x	x		Panama	x	x	x	
Estonia	x	x	x		Papua New Guinea	x		x	
Fiji	x	x			Paraguay	x	x	x	
Finland	x	x	x	x	Peru	x	x	x	
France	x	x	x	x	Philippines	x	x	x	
Gabon	x	x	x		Poland	x	x	x	**
Georgia	x	x	x		Portugal	x	x	x	x
Germany	x	x	x	x	Qatar	x	x	x	
Ghana	x	x	x		Romania	x	x	x	
Greece	x	x	x	x	Russia		x	x	
Grenada	x	x	x		San Marino			x	
Guatemala	x	x	x		Saudi Arabia				
Guyana	x	x	x		Serbia				

Table 1. continued...

Signatories to:	TRIPS	BERNE	PARIS	Memo item: OECD	Signatories to:	TRIPS	BERNE	PARIS	Memo item: OECD
Honduras	x	x	x		Seychelles				
Hong Kong	x	x	x		Singapore	x	x	x	
Hungary	x	x	x	**	Slovakia	x	x	x	**
Iceland	x	x	x	x	Slovenia	x	x	x	
India	x	x	x		South Africa	x	x	x	
Indonesia	x	x	x		Spain	x	x	x	x
Sri Lanka	x	x	x		Tunisia	x	x	x	
St. Kitts & Nevis	x	x	x		Turkey	x	x	x	x
St. Lucia	x	x	x		Turkmenistan			x	
St. Pierre & Miq.					Ukraine		x	x	
St. Vincent & Gren.	x	x	x		United Arab Emir.	x		x	
Suriname	x	x	x		U.K.	x	x	x	x
Swaziland	x	x	x		U.S.A.	x	x	x	x
Sweden	x	x	x	x	Uruguay	x	x	x	
Switzerland	x	x	x	x	Uzbekistan			x	
Syria			x		Venezuela	x	x	x	
Taiwan	x				Vietnam			x	
Tajikistan		x	x		Western Sahara				
Thailand	x	x			Zaire				
Tonga		x	x		Zimbabwe	x	x	x	
Trinidad and Tobago	x	x	x						

B. Least Developed Economies***

Signatories to:	TRIPS	BERNE	PARIS	Signatories to:	TRIPS	BERNE	PARIS
Afghanistan				Liberia		x	x
Angola	x			Madagascar	x	x	x
Bangladesh	x	x	x	Malawi	x	x	x
Benin	x	x	x	Maldives	x		
Bhutan			x	Mali	x	x	x
Burkina Faso	x	x	x	Mauritania	x	x	x
Burma	x			Mozambique	x		x
Burundi	x		x	Nepal			x
Cambodia			x	Niger	x	x	x
Cape Verde		x		Rwanda	x	x	x
Central African Rep.	x	x	x	Samoa (Western)			
Chad	x	x	x	Sao Tome Et Prin.			x
Comoros				Senegal	x	x	x
Congo Demo Rep.	x		x	Sierra Leone	x		x
Djibouti	x	x	x	Solomon Is.	x		
Equatorial Guinea		x	x	Somalia			
Eritrea				Sudan		x	x
Ethiopia				Tanzania	x	x	x
Gambia	x	x	x	Togo	x	x	x
Guinea	x	x	x	Tuvalu			
Guinea-Bissau	x	x	x	Uganda	x		x
Haiti	x	x	x	Vanuatu			
Kiribati				Yemen			
Laos			x	Zambia	x	x	x
Lesotho	x	x	x				

Notes:

* The Agreements cited here include: the *Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)*, the *Berne Convention for the Protection of Literary and Artistic Works* and the *Paris Convention for the Protection of Industrial Property*. Armenia and the Former Yugoslav Republic of Macedonia acceded to WTO membership subsequent to the completion of the analytical sections of this report (i.e. on 5 February 2003 and 4 April 2003, respectively).

** OECD Member countries not covered in the present study.

*** Least Developed according to the United Nations' classification.

Table 2. World Foreign Direct Investment Stocks¹

	Inward		Outward	
	<u>1990</u>	<u>2000</u>	<u>1990</u>	<u>2000</u>
Pooled Sample²				
Mean	13.7	32.6	18.2	38.3
% of GDP	21.7	33.9	6.4	10.5
By Group³				
<u>OECD</u>				
Mean	67.9	169.7	83.7	213.4
% of GDP	11.2	25.7	11.0	27.3
<u>Developing Nations (WTO Members)</u>				
Mean	4.30	16.5	1.15	2.74
% of GDP	20.4	38.6	4.5	4.8
<u>Developing Nations (Non-Members of WTO)</u>				
Mean	3.01	4.27	0.487	0.985
% of GDP	10.5	23.8	3.7	3.3
<u>Least Developed Nations (WTO Members)</u>				
Mean	0.21	0.81	0.02	0.06
% of GDP	12.7	33.2	0.92	2.20
<u>Least Developed Nations (Non-Members of WTO)</u>				
Mean	0.21	0.42	0.13	0.24
% of GDP	5.2	26.7	0.39	0.81

Notes: 1. The figures are in billions of real 1995 U.S. dollars. The ‘% of GDP’ refers to the “mean” expressed as a percentage of real gross domestic product. For inward stocks, the destination country’s GDP measure is used; for outward, source country’s GDP.

2. The pooled sample refers to data from the countries listed in Table 1.

3. Countries are grouped according to their levels of economic development and membership in the World Trade Organization (WTO, which administers the TRIPS Agreement). Throughout this paper, data for the OECD group cover all OECD Member countries except the Czech Republic, Hungary, Mexico, Poland and the Slovak Republic.

Sources: FDI data are from the UNCTAD *World Investment Report*, and GDP data from the *World Bank Development Indicators*.

Table 3. U.S. Outward FDI By Sectoral Composition

	Outward										
<u>Year - 1990</u>	<u>Stock</u>	<u>Food</u>	<u>Chem</u>	<u>Metal</u>	<u>Machine</u>	<u>Electr.</u>	<u>Trans</u>	<u>Petro</u>	<u>Whole</u>	<u>Finan</u>	<u>Serv</u>
1. OECD	\$370.5 bn.	3.6%	9.4%	2.6%	7.5%	3.0%	5.4%	10.5%	11.2%	23.4%	3.5%
2. Developing WTO Countries	\$63.7 bn.	5.7%	9.9%	2.5%	5.3%	4.4%	6.4%	14.2%	4.4%	20.1%	1.2%
3. Developing non-WTO Countries	\$2.5 bn.	0.3%	0.0%	0.0%	0.0%	0.2%	0.0%	n/a	1.5%	0.2%	4.0%
4. Least Developed WTO Countries	\$0.14 bn.	0.0%	0.0%	0.0%	1.6%	0.0%	0.0%	34.1%	0.0%	0.0%	0.0%
5. Least Developed non-WTO Countries	\$0.28 bn.	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	17.6%	0.0%	47.1%	1.2%

	Outward										
<u>Year- 2000</u>	<u>Stock</u>	<u>Food</u>	<u>Chem</u>	<u>Metal</u>	<u>Machine</u>	<u>Electr.</u>	<u>Trans</u>	<u>Petro</u>	<u>Whole</u>	<u>Finan</u>	<u>Serv</u>
1. OECD	\$813.4 bn.	2.7%	8.1%	1.6%	3.3%	2.8%	3.7%	6.3%	7.9%	38.0%	7.9%
2. Developing WTO Countries	\$200.4 bn.	5.5%	5.8%	1.1%	3.1%	4.2%	3.7%	12.7%	3.7%	29.7%	2.4%
3. Developing non-WTO Countries	\$14.4 bn.	1.0%	-0.1%	0.0%	0.0%	0.0%	-0.1%	42.5%	-0.1%	9.9%	3.3%
4. Least Developed WTO Countries	\$1.97 bn.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	74.0%	3.3%	1.0%	0.7%
5. Least Developed non-WTO Countries	\$0.27 bn.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	12.5%	0.0%	0.0%	4.5%

Notes:

The total outward stocks are in billions of real 1995 U.S. dollars, and represent the sum of U.S. outward FDI stocks in the respective country group. The sectoral percentage refers to the sum of U.S. outward FDI stock in that industry & country group combination as a percentage of total U.S. outward FDI stock in that country group. The abbreviated industry headings refer to:

Food – Food and Kindred Products

Chem – Chemicals and Allied Products

Metal – Primary and Fabricated Metals

Machine – Industrial Machinery & Equipment

Electr. – Electronic & Other Electric Equipment

Trans – Transportation Equipment

Petro – Petroleum

Whole – Wholesale Trade

Finan – Finance (excluding depository institutions), insurance, real estate

Serv – Services

The source of data is the U.S. Department of Commerce, Bureau of Economic Analysis.

Table 4. World Trade Flows as Share of GDP and by Selected Sectors

		% Distribution of Exports							% Distribution of Imports				
				Agri.	Indus.	Comp.				Agri.	Indus.	Comp.	
<u>Year 1990</u>	<u>Exports</u>	<u>Textile</u>	<u>Drugs</u>	<u>Chem</u>	<u>Chem</u>	<u>Office</u>	<u>Imports</u>	<u>Textile</u>	<u>Drugs</u>	<u>Chem</u>	<u>Chem</u>	<u>Office</u>	
1. OECD	\$127 bn	7.2%	1.4%	0.5%	5.2%	3.1%	\$128 bn	6.2%	1.4%	0.5%	5.7%	4.0%	
(% of GDP)	(23.8%)						(24.2%)						
2. Developing WTO	\$8.0 bn	9.2%	0.8%	1.3%	3.9%	0.4%	\$7.6 bn	6.7%	1.9%	1.4%	6.2%	1.4%	
(% of GDP)	(38.3%)						(45.2%)						
3. Developing non-WTO	\$10.3 bn	4.6%	0.5%	0.6%	2.2%	0.07%	\$8.3 bn	5.3%	2.4%	1.1%	4.3%	0.9%	
(% of GDP)	(28.5%)						(29.6%)						
4. Least Dev. WTO	\$0.59 bn	6.3%	0.09%	0.6%	7.6%	0.05%	\$0.66 bn	9.2%	2.8%	1.5%	2.5%	1.0%	
(% of GDP)	(26.3%)						(34.7%)						
5. Least Dev. non-WTO	\$0.42 bn	9.5%	0.09%	0.2%	3.9%	0.4%	\$0.71 bn	6.4%	1.9%	1.8%	1.7%	0.7%	
(% of GDP)	(19.0%)						(82.6%)						
		% Distribution of Exports							% Distribution of Imports				
				Agri.	Indus.	Comp.				Agri.	Indus.	Comp.	
<u>Year 2000</u>	<u>Exports</u>	<u>Textile</u>	<u>Drugs</u>	<u>Chem</u>	<u>Chem</u>	<u>Office</u>	<u>Imports</u>	<u>Textile</u>	<u>Drugs</u>	<u>Chem</u>	<u>Chem</u>	<u>Office</u>	
1. OECD	\$166 bn	6.2%	2.2%	0.3%	5.4%	3.8%	\$182 bn	6.3%	2.0%	0.4%	5.6%	5.6%	
(% of GDP)	(25.5%)						(24.7%)						
2. Developing WTO	\$16.9 bn	10.9%	0.6%	0.9%	4.2%	1.2%	\$16.5 bn	7.4%	1.9%	1.3%	4.8%	2.3%	
(% of GDP)	(27.3%)						(33.9%)						
3. Developing non-WTO	\$15.3 bn	3.2%	0.6%	0.5%	1.9%	6.7%	\$7.6 bn	5.2%	3.1%	0.9%	3.3%	1.2%	
(% of GDP)	(32.6%)						(23.7%)						
4. Least Dev. WTO	\$0.12 bn	8.1%	1.8%	0.4%	2.2%	0.08%	\$0.26 bn	10.7%	3.5%	1.1%	2.5%	1.7%	
(% of GDP)	(2.5%)						(5.5%)						
5. Least Dev. non-WTO	\$0.09 bn	15.9%	0.2%	0.01%	3.6%	0.2%	\$0.25 bn	5.3%	1.9%	1.2%	1.4%	1.1%	
(% of GDP)	(2.4%)						(12.2%)						

Notes:

Total Exports and Imports are in billions of real 1995 U.S. dollars, and represent the average for the respective country group. Percentage (%) distribution refers to the respective sector's export or import as a percentage of total export or import. The percentage composition for year 2000 is based on 1997 data. The abbreviated sector headings refer to:

Agri. Chem - Agricultural Chemicals

Indus. Chem - Industrial Chemicals

Comp. Office - Computer and Office Equipment

Percentages across rows do not add up to 100% due to the omission of 'Other Industries'.

The sources of data are Statistics Canada's "World Trade Analyzer" and United Nations "Comtrade" database.

Table 5. Intellectual Property Rights (IPRs) - Descriptive Statistics

A. Summary Statistics of the Index of Patent Rights				
	Mean	Standard Deviation	Minimum	Maximum
OECD Nations	3.74	0.68	1.8	5.0
Developing Nations	2.52	0.75	0	4.05
Least Developed Nations	2.41	0.97	0	3.52
All Countries	2.77	0.94	0	5
B. Correlations among alternative Intellectual Property Rights ratings				
	Index of Patent Rights	Global Comp. Rating	USTR	
Index of Patent Rights	1			
Global Competitiveness Ratings	0.719	1		
USTR	0.711	0.747	1	
C. Correlations among different instruments of IPRs				
	Index of Patent Rights	Index of Trademark Rights	Index of Copyrights	
Index of Patent Rights	1			
Index of Trademark Rights	0.723	1		
Index of Copyrights	0.720	0.863	1	

Notes: The summary statistics are based on the sample period 1990-2000. The index of patent rights is on a scale from 0 (weakest) to 5 (strongest). The Global Competitiveness ratings of IPRs are based on surveys of business leaders (see the World Economic Forum's *Global Competitiveness Report 2001*). USTR refers to enforcement effectiveness as documented by the United States Trade Representative. Data on USTR, Trademark Rights, and Copyrights are derived in Park (2001).

Table 6. Estimates of Relationship between FDI and Patent Protection

A. All Nation Sample		
Impact on inward and outward FDI (ratio to GDP) due to a 1% change in:	Inward FDI Stock (ratio to GDP)	Outward FDI Stock (ratio to GDP)
GDP per capita	1.09** [p-value = 2.5%]	2.49** [p-value = 0.00%]
Patent Rights Index	0.49** [p-value = 4.4%]	1.69** [p-value = 0.00%]
Country Risk	-0.54* [p-value = 11.9%]	0.19 [p-value = 70%]
Tariff Rate	-0.39** [p-value = 0.5%]	0.17 [p-value = 31%]
% of Data Explained	34%	47%
Number of Observations	239	212
B. Developing Nation Sample		
Impact on inward and outward FDI (ratio to GDP) due to a 1% change in:	Inward FDI Stock (ratio to GDP)	Outward FDI Stock (ratio to GDP)
Patent Rights Index	0.73** [p-value = 1%]	1.90** [p-value = 0.00%]
% of Data Explained	31%	44%
Number of Observations	135	120
C. Least Developed Nation Sample		
Impact on inward and outward FDI (ratio to GDP) due to a 1% change in:	Inward FDI Stock (ratio to GDP)	Outward FDI Stock (ratio to GDP)
Patent Rights Index	2.76** [p-value = 2%]	6.11** [p-value = 0.1%]
% of Data Explained	25%	38%
Number of Observations	61	44

Notes: The estimates in each row represent the percentage change in the either the inward FDI stock to GDP ratio or the outward FDI stock to GDP ratio per 1% change in an explanatory factor (e.g. patent rights). The p-value is the probability of incorrectly rejecting the hypothesis of no effect (or of incorrectly concluding an effect). ** indicates statistical significance at conventional levels (for p-values, 5%), * indicates modest significance (for 5% < p-values, 20%), and no asterisk indicates no statistical significance (for p-values > 20%). In the interests of space, the empirical results for the developing nation and least developed nation samples are abridged. Only the quantitative impact of patent rights is shown, along with some sample information. The other controlling variables (such as GDP per capita) are suppressed. For part C, however, tariffs and country risk are dropped as control variables due to lack of data for least developed countries.

Table 7. Estimates of Relationship between U.S. Outward FDI and Patent Protection

Sector of Origin	Country of Destination	Coefficient Estimate	p-value	N	R ²
All Industries	All Countries	0.568*	9.2%	224	0.13
	Developing Countries	0.708*	10.5%	127	0.12
Food & Kindred	All Countries	Insignificant		134	0.34
	Developing Countries	0.536*	6%	78	0.49
Chemicals	All Countries ^(d)	0.311*	17.8%	164	0.07
	Developing Countries	0.384*	12.9%	84	0.16
Pharmaceuticals	All Countries ^(d)	0.242*	13%	153	0.12
	Developing Countries ^(d)	0.361*	11.3%	77	0.16
Metals	All Countries	Insignificant		111	0.05
	Developing Countries	Insignificant		54	0.08
Machinery	All Countries	Insignificant		101	0.18
	Developing Countries	Insignificant		43	0.48
Electronics	All Countries	Insignificant		108	0.12
	Developing Countries	Insignificant		46	0.07
Transportation	All Countries	Insignificant		75	0.09
	Developing Countries	Insignificant		28	0.30
Petroleum	All Countries	1.046**	4.4%	147	0.08
	Developing Countries	1.063*	8.65%	79	0.10
Wholesale Trade	All Countries	Insignificant		164	0.11
	Developing Countries	Insignificant		87	0.16
Finance	All Countries	2.043**	1.6%	134	0.31
	Developing Countries	2.272*	5.8%	68	0.30
Services	All Countries	1.639**	2.6%	134	0.28
	Developing Countries	1.706*	11.3%	66	0.19
Computer Services	All Countries	1.680**	0.1%	127	0.60
	Developing Countries	1.467**	3.4%	57	0.52

Notes: The coefficient estimate measures the response of U.S. outward FDI to the destination country's level of patent rights. The estimates are in percentage terms (i.e. the percentage change in the respective sector's outward FDI stock to GDP ratio per 1% change in the destination country's index of patent rights). N denotes the number of observations and R² the fraction of the variation in the data explained by the model. ** indicates statistical significance at conventional levels (for p-values, 5%) and * indicates modest significance (for 5% < p-values, 20%), where p-values are as defined in the Appendix. The coefficient estimates were obtained after controlling for other determinants of FDI (such as GDP per capita) and for unobserved country-specific factors, except where noted by ^(d) to indicate that tariffs and country risk were *dropped* as control variables (see discussion in text). No estimations are available for the least developed nations due to insufficient observations; few and small stocks of U.S. outward FDI exist in least developed nations.

Table 8. Estimates of Relationship between Trade Flows and Patent Protection**A. Export Flows**

<u>Sector</u>	<u>Country of Source</u>	<u>Coefficient Estimate</u>	<u>p-value</u>	<u>N</u>	<u>R²</u>
All Industries	All Countries	0.172*	16.6%	154	0.18
	Developing Countries	Insignificant		83	0.15
	Least Developed	Insignificant		17	0.25
Textiles	All Countries	Insignificant		154	0.01
	Developing Countries	Insignificant		83	0.01
	Least Developed	Insignificant		17	0.35
Drugs	All Countries	0.992*	7.2%	152	0.12
	Developing Countries	0.834*	18.5%	83	0.26
	Least Developed	Insignificant		15	0.98
Agricultural Chemicals	All Countries	Insignificant		142	0.07
	Developing Countries	Insignificant		78	0.05
	Least Developed	Insignificant		11	0.98
Industrial Chemicals	All Countries	Insignificant		154	0.11
	Developing Countries	Insignificant		83	0.23
	Least Developed	Insignificant		17	0.26
Computer & Office Equipment	All Countries	1.28*	6.4%	146	0.12
	Developing Countries	1.58*	6.3%	77	0.24
	Least Developed	-11.6**	1.6%	15	0.94

*Table 8 continued . . .*B. Import Flows

<u>Sector</u>	<u>Country of Destination</u>	<u>Coefficient Estimate</u>	<u>p-value</u>	<u>N</u>	<u>R²</u>
All Industries	All Countries	0.315**	1.1%	154	0.46
	Developing Countries	0.243*	14.4%	83	0.55
	Least Developed	Insignificant		17	0.35
Textiles	All Countries	0.439**	4.3%	154	0.53
	Developing Countries	Insignificant		83	0.65
	Least Developed	6.313**	4.6%	17	0.81
Drugs	All Countries	0.436**	2.0%	154	0.44
	Developing Countries	0.372*	6.6%	83	0.56
	Least Developed	Insignificant		17	0.74
Agricultural Chemicals	All Countries	Insignificant		154	0.05
	Developing Countries	Insignificant		83	0.11
	Least Developed	Insignificant		17	0.85
Industrial Chemicals	All Countries	0.319**	2.0%	154	0.17
	Developing Countries	0.274*	10.4%	83	0.23
	Least Developed	Insignificant		17	0.49
Computer & Office Equipment	All Countries	0.356*	9.9%	154	0.48
	Developing Countries	Insignificant		83	0.54
	Least Developed	Insignificant		17	0.71

Notes: The coefficient estimate measures the response of trade flows to the exporting or importing country's level of patent rights. In the case of exports, the estimates represent the percentage change in the respective sector's exports to GDP ratio per 1% change in the exporting country's index of patent rights. In the case of imports, the estimates represent the percentage change in the respective sector's imports to GDP ratio per 1% change in the importing country's index of patent rights. N denotes number of observations and R² the fraction of the variation in the data explained by the model. ** indicates statistical significance at conventional levels (for p-values, 5%) and * indicates modest significance (for 5% < p-values, 20%), where p-values are as defined in the Appendix and in the notes to Table 6. The coefficient estimates were obtained via a regression equation which controlled for other determinants of trade (such as GDP per capita, tariff rates, and country risk) and controlled for unobserved factors (i.e. *individual fixed effects*). To conserve space, coefficient estimates of the other variables are not reported.