# THE EFFECTS OF TRIPS-MANDATED INTELLECTUAL PROPERTY RIGHTS ON ECONOMIC ACTIVITIES IN DEVELOPING COUNTRIES

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## I. INTRODUCTION

December 31, 1999, in addition to being the last day of the 20th century, was the deadline for all but the least-developed countries to comply with the Trade-Related Aspects of Intellectual Property Rights (TRIPs) requirements of the WTO[2] for extending and harmonizing Intellectual Property Rights (IPR). Many countries have complied in full while others are in process in some regards, but virtually all developing countries are asking, what are the economic implications of compliance? Better insights into the positive benefits of enhanced IPR will allow national governments to plan economic policy more effectively, as well as providing a counter to the voices, such as those heard in Seattle in 1999, which are roundly condemning much of the globalization taking place under the WTO process. In the developing countries, strengthened IPR are a particular target of that rhetoric.

There is nothing new or recent about the debate over the implication of IPR for developing countries. Among the issues which arose particularly strongly in the 1970s were the observation that, as many developing countries were not technologically at the forefront, the incentives provided by IPR, and patents in particular, for investment in research and development, were not meaningful. The small proportion of national compared with foreign patent applicants is often cited as evidence for that position. Rather, IPR were portrayed as 'protection for monopoly imports' of benefit to exporters at the expense of developing country importers (see e.g., UNCTAD, 1975).

Much has changed economically in the world since the 1970s, including a number of developing countries reaching the position of being state-of-the-art in several important sectors. Yet numerous countries remain in a position where they will be buyers rather than producers of key products and technologies for the foreseeable future. For those nations, enhanced IPR will potentially lead to increased imports and higher prices in some sectors. But the matter of the domestic benefits of those stronger IPR are less clearly established. Past justifications of stronger IPR as being an important 'signal' of openness to economic activities or theoretical justifications of the roles of IPR have been useful but not compelling for national leaders seeking some clearly documented evidence.

The limited empirical evidence on the effects of IPR on domestic economic activity can be explained in several ways, including the small number of countries which could be used as the basis of economic studies. TRIPs though is changing that, and with a number of developing countries now TRIPs compliant, it is possible to conduct broader based

[1] Prepared under WIPO Special Service Agreements.
[2] Annex 1C of the Marrakesh Agreement, 15 April 1994.

empirical studies. The overall objective of this study is to provide one such empirical analysis of the relationship between IPR and foreign direct investment (FDI) and imports.

## A. IPR and Economic Growth

Ideally, it would be possible to identify a direct relationship between the forms of intellectual property in place in a country and economic growth, whether measured as gross national product or the distribution of income on a per capita basis. This study considers only part of that relationship, the association between IPR and trade activity with the assumption that increases in trade, particularly in the form of FDI, will enhance economic growth.

FDI is reflected in national accounts as transfer income. When the amounts correspond to a net increase, that is, not reflecting merely a change in ownership of existing assets, by definition both overall growth and per capita growth have occurred. The issue then is more one of the distribution of that income, particularly as it affects the poor. This matter is not a direct subject of this study, but some connection between the parameters studied here and the distribution of benefits is desirable.

Theory is of limited value in predicting the welfare effects of IPR as there is no clear presumption stronger rights will always be welfare-enhancing (Winter, 1989). The analysis becomes particularly complex, and the results ambiguous, when country size is considered. For example, for small countries (those whose R&D expenditures do not affect world levels) stronger IPR increase welfare when enhancing access to products not otherwise available. Too strong protection in countries with limited R&D capacity, protection which reduces local production of 'pirate' products, would reduce welfare due to higher prices and job loss. But if the small country has both production and innovation capacity, welfare results are indeterminate. Analysis of effects on large countries must further consider the general equilibrium effects of R&D spending. In general, determinate results are possible only on a country-by-country basis and then when strong assumptions are made (see Braga, 1995).

The most complex analysis arises in an international context, and as that analysis is often cast in the context of developed (technology providing) and developing (technology receiving) countries, it is useful to examine a few of them. Deardoff (1992) considers a simple world in which there is one technology producer and multiple purchasers. From a base of unimpeded access by non-supplier countries, the welfare impacts of extending patent protection to more and more countries is considered. Overall, he concludes the effect is welfare reducing as the costs to purchasers exceeds the benefits to producers. This result can be most easily understood in the simple single invention model where prices following adoption of IPR move from competitive to monopoly levels. As a consequence, the producer surplus is one-half of the price increase while the consumer dead weight loss is one-fourth.

When the results are extended to multiple inventions, the welfare effects depend on the size of the populations in the supplying and recipient countries. Designating suppliers as developed country and recipient developing countries as purchasers of technology,

Deardoff (1992, p. 50) concludes at least the poorest countries should be exempt from the TRIPs requirements. The analysis though is based on some strong assumptions which may or, more likely in practice, may not apply, including:

1. Countries are fixed as innovators or purchasers of innovations,
2. Products are freely available without patent protection,
3. Identical linear demand curves for all countries,
4. Constant marginal production costs, and
5. Monopoly prices imposed under patent protection.

To understand the effects of a change in assumptions, consider Diwan and Rodrik's (1991) analysis, which permits different tastes between northern and southern countries (in contradistinction to #3 above). They conclude that as long as northern and southern countries have differences in preferences, both groups have the incentive to provide patent protection when R&D resources are scarce (the general case). As differences in preferences decline though, the effects become ambiguous. In general, southern countries would be expected to purchase more from the north, reducing the incentive for patent protection. For northern firms, both the marginal costs and marginal benefits of protection are reduced, so the overall effect depends on the relative magnitude of the two, which is not known *a priori*.

Helpman (1993) attempts to resolve such differences by modeling the patent rights issue as a dynamic general equilibrium problem. Considering only the case where FDI exists (the pertinent issue for the present study), he concludes southern consumers are hurt by tighter IPR due to higher prices, and hence reduced total consumption and employment. However, this model assumes an externally determined innovation rate so that stronger IPR will not increase the number of products available or reduce the costs of producing existing ones, either change which could reverse the conclusion. In general, there is a near-infinite number of possible scenarios to examine so that no general conclusion is possible theoretically so the issue becomes an empirical question.

In an empirically-based analysis, Dollar and Kraay (2000) recently studied the relationship of growth and the income of the poor for 80 developing countries over four decades. Pooled cross-section, time series regression analysis was used which allowed measurement of both time and country-specific factors. In general, the incomes of the poorest fifth of the population grew at the same rate as average income, refuting many observations that growth often disadvantaged the poor, or the poor lagged the general population in growth. The results are stable for fast and slow growing countries, and high and low income ones.

More specific to the current study, Dollar and Kraay also considered the relative growth of imports and exports, and the strength of property rights (rule of law). Defining the openness of an economy as the ratio of import plus exports over GDP[3], they find the relationship to the income of the poor to be positive but not significant. This finding is in

[3] GDP is Gross Domestic Product, the total account of a country excluding imports and exports of goods and capital.

contradiction to others, emphasizing the importance of the measure used to reflect the 'openness' of an economy. Similarly, the rule of law has a positive but highly insignificant effect on the income of the poor. The authors do not describe the measure used to capture the rule of law. However, Knack and Keefer (1995, Data Appendix) whose methodology is followed, used the International Country Risk Guide (ICRG) and the Business Environmental Risk Intelligence (BERI). Two ICRG scores are used, 'Expropriation Risk' and 'Rule of Law', the latter more closely reflecting "provisions for an orderly succession of power".

For the present study, these results together are taken as support for the assumption that the connection between FDI and imports examined here will have positive impacts on growth, and the distribution of income generated by that growth. However, those relationships are not explicitly examined for the sample of countries used here.

### B. Objectives

The overall objective of this analysis is an empirical analysis of the relationship between the strength of national IPR, and foreign direct investment (FDI) and imports. In order to conduct the analysis, it is necessary to have a measure of the 'strength' of national IPR systems. Typically, a scoring system is used; several past estimates are available which must be updated to reflect related TRIPs-related changes. Subsequently, the new IPR score can be used in an examination of the effects on FDI and imports. Thus the two sub-objectives are:

- Develop an IPR score reflecting current legislation and practice. Unlike past efforts which were very time-specific, here emphasis is placed on a system which can be updated regularly using only secondary sources of information. This is done in Section II following.
- Using the IPR scoring system developed under the preceding objective, analyze the effects of the 'strength' of IPR on FDI flows and imports for a sample of developing countries. This is done in Section III below.

## II. CONSTRUCTING AN IPR 'SCORE'

In an earlier effort at measuring the strength of national-level IPR protection, Ferrantino (1993) used a series of dummy (0/1) variables to reflect differences in national protection schemes. The factors included membership in the Paris, Berne and UPOV Conventions, as well as the term of patent protection. The results, however, showed only the duration of patent protection to be a significant explanatory factor. This was perhaps not a surprising result as membership in the Paris Convention is quite broad (about 100 countries) while UPOV had but a handful of country members corresponding to the 1980 time period of the data used, so there was relatively little variability in the independent variables to explain differences in national economic activity. Subsequent studies then attempted to incorporate several factors in a composite IPR score, the approach followed here. The development of the new scoring system is discussed below following a review of past efforts.

## A. Literature Review of Available IPR Scores

Approaches to developing a scoring system typically use one of two methods, one based on the text of national intellectual property legislation and one based on a survey of practitioners' opinions. Ginarte and Park (1997) and Rapp and Rozek (1990) are examples of the legislation-based approach. Ginarte and Park (1997) use a five point score based on the sum of five national components:

- extent of coverage (pharmaceuticals, food, etc.),
- membership in international agreements,
- loss of protection (compulsory license provisions, etc.),
- enforcement mechanisms (provisions for injunctions, pleadings, etc.), and
- duration of protection (standard = 20 years).

A sensitivity test was done on the effects of a range of weights in the ranking of countries under the system. As the results are quite insensitive to the weights tested, an unweighted sum is used.

Rapp and Rozek (1990, footnote 11) based their five point ranking system on the minimum standards set by the U.S. Chamber of Commerce; that is, most attention is given to laws "in force against infringement but not on their enforcement or implementation." Ginarte and Park (1997, p. 289) justify the lack of consideration of enforcement by noting, "the main concern about [developing countries] is the absence of laws [on infringement]". That may have been valid at the time the index was developed, but would seem to apply less today in the aftermath of the TRIPs minimum standards. Given the related base of the two indexes, it is surprising they are not very closely related ($r = .235$). Moreover, the Ginarte and Park index is closely related with the national GDP ($r = .747$) while Rapp and Rozek's is not ($r = .124$). This variability emphasizes a difficulty of using IPR scores.

A second set of indexes is based on the judgment of practitioners. Mansfield (1995) for example surveyed a total of 180 executives and patent attorneys in the US, Japan and Germany. Focus was on the chemical and drugs, and machinery and electrical equipment industries which are believed to be particularly sensitive to intellectual property (IP) protection. Respondents were asked for 14 more technologically advanced developing countries to indicate when IP protection was 'too weak' to permit transfer of sensitive technologies to (a) invest in joint ventures, (b) wholly owned subsidiaries and (c) licensing key technologies. In general, protection levels were considered more adequate for machinery than chemicals and drugs. And while there was a high level of correlation among the national respondents, US firms were more likely to consider protection levels as too weak compared with responses from Japan and Germany, possibly due to national differences in the rate of innovation.

Sherwood (1997(a)) also utilized a judgment-based ranking, relying on his own assessment of the conditions in 18 developing countries, most in Latin America. Each country was ranked on a 103 point scale for nine components including:

- enforceability (25 points)
- administration (10 points)
- copyright (12 points)
- patents (17 points)
- trademarks (9 points)
- trade secrets (15 points)
- life forms (6 points)
- treaties (6 points)
- general public commitment (3 points)

The scales were thoroughly researched with an interview period in each country. A verbal justification is given for deducting points in each component, but the overall allocation of points to each component is not discussed. Thus, there seems to be a major arbitrary component to the system despite the care which went into its construction. The relationship between the Mansfield (1995) and Sherwood (1997(a)) scales are fairly strong (r = .663), but weaker between Sherwood's and the two legislation-based systems (r = .144 and .060).

Interestingly, Sherwood (1997(a)) applied a similar, modified technique to scaling the TRIPs requirements, which received a score of 55, identical with the value given to South Korea, the highest granted. A major number of points (18 of 25) were deducted for the limited enforcement requirements in TRIPs. In contrast, the IPR aspects of NAFTA are ranked at a 68. He (Sherwood (1997(b), p. 491) considers the TRIPs level of protection to be relatively weak, "The TRIPS Agreemnt will provide sufficient protection to encourage the willing transfer of some technology, whereas a robust, investment-oriented intellectual property system is likely to facilitate a greater volume of willing transfers…"

Overall, the judgment-based ranking systems are more compelling as they include some consideration for enforcement, but those available are dated, have a significant arbitrary component, and lack a means for periodic systematic updates. We turn now to a system designed to overcome those limitations, beginning first with a practitioner survey for establishing system components.

**B. Components of an IPR Score**

When establishing the IPR score used here, protection granted to living organisms and genetically modified life forms is taken as an indicator of an entire national IP system. This is because such forms of protection tend to be both technically complex and socially controversial, so that systems which provide complete coverage in those areas likely provide substantial coverage for other forms of creation as well. That is, as goes biotechnology so goes other forms of protection.

The scores described above generally have in common the following components:

- protectable subject matter
- convention membership
- enforcement

- administration
- duration of protection

The score developed here will incorporate related components, adjusted for recent changes. For example, TRIPs harmonizes the duration of patent protection at 20 years from first application[4] so that an indication if a country is TRIPs compliant captures the duration factor as well as serving as a proxy for protectable subject matter. However, as countries have the option of protecting plants with patents or an 'effective *sui generis* system', or both[5] it is important to identify the choice made. Most developing countries are opting for Plant Breeders' Rights rather than patents for plants for which membership in UPOV, the international convention, is a clear indicator.

Additional and more current information was needed on TRIPs-era protection issues so that a practitioners survey was developed. The intent of the survey was less a direct ranking of the adequacy of protection in countries and more an attempt to measure how firms involved in the transfer of critical technologies viewed the aspects of protection offered. That is, the focus was on the corporate patenting strategy, the understanding of the role of patents in transferring products and technologies to a range of developing countries. The survey was sent to patent attorneys and licensing executives of agricultural and pharmaceutical firms in the U.S. and Europe following an extensive period of instrument development and in-person interviews with six of the respondents. Public sector licensing officers were contacted as well. In total, 17 surveys and interviews were distributed with a response rate of 59 percent. The number of respondents in the biotech sector is limited for each responding firm completed the questionnaire jointly, one per firm. In practice, there are relatively few firms in the biotech area which have direct experience with a range of developing countries.

In order to elicit the information, the respondents were led through a series of questions attempting to identify the firm's very and somewhat sensitive products/technologies. The rational for which countries and under what terms transfers would be made was then sought. The approach proved easy for the respondents to follow and provided useful information without the need to reveal anything confidential. However, it soon became clear that many firms have general perceptions of the operation of IP systems in their market countries which are not based on easily describable and observable components. They are responding rather to a generalized experience.

The survey results indicate, not surprisingly, that product market potential is the principal issue for private firms when identifying developing country markets. Public sector entities have different objectives including serving the public and product availability, but typically do not market products directly in developing countries or elsewhere. That is the task of licensees. Within the IPR sphere, the protectability of certain products and, particularly, enforcement of those rights (adequacy and speed of the court systems), were ranked second. Third in significance is the cost of protection, for which the Patent Cooperation Treaty (PCT) is seen as a source of efficiency and cost savings.

[4] Article 33.
[5] Article 27.3(b).

Executives showed a keen awareness of the role of IPR. That is, while the extent of IP protection is of great significance in selecting markets, firms are only too aware that products or technologies can be acquired in other ways than direct sales. Hence, for larger markets, a firm may take a chance on direct sales rather than loose initial sales to pirates in countries where IP protection is considered inadequate. Pharmaceutical companies seem particularly willing to sell products in countries where patent protection is judged inadequate, and even where patents are not sought. That is, effective available patent protection is desirable but not a necessary condition for pharmaceutical product sales. Agricultural firms for their part typically do not make the most current self-reproducible (i.e., non-F-1 hybrids) varieties available in the absence of PBR protection. This finding is supported by earlier studies which indicated access to current varieties was a major motivation for developing countries to adopt PBR and join UPOV (see Jaffe' and van Wijk, 1995; Lesser, 2000). Pharmaceutical companies at present are more sensitive to details of national laws, such as the availability and scope of protection, than are agricultural firms. That distinction will likely decline in the near future as countries comply with the minimum TRIPs requirements[6].

Perhaps of greater significance to technology access is the market size issue. All respondents indicated some markets are not served simply because the risk-adjusted revenue potential is too small, presumably meaning the costs of serving a market exceed the profit potential. Many of those costs are non-IP related, such as the access and costs factors encountered by many of the respondents in the Russian Federation. Yet the matter is partially IP-associated as effective IPR can limit market costs by reducing some risks and standardizing other practices. For that reason, Maskus and Penunbarti (1995) conclude small market countries require relatively stronger IP protection for the same level of access. That result, if substantiated, would provide a complex policy agenda for governments where markets for some products like seeds may be large while others, possibly pharmaceuticals, are small.

As a result of these practices taken together, the role of IP in technology transfer is more ambiguous than might otherwise be thought, and more significant for smaller than larger market countries. Perhaps most significantly though, the survey results emphasized how important a factor the enforceability of IP statutes are in a country. Jaffe' and van Wilk (1995) found *ex post* that PBR in Argentina indeed was not effective, and did not garner the expected investment in plant breeding, until rights were enforceable. The slowness of a national court system, poor standing of a foreign plaintiff, lack of technical competence, or inability to enforce a judgment once made were all reasons to downgrade the effectiveness of a national system. Duration of protection is a non-issue for few products have a market life approaching the term of patent, not to mention the standardization of the term under TRIPs.

Repeating the initial list, the duration of protection can be dropped as a component while cost of protection can be added, as follows:

[6] As pharmaceutical products are not granted an explicit exclusion from patentable subject matter in Article 27, TRIPs compliance requires they be allowed patent protection if other requirements are met.

- protectable subject matter
- convention membership
- enforcement
- administration
- cost of protection

Ways of quantifying each of these components using public sources are now explored.

- **Protectable subject matter:** as noted, TRIPs mandates a minimum scope of subject matter for patent protection so that satisfaction of the TRIPs requirements is an indication of the allowable subject matter. Countries must certify their compliance with WTO in the IP/N/1/[3 letter country code]/P[7] publication series. Those which have certified compliance are noted with a 1; a 0 is used otherwise.

The only subject area where compliance is not fully indicative is for plants, where countries under Article 27.3(b) have the option of using patents and/or Plant Breeders Rights (PBR). Membership in UPOV[8] (a 1, 0 otherwise) is taken as an indication of the selection of the PBR option. The approach of using UPOV does miss those countries which operate under a national law. At this stage, though, it is not clear whether a national system would be TRIPs compatible or indeed if national systems are often operationalized. Kenya for example had PBR legislation for years but it was never implemented before the country began the process of joining UPOV in 1999 (see Juma and Ojwang, 1989).

- **Convention membership:** in addition to membership in UPOV, signatories to the PCT are also noted (1 = member, 0 = not member). Participation in the PCT serves several functions for technology owners. Membership reduces direct and indirect costs (personnel) of application. The International Search also reduces the ambiguity of a national search in technical areas where national examiners may not have full access to current documents (see Sherwood, 1997(a), p. 273). Membership in the Paris Convention is no longer a meaningful distinction for most countries are now members and compliance with 1967 Convention Articles 1-12 and 19 is mandated by TRIPs[9].

- **Cost of protection:** while an important issue for firms, no data set of costs by developing countries presently exists while only a few countries make even posted fees readily available through a web site or other system. Thus it is not possible to include a measure of costliness in the scoring system developed here.

- **Administration:** patent office administration incorporates a range of critical factors from efficiency and transparency to adequacy of funding and training of examiners. Of these, the competence of staff is perhaps most significant, yet few patent offices provide information on the backgrounds of their employees. As an expedient, the decision was

[7] Available online under publications at www.wto.org.
[8] UPOV membership is tabulated on the web page, www.upov.org.
[9] Article 2.

made to distinguish between those patent offices which maintained a detailed web page and those which do not[10] (1 = web page exists, 0 = does not exist). The presence of the web page is then taken to reflect an office which is better supported and more interconnected. However, it must be acknowledged that this is an aspect of the scoring system which needs further consideration and, hopefully, better comparative data.

- **Enforcement:** enforcement takes particular relevance due to the emphasis placed on it by the survey respondents. Yet again there is no generally available ranking of national legal systems, assessments of the competence of justices, and the like. Here, the choice was made to use the Transparency International "Corruption Perceptions Index" (CPI) for 1998[11]. The annual Index presently ranks 99 countries on a 0 (highly corrupt) to 10 (highly clean) scale. Each country score is an average of three to14 individual surveys of the *perception*s of corruption "as seen by business people, risk analysts and the general public". All such indexes have the limitation that they reflect perceptions only, but as Kaufman, Kraay and Zoido-Lobaton (1999(a), p.2) note, the subject is "inherently subjective" yet "perceptions of the quality of governance may often be as important as objective differences in institutions across countries."

Limitations nonetheless remain for, as Kaufman, Kraay and Zoido-Lobaton (1999(b)) emphasize, there is substantial unexplained error in any estimate, to the point that individual country rankings are not statistically differentiable. Indeed, the accuracy is such that countries must be assigned to one of three groups to be statistically differentiable. That is, any score should be seen as an imperfect proxy with resultant uncertainty of the point estimates. Second is the matter of interest here – largely the competency and integrity of the IP court system – and what is measured, aggregate perceptions of corruption in private-private and private-public interactions. This distinction can be seen in reference to the U.S. which has a 1998 Corruption Perception Index value of 7.5, 18$^{th}$ on the list. Whatever the integrity of other kinds of interactions may be, the U.S. is widely regarded as having a highly effective IP court system, particularly after 1982 when patent cases were consolidated in a new Court of Appeal for the Federal Circuit (see Grubb, 1999, Chap. 2). Nonetheless, the CPI does represent a systematic effort to quantify aspects of the application of law in a diverse group of countries.

### C. Constructing an IPR Score

Of the 99 countries included in the 1998 CPI, 44 are developing countries, which constitute the sample used here[12]. The sample is not a random one, but does represent a diverse geographical and economic range.

The final step is one of identifying a proper weighting scheme for aggregating the values into a single index figure. As noted, Ginarte and Park (1997) use an unweighted sum after calculating that the ranking of a country did not change over a wide range of

[10] National patent office web pages are accessible through the 'links' menu selection on the WIPO web page, www.wipo.org.
[11] Available at www.gwdg.de/~uwvw/1999Data.
[12] The 44 countries are listed in Table 3.

weights, while Sherwood (1997(a)) used an arbitrary weighting system. For purposes here, a more systematic approach is sought. What is used is *factor analysis*, where each variable is represented as a linear function of a small number of unobservable *common-factors* and a single *specific* variate. The common factors generate the covariances among the observed responses, while the particular terms contribute only to the variances (Morrison, 1976, Chap. 9).

In this case a three-factor model with a verimax rotation[13] provided results which could be described in terms of the expected underlying relationships as follows:

| | |
|---|---|
| Factor 1 (33%): | Scope, weighing most heavily on UPOV and TRIPs compliance |
| Factor 2 (24%): | Efficiency, weighing on PCT which has an application efficiency component |
| Factor 3 (18.5%): | Transparency, weighing on the CPI |

The factor weights, which explain a total of 77 percent of the variance of the variables, are shown in Table 1.

**Table 1: Factor weightings of the index components**

| | *Scope* | *Efficiency* | *Transparency* | *Communality* |
|---|---|---|---|---|
| CPI 98 | -.028 | -.025 | .971 | .944 |
| UPOV | .860 | -.185 | -.089 | .782 |
| TRIPs | .790 | .423 | -.064 | .808 |
| PO Eff. | .534 | .354 | .254 | .474 |
| PCT | .066 | .922 | -.033 | .856 |
| % variance | 33 | 24 | 18.5 | 77 |

The aggregate factor values are used to weigh the individual index components in generating the IP score. The weights have the intuitive appeal that the greatest weight is placed on the CPI, a proxy for the enforceability of IPR, which the survey respondents indicated as the most significant aspect of the effectiveness of patents at the national level (see Section II.C above). The score has a possible 12 point scale (technically, 12.36) but in practice the max and min are 7.2 and 1.6 (Table 2).

[13] Factors were computed using Minitab Version 12.1 for Windows.

| Table 2: Intellectual property score, 1998 | | | |
|---|---|---|---|
| *Country* | *IP Score* | *Country* | *IP Score* |
| Chile | 7.2012 | Guatemala | 2.9264 |
| Botswana | 5.7584 | Argentina | 4.8960 |
| Costa Rica | 6.1424 | Nicaragua | 2.8320 |
| Namibia | 5.0032 | Thailand | 3.3060 |
| S. Africa | 7.3548 | Egypt | 2.7376 |
| Mauritus | 4.7200 | India | 3.5936 |
| Tunisia | 4.7200 | Bolivia | 3.4252 |
| Jordan | 4.4368 | Pakistan | 2.5488 |
| Peru | 4.7220 | Kenya | 4.8060 |
| Uruguay | 4.8412 | Vietnam | 2.3600 |
| S. Korea | 6.1028 | Ecuador | 3.7612 |
| Zimbabwe | 4.8208 | Venezuela | 2.1712 |
| Malawi | 4.7264 | Colombia | 2.8588 |
| Brazil | 6.6960 | Indonesia | 4.2148 |
| Jamaica | 3.5872 | Nigeria | 1.7936 |
| Morocco | 4.3488 | Tanzania | 1.7936 |
| El Salvador | 3.3984 | Honduras | 1.6048 |
| Zambia | 3.3040 | Paraguay | 2.1980 |
| Ghana | 3.9712 | Cameroon | 2.1776 |
| Philippines | 3.5892 | Malaysia | 5.4772 |
| Senegal | 3.9712 | Mexico | 6.0352 |
| Côte d'Ivoire | 3.7824 | China | 5.4160 |
| Source: Computed, see text. | | | |

## III. RELATIONSHIP OF INTELLECTUAL PROPERTY RIGHTS AND FOREIGN DIRECT INVESTMENT AND TRADE

The purpose of this section is the utilization of the IPR score developed above in measuring the effect of the strength of IPR in the recipient country on technology transfer to developing countries. The empirical analysis is focused specifically on the effect of IPR on foreign direct investment (FDI) flows and on imports. No specific connection is attempted between those two variables and national well-being, as measured in a number of ways including per capita income and income distribution, beyond the cited studies in Section I.A which connect 'internationalization' with growth, and growth with monetary benefits for the poor. It is left for subsequent studies to incorporate the IPR score analysis used here into the broader context of growth studies.

Prior to proceeding with the empirical analysis, the literature on prior IPR score studies and determinates of FDI is reviewed. The review will both identify previous results for comparison as well as variables to include in the analysis.

**A. Literature review**

This review begins at the most general level with studies of determinants of FDI, proceeding to prior studies using IPR scores, which are a special form of FDI models. The literature on the determinants of FDI, of which investment location theory is a component, is voluminous so that no attempt is made here to go beyond the basis theories and findings of relevance to IPR.

- **General studies of determinates of FDI:** McCorriston and Sheldon (1998) review the theory of determinates of FDI in an effort to explain the 'wavelike' level of inward bound FDI in the United States over the 1980 - 95 period. The classical theory explains FDI as a mechanism used by firms which are otherwise unable to accrue fully firm-specific assets, assets such as a brand image or research intensity. An empirical study would then include a number of industry-specific factors in a cross-section analysis to explain why some industries are more international than others. But that approach cannot explain the observed wave pattern to FDI.

Alternative explanations can be characterized as 'relative wealth' and 'relative cost' theories, both associated with the exchange rate. The relative cost theory is concerned with the effective cost in the currency of the investing country – depreciation of the currency of the recipient country tends to reduce costs for the investor. However, the effect of the exchange rate is more ambiguous than that for it depends on where the inputs are acquired and the finished goods sold so a depreciation could as well raise as reduce costs. The relative wealth theory counters that ambiguity by invoking capital markets imperfections which reduce the ability of financiers in the recipient country of evaluating the assets of a foreign investor. A currency depreciation increases the value of the would-be acquirer in the eyes of a financial institution, reducing the credit constraint to FDI. Studies have generally shown that FDI is inversely related with the real value of the dollar, which is consistent with the relative wealth theory. Relative wealth is also affected by relative stock prices.

In their analysis, McCorriston and Sheldon (1998, Table 2) attempt to explain cross-border acquisitions in U.S. manufacturing using both the real U.S. dollar exchange rate and the relative stock price in a time series analysis. Both variables have the expected signs and are statistically significant, again providing consistency with the market imperfection hypothesis. The authors (1998, Table 3) then disaggregate the FDI data by sector, analyzing separately food, chemicals, fabricated metals, machinery, and other manufacturing. While the aggregate results carried over for fabricated metals and other manufacturing, neither explained the amount of cross-border investment in the food sector. The reasons why the food sector responds differently to relative wealth factors, why possibly attributable to omitted variables problems or data quality limitations, are not well understood.

Gopinath, Pick and Vasavada (1998) extend the preceding analysis in two ways by (a) considering volatility in the real exchange rates as a measure of riskiness of the investments, and (b) considering effects on exports and foreign affiliate sales as well as outward FDI. In a pooled time series/cross-section study of 10 high income countries, the independent variables were normalized (divided) by GNP to account for income effects and possible differences in factor costs. An appreciation of the dollar increases outward FDI and resultant affiliate sales, while reducing exports. Exports and FDI are then substitutes, but only partially, for FDI is more responsive to appreciation of the dollar than are exports. Higher volatility of real exchange rates as expected depress both outward FDI and affiliate sales. Despite those results, Erb, Harvey and Viskanta (1996) argue that exchange rate volatility is an *ex post* measure of risk, while country risk ratings are better *ex ante* measures.

Wheeler and Mody (1992) extend the analysis by considering location theory, particularly the opposing forces on firms making choices among recipient countries. According to the traditional, or 'gravity' model of trade, firm choices are based on comparative advantage 'classical' variables of market size, openness of the economy, transportation, and relative costs. These variables come from the so-called ergodic location theories, long term patterns which can be affected, but only temporarily, by subsidies. In counter-distinction is the non-ergodic theory which draws heavily on agglomeration economies. Investment creates specialized services, which attract further investment so that an early advantage, from whatever source, tends to be perpetuated. Disrupting this notion of 'winning' a location tournament is the desire for firms to reduce risk through geographic diversification.

Wheeler and Mody (1992) attempt to distinguish between these opposing theories by construction an outward-FDI flow model for U.S. firms for the 1980s. The cross-section/time series analysis uses an annual dummy to capture the gross annual changes but no country dummies as that would leave only within-country differences to be explained by the analysis. One country is used as a numeraire to avoid possible spurious regression results due to non-stationarity of the investment series. Distinguishing among the competing theories is accomplished by three sets of data, (a) classical variables like costs, market size and taxation, (b) agglomeration benefits such as infrastructure and degree of industrialization, and (c) measures of riskiness. In general, risk was of little significance, while both the classical variables and agglomeration factors helped explain the location of investments. Important factors varied across industries with, for example, labor costs being more significant for the electronics sector, likely because assembly plants are located in areas of low labor costs. The *magnitude* (or, more properly, the elasticities) of the effects are heavily influenced by the degree of industrialization. When production is for the domestic market, openness of the economy actually *reduced* investment, which is attracted by high trade barriers.

- **FDI and IPR:** Rapp and Rozek (1990) studied the *relationship* between the strength of IPR systems and 'modernization variables' including GDP, access to electricity, and health factors. The relationship was found to be a statistically strong positive one, but there is no indication of causality. That is, strong IPR could be leading to modernization, or 'modern' nations could be adopting stronger IPR as the economy reaches a critical

level. Critics of IPR frequently note that the Netherlands and Switzerland did not adopt patent laws until 1912 and 1907, respectively (implying the same situation would apply at the end as the beginning of the century), when their economies were well advanced, while stronger IPR have long been associated with higher per capita GDP (Grief, 1987).

As if to emphasize the *causality* issue, Ginarte and Park's (1997) work focused on identifying determinants of a country's level of patent protection. Using their own IPR score (see Section II.A), the authors find a strong correlation between the 'strength' of IPR and GDP per capita lagged five years. However, once variables representing the determinants of economic development (R&D expenditures, market freedom, openness) are added, the explanatory power of GDP vanishes, suggesting it serves as a proxy. Dividing the sample of 48 countries in two based on GDP, R&D is a better explanation of the strength of IPR for the richer nations, which, the authors conclude, have more to protect. Conversely, they argue that in less wealthy countries, most R&D spending is by the public sector, which is less likely to use IPR than private firms. Yet there is a minimum critical size for the research sector, as indicated when R&D spending is replaced by the R&D/GNP ratio.

A policy ramification drawn by Ginarte and Park (1997) is that less wealthy countries (which have lower levels of R&D spending) should economize on the institutional costs of providing IPR protection through some form of cooperation. Yet the point that stronger IPR is less beneficial for the less technologically advanced countries will not escape policy makers, as noted above. Note however most of the emphasis is on the *innovation* effect of IPR as opposed to its technology transfer role emphasized in this paper.

Seyoum (1996) examined the relationship of FDI and IPR from the perspective of government control; can governments affect inward FDI more effectively through macroeconomic policy, or strength of IPR? IPR, in his view, is taking on additional significance as technology-based products are supplanting natural resources in creating national wealth while production can be increasingly easily moved between countries. Using a cross-section/time series data set for 27 randomly selected countries for 1975-90, the author used two sets of independent variables, four (copyright, patents, trade secrets, etc.) to represent IPR and four (market size, public investment, external debt and exchange rate stability) to capture policy factors. The independent variable was normalized as a percentage of GDP. The IPR score is based on the views of practitioners using a 1 – 3 scale in the 27 sample countries.

Results are separated for the least developed, emerging and developed economies in the sample. For the less developed, policy factors explain 21 percent of the variation in FDI flows, IPR factors, 13 percent. The relative importance is reversed for the emerging economies where economic policy variables account for only 28 percent of variation while IPR aspects capture 43 percent of the FDI flow variation. Among this second group, "enforcement is the most important concern", as has previously been noted.

In two high-profile studies, Mansfield (1994, 1995) examined FDI outward flows for U.S., German and Japanese firms. The IPR score used is explored elsewhere (see Section II.A) so that attention here is focused on the empirical estimation. Due to data limitations, only U.S. firms are included in the analysis for the years 1990-93. In addition to the IPR score, the independent variables include market size (GNP), stock of FDI, degree of industrialization, and 'openness'. The first three variables (plus a dummy variable for Mexico) are significant with the results indicating that a 10 percent increase in the IPR score will, other factors held constant, increase annual FDI inflows to a country by about $ 200 million. Caution is advised in interpreting that result. The degree of industrialization might be expected to have a positive effect on FDI inflows, but in this model the result is negative.

Braga (1995) both reviews a number of other empirical studies as well as conducts his own. He notes that the effect of stronger IPR on trade flows is ambiguous; if the market-power (leading to higher prices) effect dominates the market-expansion (or availability) effect, trade will diminish, and vice versa, so the matter is an empirical one. Ferrantino (1993) found the latter dominates the former – stronger IPR are trade promoting. In his own analysis of the total foreign assets of U.S. firms, and using the Rapp and Rozek (1990) IPR score (see Section II.A), Braga (1995) includes as independent variables GDP, growth rates, and a measure of trade barriers. Results show that a higher IPR score has a positive impact on aggregate U.S. investment abroad, but the sectoral models are less robust. He cautions that a formal model of the equilibrium distribution of FDI is needed for more precise inferences, but as a minimum predicts the TRIPs standards will serve as a "threshold indicator".

In summary, empirical studies generally support an expectation that stronger IPR protection does indeed enhance both FDI and imports. The relative wealth theory is better supported empirically than the relative cost model, but in fact both require the inclusion of an exchange rate variable in the analysis. Results across time and models do however vary according to:

- production for export or domestic consumption: openness of the economy favor the former over the latter,
- degree of industrialization: more industrialized nations show a more pronounced response to the strength of IPR, but that may be due to either a causal relationship or a statistical reality that more industrialized countries are more dependent on foreign technologies and capital,
- sector: more technologically advanced sectors (like electronics) are more IPR dependent than less technical ones (like food processing),
- exchange rate: due either to the cost or wealth effect, and
- stock of existing FDI: possibly as a result of the agglomeration effect, countries with significant prior FDI tend to attract more.

These factors must be considered in the current analysis.

## B. Selection of Variables for Analysis and Data Sources

Based on the preceding, the independent variables can be grouped into three categories as follows:

1. classical 'gravity'-type variables describing business justifications for selecting one country over another, such as market size, costs openness and taxation,
2. agglomeration benefits like infrastructure, FDI stock and degree of industrialization, and
3. riskiness, such as the rule of law and exchange rate variability.

The dependent variables are FDI and exports for the full sample of countries. Additional dependent variables such as high tech exports and royalties earned or paid are also used, but for only the part of the data set for which data are available.

Model forms are quite variable, including trans-log, semi-log and linear, with no clear theoretical justification for one form over another. This will be left as an empirical, goodness-of-fit matter in the current analysis. Most studies do use a cross-section/time series (CSTS) approach which helps accommodate for unexplained inter-year variability. CSTS analysis however does increase the econometric complexity of the analysis. For the current application, the TRIPs provisions have been in place in a range of countries for a very short time period meaning TS analysis is not feasible, leaving only simple CS analysis. Specific variables and data sources are identified below. All data are for 1998 unless otherwise noted.

**Dependent Variables:**

FDI inflows (UNCTAD, World Investment Report, 1999, Annex table B.1)
Merchandise Imports (WB, World Development Index, 2000, Table 4.6)

High-Technology Exports (WB, World Development Index, 2000, Table 5.12)
Royalty and License Fees (WB, World Development Index, 2000, Table 5.12)

**Independent Variables:**

IPR Score – computed, see Section II.D.
FDI inward stock (UNCTAD, World Investment Report, 1999, Annex table B.3)
Risk: Country Credit Ranking (iiC.C.R.)[14] OR standard deviation of exchange rate (WB, World Development Index, various years, Table 5.6)
GNP (WB, World Development Index, 2000, Table 1.1)
Openness: notifications under Article 5.1 of TRIMs[15] OR exports/GNP
Exchange rate, 1999 (WB, World Development Index, 2000, Table 5.6)
Exchange rate, prior years (FAO Trade Yearbook, 1998, pp. xxx-xxxi)
Degree of industrialization/industry value added (WB, World Development Index, 2000, Table 6.6)
Real exchange rate: computed by dividing the exchange rate by measures of external purchasing parity index (WB, World Development Index, 2000, Tables 4.12 and 5.6)

[14] Available online at www.iimagazine.com
[15] Available online at www.wto.org

Manufacturing wages (WB, World Development Index, 2000, Table 2.6)
Road quality index (100 = expected for country at development level) (WB, World Development Index, 2000, Table 5.9)
Manufacturing tariff (WB, World Development Index, 2000, Table 6.6)
Internal purchasing parity index (CIA)[16]

**C. Results and Discussion**

For this analysis, a linear model using a non-normalized dependent variable fit best in terms of expected signs and the multiple correlation coefficient[17]. Initially, all variables indicated by the literature review were included; subsequently those with unexpected signs or being highly statistically insignificant were excluded. Selection among alternative formulations of a variable, such as measures of 'openness', were done the same way. In the final analysis, variables were retained if there was a strong theoretical or empirical justification for their inclusion, even if the statistical significance was low. The best model results for both the FDI and export models are shown in Table 3. The FDI model is fit using the full 44 country data set while the imports model due to data limitations used only 38 countries[18]

**Table 3: Statistical results**

| *Model* | *FDI '98* | | *Imports '98* | |
|---|---|---|---|---|
| Intercept | -15968 | (-1.78)* | -36129 | (-.97) |
| IPR score | 1562.7 | (1.88)* | 8886 | (2.56)** |
| Mfg. Tariff | 228.1 | (1.26) | 400.2 | (.55) |
| FDI '97/GNP | 39.33 | (.88) | ***** | |
| Degree Indus. | 262.8 | (1.95)* | 1295.2 | (2.40)** |
| Real Exchange Rate | 3.35 | (.07) | -53.6 | (-.27) |
| Real Internal prices | ********** | | -426.2 | (-1.33) |
| n | 44 | | 38 | |
| R-sq (adj) | 12.3% | | 24.0% | |

* significant at the 5% level.
** significant at the 10% level.
NOTE: t-statistics in parentheses.

Several alternatives to these models were attempted and discarded. Neither risk measure (credit index and variability of exchange rates) had any effect on the results; neither did both measures of openness. GNP is strongly correlated with both FDI and exports and so is not meaningful. Two key gravity-model variables, manufacturing wages and road infrastructure, also had no effect on the results.

[16] Available online at www.cia.gov
[17] Estimates were made using Minitab Version 12.1 for Windows.
[18] The six excluded countries are: Zimbabwe, Malawi, Zambia, Senegal, Vietnam and Cameroon.

Overall, the two models fit moderately well, at least considering the purely cross-sectional nature of the analysis. Indeed, to attribute effects to TRIPs at an early stage in the compliance process (1998), it is necessary to assume many FD investors acted in part in anticipation of the benefits of strengthened IPR. That is certainly plausible as legislative changes are frequently announced, and drafts circulated, well before enactment. Butler and Marion (1985, p. 74) examining U.S. PBR law likewise found that the effects of strengthened IPR could be detected well in advance of enactment. The recentness of the IPR effects does indicate the analysis should be confirmed in a few years, preferably using CS-TS methods, when more data are available. Moreover, a general equilibrium analysis is indeed required to understand the overall consequences of changing IPR legislation for part of what is being measured here is a reallocation of monies among countries rather than new and additional funds being made available.

In most cases, the variables have the expected signs. Imports for example are reduced when prices (external and internal) are higher, but the significance of the effect is minimal. That could be due to the dual use of imports for domestic consumption and as inputs into re-exports, which effects tend to counter themselves. FDI is enhanced by higher tariffs, in line with the benefit of domestic production to avoid the high tariffs and/or as protection from import competition. Again though, the statistical significance is not very strong, perhaps indicating a decline in the role of tariffs under the new WTO agreement. The significance of the industrialization variable indicates that the more industrialized countries are more international – whether this is due causally to agglomeration factors or is simply a control variable cannot be determined from these results.

Most pertinent here, the IPR index is positive and significant in both equations. That is, stronger IPR increases both FDI and imports. In the latter case, the availability effect of IPR overcomes the price factor in increasing consumption. On average, the results indicate a one point increase in the IPR score (about 10 percent) will increase a country's FDI by $ 1.5 billion (50 percent of the mean amount) and imports by $8.9 billion (40 percent of the mean amount). The FDI effect is significantly greater than the $200 million found by Mansfield (1995, see above) but he considered only US sources and an earlier period when FDI was less. Moreover, the forms of the indexes are not comparable. Of course, these results are averages only and **do not** imply that an increase in the IPR index will necessarily lead to the FDI increase forecast here for a particular country at a specific time. Among other factors, the level of industrialization is a significant factor so that less industrialized countries can expect a more modest effect of IPR strength on FDI and imports. However, overall the results do indicate that strengthening IPRs is an effective policy tool for countries seeking to internationalize the economy or, conversely, increased internationalization is a benefit of TRIPs compliance. This conclusion is particularly relevant in the WTO-era when national governments have fewer policy options.

The analysis was rerun using as dependent variables high tech exports and license fees paid. Due to data limitations, these analyses were limited to 34 and 35 countries, respectively. The results (not shown here) are generally consistent with those in Table 3.

That is, the IPR score is positive if not strongly significant. Indeed, the only significant variable is the degree of industrialization in the high tech export model, a not surprising result.

## IV. SUMMARY AND CONCLUSIONS

This analysis undertakes a more complete and current understanding of the relationship between international economic activity and IPR for developing countries in the post-TRIPs era. Under TRIPs, signatory countries are required to establish a prescribed minimal level of IPR protection. This is, and has long been, a contentious matter for countries where the costs of strengthened IPR in royalty payments is easily identified. Benefits though are more elusive to document. Here, a link is examined between stronger IPR protection and two key international factors, foreign direct investment and imports. No specific connection is made here between increases in those factors and national well-being, although through the literature it is possible to trace the association between international linkages and economic growth and rising per capita income, including that for the poorest decile. The results presented here should benefit policymakers in developing countries wishing to understand the possible benefits of strengthened IPRs.

The analysis requires a means of measuring the relative strength of national IPR protection, and IPR 'score'. Several such scores have been developed in the past, of two types, one based on an evaluation of legislation alone and one on practitioners' judgments. All at this point are dated in this TRIPs era, and cannot be readily updated as more countries comply with TRIPs mandates. A new score is developed here which uses only secondary data. The components and general weighting of factors is based on a survey of technology licensers in the biotechnology area, considered to be a complex aspect of property rights control and hence indicative of major issues. The scoring system consists of a 'corruption index', membership in UPOV and the PCT, compliance with TRIPs, and a measure of patent office competency, as proxied by the existence of a web site. Rather than using arbitrary weights in establishing the score, as is often done, factor analysis is applied. The result is three factors which can be titled 'scope', 'efficiency', and 'transparency', which together explain 77 percent of the variance.

The resultant score is on a 12 point basis, and maintains the rankings of the earlier attempts. It is readily updatable, but has the limitation of a weak means of measuring relative patent office competency, a difficult matter indeed given limited available information, but one on which more work is needed.

Prior studies have generally shown a positive relationship between an IPR score and both FDI and imports. Results however are not consistent for all sectors for reasons which are not entirely explained. The positive relationship of the IPR score and imports indicates that FDI and imports are complements, and further that the availability factor under IPR outweighs the higher price typically associated with protected products and technologies.

The current analysis replicated the prior studies using the newly developed IPR score, applied to 1998 data for 44 developing countries. The use of a single year (a cross-sectional model) as opposed to the typical cross-section/time series analysis is necessitated by the recentness of the TRIPs standards, meaning there is no really relevant prior period. For greater confidence in the results, the analysis should be rerun after a period of several years when the data availability will be enhanced. Despite the pure cross-sectional nature of the analysis, the statistical results are reasonable. A number of variables, such as various measures of risk and wage rates, had very low statistical significance and were not retained.

Most importantly for this analysis, the relationship between the IPR score and both FDI and imports is both positive and significant (at the 10 and 5 percent levels, respectively). A one point increase in the IPR score (about 10 percent) would on average increase FDI by $ 1.5 billion. Of course, this result should not be interpreted to mean that amount would apply to any particular country, but the direction of the effect is quite robust. These and prior results are non-general equilibrium results, meaning part of the observed effects relate to movements among countries rather than all new investment funds. A general equilibrium analysis is needed to understand the effects of simultaneous changes by all countries.

This result, taken in the context of previous studies, is compelling evidence that stronger IPR do indeed provide some domestic benefits for developing nations. This is a particularly relevant factor in the WTO era when governments have fewer policy options available. Indeed, the current study shows that higher tariffs also contribute to greater FDI, likely due to the creation of protected markets. But the factor is not as significant as found in past studies, which is in line with the WTO tariff-reducing role.

In a broader perspective, this analysis does not identify what specifically about IPR leads to greater internationalization. Clearly the protection aspect is significant, for IPR tend to be more important for more valuable and readily copied inventions. Yet a major aspect of the score used here and in prior studies is based on the transparency of legal systems – the options to protect one's properties in whatever forms. Hence, stronger IPR could serve in the analysis as a proxy for other legal and governmental factors. At the same time, investors might look to the operation of property rights systems as an indicator of the general system for protecting property rights. Others have suggested this role for IPRs for a long time; in Penrose's (1973, p. 785) words, "it may be that cooperation in the [patent] system on the part of less developed countries will help them to obtain the cooperation of [multinational] firms". Yet the results in general combined with the survey results do support the view that investors are very aware of IPR systems in individual countries and act carefully within that context. Countries wishing to attract that group are advised to strengthen the IPR systems accordingly.

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