Nunnenkamp, Peter; Spatz, Julius

Intellectual property rights and foreign direct investment: A disaggregated analysis

Review of World Economics

Provided in Cooperation with:
Kiel Institute for the World Economy – Leibniz Center for Research on Global Economic Challenges

Suggested Citation: Nunnenkamp, Peter; Spatz, Julius (2004) : Intellectual property rights and foreign direct investment: A disaggregated analysis, Review of World Economics, ISSN 1610-2878, Springer, Heidelberg, Vol. 140, Iss. 3, pp. 393-414

This Version is available at:
https://hdl.handle.net/10419/3395

Intellectual Property Rights and Foreign Direct Investment: A Disaggregated Analysis

Peter Nunnenkamp and **Julius Spatz**

Kiel Institute for World Economics

Abstract: This paper aims at overcoming several shortcomings of previous empirical studies on the relationship between IPR protection and FDI. First of all, we use sectorally disaggregated FDI data for a large sample of host countries. Second, we address the proposition that stronger IPR protection raises not only the quantity but also the quality of FDI. Third, we check to which extent the relationship between IPR protection and FDI is affected by applying alternative measures of IPR protection. Our empirical findings support the hypothesis that the threat of an unauthorized use of intellectual-property-related assets and, thus, FDI depends on industry as well as host-country characteristics. Furthermore, stronger IPR protection may help induce high-quality FDI. JEL no. F21, F23
Keywords: Intellectual property rights; ownership advantages; imitative capacity; quantity and quality of FDI; industry characteristics; host-country characteristics

1 Introduction

An essential ingredient of economic globalization is that multinational enterprises are striving to make use of their intellectual-property-related assets beyond national borders. However, multinational enterprises are reluctant to engage in countries where an unauthorized use of such assets by outsiders is not prevented. The protection of intellectual property rights (IPRs) remains far from being harmonized across countries, even though the Agreement on Trade-Related Intellectual Property Rights (TRIPS), representing one of the pillars of the WTO framework that emerged from the Uruguay Round, contains a set of minimum standards for IPR protection.

Remark: We are grateful to Rolf J. Langhammer and an anonymous referee for many helpful comments and suggestions on an earlier draft of the paper. We would also like to thank Christiane Gebühr and Michaela Rank for excellent research assistance. The usual disclaimer applies. Please address correspondence to Peter Nunnenkamp, Kiel Institute for World Economics, Duesternbrooker Weg 120, 24105 Kiel; e-mail: nunnenkamp@ifw.uni-kiel.de

Yet, the question of how important IPR protection is in the international competition for foreign direct investment (FDI) is still unsettled. Theoretical reasoning and empirical investigations point to an ambiguous relationship between IPR protection and the distribution of FDI across countries. In the present paper, we hypothesize that there are ambiguities at least partly because the threat of an unauthorized use of intellectual-property-related assets depends on industry characteristics as well as host-country conditions. Hence, we analyze the impact of IPR protection on FDI for different host countries and on a sectorally disaggregated level. Furthermore, in contrast to earlier studies, we apply different measures of IPR protection and we consider alternative dependent variables, including the technology content of FDI, in order to test the proposition that IPR protection raises not only the quantity of FDI but also impacts on FDI-related activities that many host countries consider to reflect the quality of FDI.

The paper is structured as follows: Section 2 shortly reviews previous findings and offers hypotheses on open questions. The data and estimation procedures are described in Section 3. Empirical results are presented in Section 4. Section 5 summarizes and offers some conclusions.

2 Previous Findings and Hypotheses

Earlier studies, including Ferrantino (1993), Maskus and Eby-Konan (1994), and Lee and Mansfield (1996), present mixed results on the relationship between IPR protection and FDI. Ambiguous findings may be due to several reasons: measurement problems related to IPR protection, the use of highly aggregated FDI data, and substitution effects between FDI and other forms of making use of intellectual property beyond national borders. The focus of recent studies has been on the third factor, especially on licensing as an alternative internationalization strategy. Yang and Maskus (2001) show that royalties and license fees received by US companies rise with stronger IPR protection in 23 partner countries. Horstmann and Markusen (1987) argue that, once a strong level of IPR protection is achieved, FDI tends to be replaced by licensing. Smith (2001) uses sales of US affiliates as an FDI-related dependent variable and finds that the effects of stronger patent rights on FDI are more pronounced than the effects on US exports, but less pronounced than the effects on licensing by US firms.[1] Nicholson (2003)

[1] It is striking that the cross-section analysis is performed for the year 1989 in the recently published paper of Smith (2001). The reasons given in the paper are not convincing. For

analyzes the effects of IPR protection by using the number of US firms engaging in FDI or licensing as dependent variables.

Measurement problems as well as industry characteristics and host-country conditions have received less attention in the empirical literature, even though both factors are likely to matter for the relationship between IPR protection and FDI. Maskus (1998: 198) argues that the ambiguous findings of earlier studies could be due to crude measures of IPR protection. This is why we consider alternative measures, including recent survey data on IPR protection, in our empirical estimates.[2]

In addition, there are various reasons to suspect that the impact of IPR protection on FDI is blurred unless industry characteristics and host-country conditions are taken into account. The relevance of these factors can be derived from the so-called OLI framework, developed by Dunning (1977, 1981), according to which FDI is driven by the interplay between ownership advantages, locational conditions, and internalization motives. As concerns industry characteristics, Maskus (1998, 2000) posits that IPR protection is more important for FDI in industries with considerable intellectual-property-related ownership advantages than for FDI in services as well as in low-tech and standardized manufacturing.[3] Likewise, host-country conditions can be expected to shape the relationship between IPR protection and FDI. For example, we suspect IPR protection to be a minor pull factor for FDI in neighboring countries and in host countries with huge domestic markets, since closeness and market size are likely to dominate the investment decision. Furthermore, the sensitivity of FDI to IPR protection is supposed to depend on the host countries' capacity for local imitation. On the one hand, IPR protection can be expected to induce more FDI in host countries with some imitative capacity. On the other hand, the effect of IPR protection on FDI may turn negative if imitative capacity goes hand in

---

example, information on IPR protection is available for 25 years, rather than "for only one year" (Smith 2001: 421). The cross-time variability of variables, considered to be minor by Smith, would increase considerably if more recent developments in IPR protection and booming FDI were taken into account. Furthermore, in contrast to the argumentation of Smith, there are good reasons to expect substantial cross-industry variability, which can be explored with publicly available sectorally disaggregated data.

[2] The strengths and weaknesses of these measures will be discussed in Section 3.

[3] Survey results presented by Lee and Mansfield (1996) reveal that the reluctance of US multinationals to transfer new technology to subsidiaries, or to engage in joint ventures was highest in the chemical industry, and lowest in the metal industry when IPR protection was considered weak. However, these findings are hardly related to industry characteristics such as human capital intensity and R&D intensity.

hand with particularly strong IPR protection, since licensing becomes more attractive.

This reasoning suggests that "the need is acute for sectoral breakdowns of investment" (Maskus 2000: 15) in order to allow for a better understanding of the role of IPR protection. Yet, FDI is typically considered in aggregated terms in previous regression analyses on the determinants of FDI. Few empirical studies take into account that the impact of IPR protection on FDI is highly likely to be industry-specific:

- Primo Braga and Fink (2000) allow for some industry-specific effects. However, these authors consider just three industries (chemicals, machinery, and electrical equipment), the sample of host countries remains fairly small, and the results refer only to 1992 (i.e., the recent boom of FDI is not captured).
- Smarzynska (2004) finds that weak IPR protection deters FDI in a group of technology-intensive industries, without further differentiating these industries. This study is restricted to host countries in Eastern Europe and the former Soviet Union. Hence, it remains open to question whether similar results apply to host countries in other regions.[4]
- Nicholson (2003) considers two industry characteristics, namely capital costs and investment in R&D, which are interacted with IPR protection. While the number of US firms engaging in FDI does not depend significantly on investment in R&D, firms in industries with high capital costs are shown less likely to engage in FDI when IPR protection is high. In the analysis below, we assess additional industry characteristics and define these characteristics on the basis of the operations of foreign subsidiaries, rather than following Nicholson's approach to take industry data for the United States.[5]

The aforementioned studies have in common that (i) they do not apply alternative measures of IPR protection and (ii) the analysis is restricted to the number of FDI projects (Nicholson 2003) or the quantity of FDI. The subsequent analysis attempts to overcome these shortcomings. However, the use of disaggregated data on FDI and FDI-related activities prevents us from

---

[4] Note that various countries in Central Europe and the former Soviet Union were preparing for full membership in the EU and had, thus, to implement EU laws on IPR protection.

[5] We suppose that imitative threats are more closely related to the characterization of the operations of subsidiaries in host countries than to the general characterization of industries in the home country.

evaluating substitution effects between FDI and other internationalization strategies. Similarly disaggregated data on licensing are not available to us. Yet, the existing evidence on substitution effects, notably from Smith (2001), is referred to in the interpretation of our results.

3 Data and Approach

The subsequent analysis is based on FDI and FDI-related activities of US direct investors. This is because the BEA (2003) online database provides sectorally disaggregated data on US FDI stocks in 166 countries, as well as detailed supplementary information on FDI-related economic activities of US affiliates in 58 countries. As concerns the latter, we use sales, value added, employment, total employee compensation, total exports, exports to and imports from the parent company, local R&D expenditure, and license fees paid to the parent company. FDI data are restricted to manufacturing, which is disaggregated into seven industries in 1995 and five industries in 2000.[6]

In the BEA (2003) data there are three variable values which deserve special attention: (a) zero observations, (b) * observations, which denote a value of less than one-half of the respective reporting unit, and (c) D observations to avoid the disclosure of data of individual companies. To take account of the zero and * observations, we make use of left-censored tobit models where the censoring point is set at one-half of the respective reporting unit. D observations are excluded from the empirical analysis.

The BEA (2003) data on FDI are supplemented by World Bank (2002) data on GDP per capita and population of the host country, average years of schooling taken from Barro and Lee (2000), an indicator of investment costs derived from survey results on corruption and regulatory quality presented by Kaufmann et al. (2002), and the distance between Kansas City and the host-country capitals provided by the US Geological Service. To capture the degree of IPR protection, we apply two different measures, namely the widely used index developed by Ginarte and Park (1997) and survey results presented by the WEF (2002). In this way, we account for possible measurement problems. The Ginarte–Park index reveals the protection

[6] Food, chemicals, metals, machinery, electronic equipment (the last two subsectors are aggregated in 2000), transport equipment, and other manufacturing (not available in 2000).

of patent rights in more than 100 countries, covering the period 1960–1995.[7] The index comprises five categories of national patent laws: extent of coverage, membership in international patent agreements, provisions for loss of protection, enforcement mechanisms, and duration of protection. The summary index ranges from zero to five, with higher values indicating stronger levels of protection.

World Economic Forum (WEF) data may help overcome some of the shortcomings of the Ginarte–Park index. First, this index refers to patent protection "on the books" only,[8] whereas it can reasonably be assumed that respondents of the WEF survey took enforcement problems into account when answering the question whether IPR protection is "weak or nonexistent" (score 1) or "equal to the world's most stringent" (score 7).[9] Second, the WEF survey is not restricted to patent protection, but relates to IPR protection in general. Third, this source provides for a more recent assessment and captures the effects of the TRIPS agreement on the level and variation of IPR protection. The additional information derived from WEF data comes at a cost, however. Survey results are available for only 75 countries, and not over time. Subjective survey data may be biased in that respondents may have different concepts in mind when answering one encompassing question about IPR protection, and they may not be able to assess the differences in IPR protection across countries. Moreover, survey data may be more prone to endogeneity problems than the Ginarte–Park index, as survey respondents may regard high FDI as an indication of favorable investment conditions, including strong IPR protection.[10]

The different strengths and weaknesses of alternative measures of IPR protection notwithstanding, both measures reveal a similar degree of variation across countries.[11] Differences between the two indices are partly to be attributed to varying country coverage.[12] For some countries, however,

---

[7] We are most grateful to Walter G. Park, who provided us with the 1995 data on the Ginarte–Park index.

[8] Note that the enforcement mechanisms, which constitute one of the five elements of the Ginarte–Park index, relate to statutory provisions, namely the availability of preliminary injunctions, contributory infringement pleadings, and burden-of-proof reversals.

[9] See indicator 6.03 in WEF (2002: 398).

[10] We owe this point to an anonymous referee.

[11] For a detailed description of the data, see Nunnenkamp and Spatz (2003).

[12] Most notably, the sample of the WEF comprises only five African countries, compared to 40 in the case of the Ginarte–Park index.

deficiencies in actual enforcement of IPR protection on the books seem to account for particularly low scores in the survey by the WEF.[13]

The empirical analysis is carried out in several steps. In the base run, we simply include the degree of IPR protection into a gravity-type model of the determinants of FDI and estimate left-censored tobit models. As dependent variable we use current FDI stocks.[14] The gravity model suggests to include the following more traditional FDI determinants as controls (expected sign in parentheses): per capita income of the host country (GDPPC: +); size of the host country, measured by population (POP: +); distance between the United States and the host country of US FDI in miles (DIST: –). In addition, we consider the sum of two institutional indicators (INST), namely control of corruption and regulatory quality (Kaufmann et al. 2002), as a proxy of the cost of undertaking FDI in the respective host country.[15] We expect the coefficient of INST to be positive, given that higher indicator values reveal better control of corruption and higher regulatory quality. Finally, we include the human capital endowment of host countries, proxied by average years of schooling (SCHOOL). The coefficient of SCHOOL should be positive as FDI frequently depends on the availability of complementary local factors of production. On the other hand, higher values of SCHOOL are supposed to reflect stronger local imitative capacity which tends to discourage FDI when IPR protection remains weak. Here and in the subsequent steps, the standard errors of the regression coefficients are corrected using White's (1980) heteroskedastic-consistent covariance matrix estimator.

We then turn to nonlinearities in the relationship between the degree of IPR protection and FDI. We start by analyzing how this relationship is shaped by host-country conditions. To this end, we interact IPR protection with GDPPC, POP, DIST, INST, and SCHOOL using multiplicative interaction terms. In order to assess the role of industry characteristics, manufacturing industries are classified according to five indicators—technology intensity, human capital intensity, labor intensity, export intensity, and the degree of vertical integration. Against this backdrop, industry-specific esti-

---

[13] For instance, Russia and Ukraine scored above the average for Central and Eastern Europe according to the Ginarte–Park index in 1995, while they ranked at the bottom of the WEF survey.

[14] In addition, we used lagged FDI flows. These results are not reported here as they turned out to be similar to the results on FDI stocks.

[15] This is similar to Carr et al. (2001), who consider the average of several indicators of perceived impediments to FDI, taken from the *World Competitiveness Report*, as a proxy of the cost of investing in foreign countries.

mations of the sensitivity of FDI to IPR protection are performed by modifying our base run so that not only the intercept but also the coefficient of the IPR protection index is allowed to differ across industries.

Finally, we address the issue of whether higher IPR protection helps attract not only a higher quantity but also a higher quality of FDI. We consider three quality-related dependent variables: the technology content of FDI as captured by local R&D expenditure of US affiliates; the value added of US affiliates in the host country; and the exports of the US affiliates in the host country. The choice of these dependent variables is closely related to what host countries typically regard as higher-quality FDI. At least until the use of performance requirements was restrained or even prohibited through bilateral and multilateral agreements (notably, the TRIMS agreement), various host countries attempted to derive more benefits from FDI by imposing technology sharing requirements, local content requirements, and export performance requirements on foreign investors.[16] We regress each quality indicator on the IPR protection indices and predicted FDI stocks using a 2SLS approach.[17]

4 Empirical Results

As noted before, the specification of the base run is fairly conventional. We regress current FDI stocks (in logs) on host countries' log per capita income (GDPPC), log population (POP), the distance between the United States and the host country (DIST), the cost of investing abroad (INST), and log average years of schooling (SCHOOL). To capture the degree of IPR protection, we add the Ginarte–Park index (GP) and, alternatively, the WEF index. All estimates also include a constant term and industry dummies that are not shown in the subsequent tables. The base-run results for GP refer to the year 1995, i.e., the most recent year for which the Ginarte–Park index is available, whereas the results for WEF refer to 2000 as comparable WEF data are not available for earlier years (Table 1).

The control variables reveal the expected sign and are highly significant with few exceptions. In particular, the results support the conventional wisdom of gravity models that FDI is attracted by geographical proximity

---

[16] This is not to say that performance requirements were generally successful in achieving their aims. For a critical assessment of performance requirements, see Moran (1998).

[17] We are grateful to an anonymous referee for suggesting this econometric specification.

Table 1: *IPR Protection and FDI in Manufacturing:*[a] *Base-run Results*

	(1)	(2)	(3)
	1995		2000
	Full sample	Reduced sample	
GDPPC	0.99	1.53	1.48
	(0.00)	(0.00)	(0.00)
POP	1.71	1.56	1.68
	(0.00)	(0.00)	(0.00)
DIST	−1.25	−1.03	−1.00
	(0.00)	(0.00)	(0.00)
INST	0.71	0.02	0.44
	(0.00)	(0.90)	(0.10)
SCHOOL	1.79	1.07	0.97
	(0.00)	(0.06)	(0.16)
GP	0.23	0.13	
	(0.21)	(0.53)	
WEF			−0.06
			(0.84)
Observations	545	356	249
Uncensored	278	262	191
Left-censored	267	94	58
Pseudo R^2	0.33	0.27	0.25

[a] A constant term and industry dummies are also included, their coefficients are not reported here; p-value in parentheses.

Source: Own calculations based on BEA (2003); WEF (2002); data on GP index provided by Walter G. Park.

(DIST) as well as by large markets (POP) and high per capita income (GDPPC) in the host countries.[18] At the same time, FDI stocks tend to be positively related to host countries' educational attainment (SCHOOL), whereas higher costs of investing abroad (INST) tend to discourage FDI.

IPR protection turns out to be insignificant in the base run. It cannot be ruled out that this result is due to collinearity between IPR protection and GDPPC as well as INST. Another interpretation is that the base run supports previous findings according to which nontraditional determinants of FDI continue to play a marginal role (Nunnenkamp and Spatz 2002; Jost and Nunnenkamp 2003).

[18] For a discussion on the persistent relevance of market-related determinants of FDI, see Nunnenkamp and Spatz (2002).

Put differently, IPR protection may not provide additional explanatory power to market- and location-related driving forces of FDI. Nevertheless, it may be surprising that IPR protection remains insignificant in all three specifications reported in Table 1.[19] Sample selection does not appear to play an important role. The coefficient of GP is hardly affected when the Ginarte–Park index is considered for a reduced sample, i.e., only for those countries for which WEF data are also available. In this way, mainly African countries are excluded, many of which tend to be characterized by relatively strong IPR protection on the books whereas the enforcement of IPRs may be deficient. Likewise, replacing GP by WEF has little effect, which is in conflict with the proposition that recent survey data provide a better indication of effective IPR protection. At the same time, the insignificance of both GP and WEF does not support the view that IPR protection has become more relevant in recent years.

Yet, a major qualification applies to the results reported in Table 1, independently of whether IPR protection is measured by GP or WEF: The impact of IPR protection on FDI may be blurred as long as host-country characteristics and industry-specific factors are ignored. Host-country characteristics are expected to be relevant in that they reflect (a) host countries' alternative pull factors for FDI and (b) their capacity to imitate inventions and make unauthorized use of ownership advantages. At the same time, varying industry characteristics within the manufacturing sector are supposed to blur the impact of IPR protection as long as FDI is considered in aggregated terms. We refine our estimations in the following to explore these possibilities.

In order to identify differences related to host-country characteristics, we estimate the impact of the Ginarte–Park index and the WEF index on FDI stocks in the manufacturing sector by adding multiplicative interaction terms between GP and WEF, respectively, and host-country characteristics (Tables 2 and 3). The signs of the controlling variables are the same as in the base run in Table 1. Moreover, the estimation results for IPR protection *per se* as well as its interaction with host-country characteristics underscore the base-run finding that, in contrast to what one might expect from the discussion of the relative strengths and weaknesses of the two indicators in Section 3, it makes little difference whether IPR protection is measured by GP or WEF.

---

[19] The same is true when FDI stocks are replaced by lagged FDI flows (results not shown).

Table 2: *IPR Protection and FDI Stocks in Manufacturing:*[a] *Results for the Year 1995 according to Host-Country Characteristics*

	(1)	(2)	(3)	(4)	(5)
GDPPC	1.54	0.96	0.88	0.99	1.04
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
POP	2.12	1.60	1.79	1.76	1.75
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DIST	−1.30	−1.23	−4.01	−1.27	−1.30
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
INST	0.68	0.73	0.77	1.46	0.75
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SCHOOL	1.54	1.83	2.14	1.61	4.26
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
GP	1.84	0.10	−8.18	0.41	1.84
	(0.07)	(0.77)	(0.00)	(0.05)	(0.02)
GP × GDPPC	−0.14				
	(0.10)				
GP × POP		0.05			
		(0.62)			
GP × DIST			0.99		
			(0.00)		
GP × INST				−0.22	
				(0.06)	
GP × SCHOOL					−0.90
					(0.04)
Observations	545	545	545	545	545
Uncensored	278	278	278	278	278
Left-censored	267	267	267	267	267
Pseudo R^2	0.33	0.33	0.34	0.33	0.34

[a] A constant term and industry dummies are also included, their coefficients are not reported here; p-value in parentheses.

Source: Own calculations based on BEA (2003); data on GP index provided by Walter G. Park.

Yet, the results reported in Tables 2 and 3 provide considerable support to the hypothesis that the impact of IPR protection on FDI depends on host-country characteristics. Nonlinearities emerge for four of the five host-country characteristics considered. Country size, measured by population (POP), represents the exception (specification 2). For both GP and WEF, the interaction term with POP turns out to be insignificant, which is in conflict with the proposition that foreign investors, generally, tend to disregard IPR protection in host countries where large domestic markets provide a strong

Table 3: *IPR Protection and FDI Stocks in Manufacturing:*[a] *Results for the Year 2000 according to Host-Country Characteristics*

	(1)	(2)	(3)	(4)	(5)
GDPPC	2.02	1.46	1.28	1.37	1.36
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
POP	2.26	1.40	1.75	1.69	1.72
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DIST	−1.16	−0.93	−3.14	−1.10	−1.25
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
INST	0.38	0.50	0.55	1.36	0.73
	(0.16)	(0.07)	(0.05)	(0.03)	(0.01)
SCHOOL	0.81	0.96	1.41	0.81	6.54
	(0.25)	(0.17)	(0.05)	(0.25)	(0.00)
WEF	1.70	−0.29	−4.34	0.25	3.17
	(0.65)	(0.47)	(0.02)	(0.48)	(0.00)
WEF × GDPPC	−0.14				
	(0.05)				
WEF × POP		0.07			
		(0.39)			
WEF × DIST			0.51		
			(0.02)		
WEF × INST				−0.19	
				(0.10)	
WEF × SCHOOL					−1.59
					(0.00)
Observations	249	249	249	249	249
Uncensored	191	191	191	191	191
Left-censored	58	58	58	58	58
Pseudo R^2	0.26	0.25	0.26	0.25	0.27

[a] A constant term and industry dummies are also included, their coefficients are not reported here; p-value in parentheses.

Source: Own calculations based on BEA (2003); WEF (2002).

stimulus to FDI. This suggests that the often-mentioned case of China is an exception in that foreign investors are eager to engage there even though they keep complaining about the lack of IPR protection.

As concerns geographical proximity between the United States and the host countries of FDI, the significantly positive coefficient of the interaction term in specification (3) reveals that IPR protection becomes a more important pull factor when host countries are located further away from the United States (and distance becomes a less important deterrent when IPR

protection in the host country is strong). By differentiating specification (3) with respect to GP and DIST and setting the respective derivative equal to zero, one my calculate two thresholds indicating the strength of the interaction. On the one hand, for host-countries located less than 3,900 miles[20] from the United States, the total effect of an increase in the GP index is no longer positive. Hence, because of geographical proximity, IPR protection is not a relevant pull factor of US FDI for large parts of the Americas and the Caribbean. The minor importance of GP for US FDI in this group of host countries may also be due to the existence of preferential agreements on economic cooperation which the United States had concluded with neighboring countries. The NAFTA agreement with Canada and Mexico, but also free trade agreements with several Caribbean and Latin American partner countries increasingly included a comprehensive treatment of investment issues, substantive provisions against infringements of IPRs, and elaborate dispute settlement mechanisms. This means that US direct investors enjoy a higher degree of IPR protection than reflected in the indicators applied here. As a consequence, the substitution of licensing for FDI becomes more likely in these host countries. On the other hand, more distant host countries need to achieve IPR protection in the order of a Ginarte–Park index value of slightly above 4 in order to compensate for their locational disadvantage in attracting US FDI. This amounts to fairly strong IPR protection, recalling that the Ginarte–Park index ranges from 0 to 5.[21]

The negative interaction term between IPR protection and our proxy for the cost of investing abroad is not surprising. As noted earlier, INST reflects host-country conditions in terms of control of corruption and regulatory quality. In a sense, this variable provides a more general assessment of institutional development achieved by the host countries of US FDI. Taking further into account that IPR protection is highly correlated with INST, foreign investors may take it for granted that IPR protection is sufficiently strong once the institutional development of host countries is rated fairly advanced (above an index value of 1.8 in the case of GP, with −5 and 5 representing the lower and upper limit, respectively, of the composite index of institutional development according to Kaufmann et al. 2002). Below this threshold, however, host countries can attract US FDI by strengthening IPR protection, which may be less time-consuming than broader

[20] The corresponding distance threshold for the WEF index is 4,700 miles.

[21] Considering WEF instead of GP, the threshold is slightly above 6 with the WEF index ranging from 1 to 7.

institutional reforms in order to control corruption and improve regulatory efficiency.

Finally, we find significant interaction terms with regard to GDPPC and SCHOOL. However, nonlinearities resulting from the negative interaction term between IPR protection and GDPPC are practically irrelevant.[22] By contrast, nonlinearities turn out to be relevant when the endowment of human capital is regarded as a host-country characteristic. The estimates support the view that local availability of human capital in combination with strong IPR protection may result in FDI being replaced by other means of making use of ownership advantages, with licensing representing the most likely candidate. If the Ginarte–Park index exceeds the threshold of 4.7, which is close to the upper limit of this index, the effect of schooling on FDI turns negative. However, no host country of US FDI has strengthened IPR protection beyond this point. If IPR protection is measured by WEF, the threshold is considerably lower (4.1, with the upper limit of WEF being 7) and 32 host countries fulfill this condition. At the same time, the effect of IPR protection on FDI depends on educational attainment in the host countries. The regression results suggest that both GP and WEF have a positive impact on US FDI for host countries with average years of schooling of up to about 7.5 years. Roughly two-thirds of all sample countries are below this threshold. However, additional estimates we performed point to a hump-shaped interaction between GP and SCHOOL. We divided the sample into three subgroups of equal size according to SCHOOL, and ran a modified left-censored regression which allows the intercept and the coefficient of GP to differ between the three subgroups. The results (not shown) support the hypothesis that host countries' capacity for local imitation plays a role in shaping the relationship between IPR protection and FDI. The coefficient of GP is practically zero and insignificant for the subgroup with particularly low average years of schooling, i.e., where the threat of local imitation is lowest. The threat of local imitation increases with better local endowments of human capital. It is consistent with this view that the coefficient of GP is significantly positive for the intermediate schooling group. The coefficient of GP turns completely insignificant again for the subgroup with the highest educational attainment, where the replacement of FDI by licensing is most likely.

---

[22] For example, based on the coefficients of WEF and WEF × GDPPC in Table 3, the impact of IPR protection on FDI would remain positive unless per capita income exceeded 230,000 US$.

After having found evidence that host-country conditions have an important say in the relationship between IPR protection and FDI, we now turn to the role of industry characteristics. We focus on factors that are supposed to reflect the significance of ownership advantages and, thus, the benefits imitators may derive and, accordingly, the costs foreign direct investors may suffer from infringements of IPRs in the particular industry. In Table 4, seven manufacturing industries for which the relevant data are available are classified according to five characteristics. The technology intensity as well as the human capital intensity are shown to be relatively high in machinery and transport equipment. This points to strong ownership-specific advantages in these industries, which means that the potential benefits of host countries and the costs of foreign direct investors resulting from IPR infringements are high. The opposite case applies to the food and metals industries, for which the technology intensity is clearly below the average for total manufacturing and the human capital intensity is moderate at best.

The regression results reported in Table 5 for the interaction of GP and WEF with dummies for specific manufacturing industries clearly reflect these differences in industry characteristics. Taking into account that the industry classification differs slightly between the years 1995 and 2000,

Table 4: *Industry Characteristics: Selected Indicators*[a]

	Technology intensity[b]	Human capital intensity[c]	Labor intensity[d]	Export intensity[e]	Vertical integration[f]
Transport equipment	8.7	36.9	15.7	25.8	45.2
Machinery	19.5	42.4	13.6	38.9	25.9
Electrical equipment	7.7	18.4	30.6	23.4	41.4
Chemicals	13.9	42.5	11.1	32.4	10.2
Food	6.5	28.3	15.6	20.7	3.9
Metals	3.1	33.4	17.6	26.4	11.7
Other manufacturing	5.3	31.9	12.2	26.9	13.4
Total manufacturing	9.8	32.5	15.1	28.8	23.1

[a] Based on data for US affiliates in all host countries in the year 1995. – [b] Sum of R&D expenses of US affiliates plus license fees paid to US parents in percent of value added. – [c] Wages and salaries per employee of US affiliates (US$1,000). – [d] Number of employees of US affiliates per US$1,000 of value added. – [e] Export sales of US affiliates in percent of total sales. – [f] Sum of exports of US affiliates to, and imports from, US parents in percent of sales of US affiliates.

Source: Own calculations based on BEA (2003).

Table 5: *IPR Protection and FDI Stocks in Manufacturing:*[a] *Results for Specific Industries*

	1995		2000
GDPPC	0.96	GDPPC	1.49
	(0.00)		(0.00)
POP	1.70	POP	1.66
	(0.00)		(0.00)
DIST	–1.25	DIST	–0.97
	(0.00)		(0.00)
INST	0.71	INST	0.44
	(0.00)		(0.10)
SCHOOL	1.81	SCHOOL	0.99
	(0.00)		(0.14)
GP-Transport equipment	1.08	WEF-Transport equipment	0.58
	(0.03)		(0.10)
GP-Machinery	1.03	WEF-Machinery[b]	0.32
	(0.02)		(0.37)
GP-Electrical equipment	0.63		
	(0.10)		
GP-Chemicals	–0.17	WEF-Chemicals	–0.27
	(0.58)		(0.42)
GP-Food	–0.17	WEF-Food	–0.61
	(0.62)		(0.07)
GP-Metals	–0.23	WEF-Metals	–0.20
	(0.50)		(0.58)
GP-Other manufacturing	0.42		
	(0.24)		
Observations	545	Observations	249
Uncensored	278	Uncensored	191
Left-censored	267	Left-censored	58
Pseudo R^2	0.34	Pseudo R^2	0.27

[a] A constant term and industry dummies are also included, their coefficients are not reported here; p-value in parentheses. – [b] Includes electrical equipment and computers.

Source: Own calculations based on BEA (2003); WEF (2002); data on GP index provided by Walter G. Park.

the industry-specific coefficients of GP and WEF reveal a high degree of conformity. For both measures of IPR protection, we find the strongest impact of IPR protection on FDI stocks in transport equipment. GP has a similarly strong impact in machinery; the positive coefficient of WEF remains insignificant in this industry, possibly because data constraints prevent us from disaggregating electrical equipment from other machinery

in the estimate for 2000. The estimate for 1995 shows that IPR protection had also a positive, but somewhat weaker impact on FDI stocks in electrical equipment. By contrast, the coefficients of both GP and WEF are negative, though insignificant with one exception, in other industries.

Electrical equipment and the chemical industry deserve closer inspection. Ownership-specific advantages in electrical equipment are moderate when technology intensity is considered, and still weaker according to human capital intensity. Nonetheless, US direct investors appear to be concerned about insufficient IPR protection in this industry. This is, possibly, because electrical equipment stands out in two respects: The operations of US affiliates in the host countries are extremely employment-intensive, and US affiliates are closely integrated in production sharing with their parent companies via intrafirm trade.[23] While the latter characteristic may reveal insights into the global operations of US parents, the first characteristic may add to the threat of local imitation through dissemination of knowledge acquired by the employees working in US affiliates abroad.

Foreign employment and vertical integration may also help explain why IPR protection does not appear to have affected FDI stocks in the chemical industry. In both regards, chemicals represent the opposite extreme to electrical equipment. Stand-alone operations of foreign subsidiaries of US chemical producers and the relatively small number of workers employed in the host countries seem to have diminished the threat that ownership-specific advantages could be copied easily. However, there may be another reason why we have to reject the hypothesis advanced by Maskus (2000: 4), who considers IPR protection to be highly relevant for foreign direct investors in the chemical industry, and, rather, support empirical findings by Primo Braga and Fink (2000). US FDI stocks in the chemical industry are strongly concentrated in industrialized host countries.[24] Taking into account that IPR protection is stronger in industrialized countries than in developing countries, a substitution of licensing for FDI seems more likely in chemicals than in other manufacturing industries.

---

[23] In both regards, electrical equipment reveals indicator values in Table 4 that are about twice as high as the average for total manufacturing.

[24] In 2000, developing countries in Africa, Asia, Latin America, and the Middle East hosted just 18 percent of US FDI stocks in the chemical industry. Their share in US FDI stocks in total manufacturing was considerably higher with 27 percent (BEA 2003).

Table 6: *IPR Protection and Quality Indicators of FDI in Manufacturing:*[a] *Results for the Years 1995 and 2000 (2SLS)*

	Dependent variable					
	R&D expenses		Value added		Exports	
	1995	2000	1995	2000	1995	2000
FDI stock	0.78	0.76	0.58	0.56	0.71	0.63
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GP	0.55		0.20		0.39	
	(0.00)		(0.15)		(0.14)	
WEF		0.45		0.10		0.83
		(0.00)		(0.29)		(0.00)
Observations	217	151	226	163	173	96
Uncensored	129	105	219	162	156	83
Left-censored	88	46	7	1	17	13
Pseudo R^2	0.30	0.26	0.17	0.22	0.12	0.18

[a] A constant term and industry dummies are also included, their coefficients are not reported here; p-value in parentheses.

Source: Own calculations based on BEA (2003); WEF (2002); data on GP index provided by Walter G. Park.

In the final step of our analysis, we consider three quality indicators of FDI as dependent variables.[25] As noted in Section 3, policymakers typically perceive FDI to deliver higher benefits to host countries if foreign direct investors apply advanced technologies, as evidenced by local R&D expenditure, create value added, and increase exports. Table 6 reports the results of a 2SLS left-censored regression of GP and WEF, respectively, on these indicators, controlling for FDI stocks predicted on the basis of specifications (1) and (3) in Table 1. In other words, the question is whether, given a certain FDI stock, host countries with strong IPR protection receive higher benefits from FDI than host countries with weak IPR protection.

The results suggest that host countries cannot only attract more FDI but may also derive more benefits from FDI by strengthening IPR protection. Yet, policymakers seeking to attract high-quality FDI may be well advised not to read too much into the results of Table 5. Several qualifications have to be taken into account. The effects of both measures of IPR protection on R&D expenditure of US affiliates appear to be particularly strong. It

[25] All quality indicators are expressed in US$.

cannot be ruled out, however, that this is due to omitted variable problems, i.e., R&D expenses and IPR protection being driven by a third factor; both variables tend to increase with higher economic development of host countries. Omitted variable problems are less obvious in the case of exports. But the significantly positive coefficient of WEF may result from WEF capturing host-country characteristics that are more important in shaping the export orientation of US affiliates. For instance, open host countries, in terms of foreign trade policies, tend to protect IPRs more strongly than relatively closed host countries.[26] Finally, the positive effect of IPR protection on the value added of US affiliates in the host countries remains insignificant.

5 Summary and Conclusions

This paper aims at overcoming several shortcomings of previous empirical studies on the relationship between IPR protection and FDI. First of all, FDI is analyzed on a disaggregated level since the threat of an unauthorized use of intellectual-property-related assets is expected to depend on industry as well as host-country characteristics. Second, we address the proposition that stronger IPR protection raises not only the quantity of FDI but also the quality of FDI in terms of its technology content as well as the value added and exports created by FDI. Third, we check to which extent the relationship between IPR protection and FDI is affected by applying alternative measures of IPR protection.

The measurement of IPR protection proved to be less relevant than expected. The results achieved on the basis of the survey presented by the WEF (2002) reveal strong similarities to results for the widely used index developed by Ginarte and Park (1997). By contrast, the empirical findings underscore the need to consider FDI in disaggregated terms. Both, host-country characteristics and industry characteristics have an important say in the relationship between IPR protection and FDI stocks held by US companies in the manufacturing sector of developing and developed host countries. Host-country characteristics matter in that IPR protection has weaker effects in countries with dominating pull factors for FDI, notably proximity to the United States. We also find some evidence that FDI is sig-

[26] Note that industrialized countries, on average, have lower import barriers than many developing countries.

nificantly increased by stronger IPR protection only where local imitative capacity, proxied by schooling, can be regarded as moderate. The effects remain insignificant for countries with insufficient local capacity for imitation as well as for advanced countries, in which particularly strong IPR protection may induce a substitution of licensing for FDI.

Industry characteristics reflect the significance of ownership-specific advantages which, in turn, reveal the benefits host countries can derive and the costs foreign direct investors suffer from infringements of IPRs. It fits into this reasoning that the impact of IPR protection turns out to be strongest in the human-capital- and technology-intensive machinery and transport equipment industries. By contrast, IPR protection does not play an important role in the food and metals industries, which are characterized by a particularly low technology intensity. In the chemical industry, stand-alone operations of US affiliates and the relatively small number of workers they employed in the host countries tend to have diminished the threat that ownership-specific advantages could be copied easily.

Finally, we find that host countries cannot only attract more FDI but may also derive more benefits from FDI by strengthening IPR protection. Especially R&D expenditure by US affiliates tends to rise with stronger IPR protection. Yet, policymakers, who are increasingly eager to lure foreign direct investors, should not expect too much from strengthening IPR protection as a stimulus to more and higher-quality FDI. For various developing countries, the effects on the quantity of FDI are likely to be dominated by pull factors related to the host country's market and location. In advanced host countries with strong IPR protection, FDI may increasingly be replaced by licensing. Quality aspects of FDI, though positively correlated with stronger IPR protection, are likely to be driven in the first place by factors that could not be captured in the present analysis. The export orientation of FDI is a case in point: The openness of host countries, in terms of their trade policy, may be more important than IPR protection in stimulating FDI-related exports.

Policymakers should also be aware that sufficient IPR protection may be taken for granted by foreign direct investors in the future. The trend toward a harmonization of IPR protection will probably continue due to unilateral measures and the implementation of multilateral obligations. As a consequence, host countries would no longer be able to distinguish themselves from other competitors for FDI by strengthening IPR protection. Similar to the liberalization of other regulatory and administrative measures of host countries with regard to the activities of foreign direct investors,

the expected convergence of national IPR regimes will have as an effect that adequate IPR protection is a necessary condition for FDI, at least for host countries lacking other strong pull factors, while strengthening IPR protection suffers from diminishing returns in inducing more and better FDI.

References

Barro, R. J., and J.-W. Lee (2000). International Data on Educational Attainment: Updates and Implications. Working Paper 42. Center for International Development <http://www.cid.harvard.edu/ciddata/ciddata.html>.

BEA (Bureau of Economic Analysis) (2003). Online Data Base on U.S. Direct Investment Abroad <http://www.bea.doc.gov/bea/di/di1usdbal.htm>.

Carr, D. L., J. R. Markusen, and K. E. Maskus (2001). Estimating the Knowledge-Capital Model of the Multinational Enterprise. *American Economic Review* 91 (3): 693–708.

Dunning, J. H. (1977). Trade, Location of Economic Activities and the MNE: A Search for an Eclectic Approach. In P.-O. Hesselborn, B. G. Ohlin, P.-M. Wijkman (eds.), *The International Allocation of Economic Activity*. London: Basingstoke.

Dunning, J. H. (1981). *International Production and the Multinational Enterprise*. London: George Allen and Unwin.

Ferrantino, M. J. (1993). The Effect of Intellectual Property Rights on International Trade and Investment. *Review of World Economics/Weltwirtschaftliches Archiv* 129 (2): 300–331.

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

Horstmann, I. J., and J. R. Markusen (1987). Licensing versus Direct Investment: A Model of Internalization by the Multinational Enterprise. *Canadian Journal of Economics* 20 (3): 464–481.

Jost, T., and P. Nunnenkamp (2003). Deutsche Direktinvestitionen in Entwicklungs- und Reformländern: Haben sich die Motive gewandelt? *Die Weltwirtschaft* (1): 107–130.

Kaufmann, D., A. Kraay, and P. Zoido-Lobatón (2002). Governance Matters, II: Updated Indicators for 2001–02. World Bank, Washington, D.C. <http://www.worldbank.org/wbi/governance/govdata2001.htm>.

Lee, J.-Y., and E. W. Mansfield (1996). Intellectual Property Protection and US Foreign Direct Investment. *Review of Economics and Statistics* 78 (2): 181–186.

Maskus, K. E. (1998). The International Regulation of Intellectual Property. *Review of World Economics/Weltwirtschaftliches Archiv* 134 (2): 186–208.

Maskus, K. E. (2000). Intellectual Property Rights and Foreign Direct Investment. Policy Discussion Paper 0022. University of Adelaide, Centre for International Economic Studies, Adelaide.

Maskus, K. E., and D. R. Eby-Konan (1994). Trade-Related Intellectual Property Rights: Issues and Exploratory Results. In A. V. Deardorff and R. M. Stern (eds.), *Analytical and Negotiating Issues in the Global Trading System*. Ann Arbor: University of Michigan Press.

Moran, T. H. (1998). *Foreign Direct Investment and Development. The New Policy Agenda for Developing Countries and Economies in Transition*. Washington, D.C.: Institute for International Economics.

Nicholson, M. (2003). The Impact of Industry Characteristics on International Technology Transfer. Federal Trade Commission. Washington, D.C.

Nunnenkamp, P., and J. Spatz (2002). Determinants of FDI in Developing Countries: Has Globalization Changed the Rules of the Game? *Transnational Corporations* 11 (2): 1–34.

Nunnenkamp, P., and J. Spatz (2003). Intellectual Property Rights and Foreign Direct Investment: The Role of Industry and Host-Country Characteristics. Kiel Working Paper 1167. Institute for World Economics, Kiel.

Primo Braga, C. A., and C. Fink (2000). International Transactions in Intellectual Property and Developing Countries. *International Journal of Technology Management* 19 (1/2): 35–56.

Smarzynska, B. K. (2004). The Composition of Foreign Direct Investment and Protection of Intellectual Property Rights: Evidence from Transition Economies. *European Economic Review* 48 (1): 39–62.

Smith, P. J. (2001). How Do Foreign Patent Rights Affect U.S. Exports, Affiliate Sales, and Licenses? *Journal of International Economics* 55 (2): 411–439.

WEF (World Economic Forum) (2002). *The Global Competitiveness Report 2001–2002*. New York: Oxford University Press.

White, H. (1980). A Heteroskedastic-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica* 48 (4): 817–838.

World Bank (2002). *World Development Indicators*. CD-ROM. Washington, D.C.

Yang, G., and K. E. Maskus (2001). Intellectual Property Rights and Licensing: An Econometric Investigation. *Review of World Economics/Weltwirtschaftliches Archiv* 137 (1): 58–79.