Intellectual Property Rights and Trade: Firm-level Evidence from Low and Middle Income Countries.[1]

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Abstract

After reviewing the main conclusions of the literature on Intellectual Property Rights and trade, we use firm data from World Bank Enterprise Surveys carried out in 10 low- and middle-income countries between 2002 and 2005 to address the question "how trade-related are intellectual property rights?" from the perspective of developing countries. We test the "market expansion" hypothesis put forth in the literature, namely whether firms' exports are biased towards countries with stronger IPR protection because imitation is more difficult there. The results support strongly the importance of IPR protection in the destination country as a driver of exports. Moreover, strong IPR in destinations countries matter disproportionately more for oligopolistic industries, as these are more sensitive to the risk of being imitated and more for firms with foreign ownership.

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1. Introduction

After the Uruguay round in 1994, World Trade Organization (WTO) members were required to adjust their standards of Intellectual Property Rights (IPRs) protection under the Trade-related Intellectual Property (TRIPs) agreement. This requirement did put higher demands on developing countries where both *de jure* levels of IPRs protection and their enforcement were generally weaker than those of developed countries. As a result, over the 1990-2000 period, the average degree of IPRs protection of countries with income per capita levels below $10,000, as measured by the Ginarte and Park index,[2] increased by 56%. In the five-year period following the TRIPs agreement, China increased its measure of IPRs protection from 1.55 to 2.48, while India increases its measure from 1.51 to 2.58 (Sener, 2006).

One key question is whether developing countries should expect positive development and welfare dividends from their efforts on the IPRs front. Critics have argued that the TRIPs agreement puts them at a competitive disadvantage and is in fact akin to a protectionist policy by developed countries. Supporters from rich countries reply to these complaints by pleading that stronger IPRs protection in the world promotes innovation, stimulates technological progress, and that higher security (less risk of imitation) in developing countries results in more technology transfers from rich to poor countries, with positive effect on growth and welfare for all.

Part of the debate in the large literature on this issue has dealt with the impact of stronger IPRs protection on international trade, with ambiguous results both in theoretical and empirical contributions. Why should IPRs be trade-related? First, stronger IPRs protection stimulates innovation,[3] which affects growth, in particular through technology transfers, and therefore trade. Second, differences in IPRs protections across countries should affect firms' decisions on whether and how to serve each potential foreign market, therefore having an impact on how innovation translates into technology transfers and trade flows across countries.

Indeed, innovation may mean new products, higher quality of existing products, increasing product variety, etc. Technology transfers, in turn, are linked to the mode of innovation and may be driven by imitation, trade in

[2] See Section 3 below for more details on this index.
[3] See for example Sharma and Straub (2010).

technology, foreign direct investment, licensing of intellectual assets, with different impacts on trade flows. Finally countries' openness to trade and trade intensity themselves may impact on IPRs protection and this endogeneity problem complicates the understanding of the link between stronger IPRs protection and trade.

In most of the literature, the analysis of the link between IPRs protection and international trade is set at the country level, leading to conclusions on how firms' environment, such as the level of development or openness to trade matter. However, since modes of innovation and of technology transfer are driven by firms' behavior, a better understanding can be obtained by also taking into account firms' and sectors' characteristics.

This paper looks at the effect of IPRs protection on international trade using firm survey data including 5,255 manufacturing firms across 10 developing countries, with information on firms exporting behavior, including their main export destinations.

In doing so, it provides a double contribution. First, this allows us to take into account simultaneously in our analysis country-, sector-, and firm-level determinants. In particular, controlling for characteristics of the environment and of the individual productive units, we want to find out to what extent the relationship between IPRs protection and international trade varies according to key sectoral characteristics such as market competitiveness or industry-specific innovativeness.

Second, most of the previous literature has attempted to explain how stronger IPRs affect technology transfers through more exports or more FDI *from developed to developing countries*. Contributions that investigate the trade-related IPRs issues from the perspective of developing countries are few and generally limited to a specific country or sector.[4] Our analysis is much broader in scope, as it includes firms from 10 countries and 120 isic4-level sectors, covering in each of these countries a representative sample of the industrial structure.

The paper is organized as follows. Section 2 first presents the main assumptions of the theoretical literature on the link between IPRs protection in developing countries, international trade and technology transfers.[5] It then reviews empirical papers that have analyzed the effects of stronger IPRs

[4] Examples are Liu and Lin (2005) about Taiwan and Smith et al (2009) about the pharmaceutical sector. See the review below.

[5] This is not meant to be an exhaustive review of this literature (for such a review see for example the recent paper by Dinopoulos and Segerstrom, 2010, or the survey by Hassan, Yaqub and Diepeveen, 2010). In particular, we omit papers discussing the consequences on welfare.

protection on exports from developed to developing countries, as well as the contributions focusing on developing countries firms. It lays down the main arguments found there on whether and how trade across developing countries is related to IPRs, to guide our empirical analysis. Section 3 then describes the data and provides the results from the empirical analysis, and Section 4 concludes.

2 International Trade and Intellectual Property: Theory and Some Empirical Results

2.1 Theory

Most of the theoretical literature (for example Helpman, 1993; Lai, 1998, Glass and Saggi, 2002, Gancia and Bonfiglioli, 2007, Dinopoulos and Segerstrom, 2010), assume that the structure of the economy consists of two regions: the North, which represents high-wage developed countries, and the South, which stands for low-wage developing countries. Free trade is allowed between the two regions. The efficiency of Northern labor in innovation is much higher so only Northern firms innovate. They can either export goods to the South, or set up affiliates firms in the South in order to transfer manufacturing operations to locations with lower labor cost. Imitation happens in the South, targeting Northern firms or the local affiliates of multinational enterprises.

In these North-South trade models, innovation is endogenous and depends, through a number of potential channels, on the strength of IPRs protection. In Helpman (1993), Lai (1998) and Branstetter et al. (2007) innovation results in the introduction of a new variety leading to an increase in product variety (with a positive impact on consumers' surplus), while in Glass and Saggi (2002), Sener (2006) and Dinopoulos and Segerstrom (2010), innovation increases product quality.

IPRs enforcement in the North is generally assumed to be perfect, while it is imperfect in the South. Therefore enforcing stronger IPRs in the South is the main issue. This is either modeled as a reduction in the rate of imitation, by considering that stronger IPRs protection makes the process of technology licensing from North to South easier (see Yang and Maskus, 2001), increases the duration of patents (Dinopoulos et al., 2010) or commits imitators in the South to transfer part of their profits to Northern firms (Gancia and Bonfiglioli, 2007).

In a nutshell, these papers reach pretty homogeneous conclusions, regardless of the modeling choices for the mode of innovation and the effect of stronger IPRs. From a theoretical viewpoint, whether IPRs protection induces more or less trade from North to South is ambiguous, as the net outcome is the result of two opposite effects: the "market expansion" and the "market power" effects.

The first effect stems from the fact that stronger IPRs protection in the South means less imitation by Southern firms. With constant demand in the South, Northern firms benefit from a relative market expansion and export more. This may be strengthened by a dynamic effect, as better IPRs protection stimulates innovation in Northern countries, thus further increasing future exports to the South.

The second, opposite, effect relates to the fact that stronger IPRs protection in the South increases Northern firms' market power. As a result, they export less, restricting the quantities offered and increasing their prices. The first effect probably dominates if IPRs protection is strengthened in a small country, while the second effect is likely to dominate if this occurs in a large country.

2.2 Some empirical results

The tradeoff between the market expansion and the market power effects is highlighted by Maskus and Penubarti (1995), who adopt the Helpman-Krugman (1985) trade model to analyze how variations in patent laws influence trading decisions using country-level data. They conclude that stronger patent laws in developing countries induce more imports from OECD countries but then add "*there is no clear presumption that, comparing two otherwise identical nations, the country with the stronger patent law will attract more imports of patentable commodities*". There is also some evidence that IPRs affect trade differently across industries (e.g., Maskus and Penubarti, 1995, Fink and Promo Braga, 2004, Park and Lippoldt, 2003), adding to the ambiguity of the results.

Awokuse and Yin (2008) show that the market expansion effect is significant for China's imports from OECD countries, particularly for knowledge-intensive goods, but insignificant when considering imports from non-OECD countries. These results seem to comfort the assumption that enhancing IPRs stimulates imports from the North, particularly in sectors with high level of innovativeness. At the opposite, Primo and Fink (1997), using a gravity model of bilateral trade for 89 countries, find that stronger IPRs protection increases bilateral trade flows of manufactured non-fuel imports, but this effect is

insignificant for trade flows in high technology. They conclude that more empirical research is needed at the firm level.

Liu and Lin (2005) analyze Taiwan exports in three high-tech industries (semiconductor, information and communication equipment) and conclude that an improvement in IPRs has a positive impact on exports towards countries with stronger R&D ability than Taiwan, as well as when the importing country was a strong potential imitator. Looking at the pharmaceutical sector, Smith et al (2009) found that TRIPS had increased trade in developed countries at the expense of developing countries. Park and Lippoldt (2003) similarly conclude that patent rights have an insignificant influence on total exports for least developed countries.

3. Empirical Evidence

In this section we address the question "how trade-related are intellectual property rights?" from the perspective of developing countries.

We uses firm-level data from comparable surveys across 10 countries to address the main question outlined above, namely whether firms' exports are biased towards countries with stronger IPR protection, presumably because imitation is more difficult there. In doing so, we also try to relate our results to both the market expansion and the market power effects highlighted above.

Data description

Firm data

The firm-level data is taken from a subset of the World Bank Enterprise Surveys[6] carried out in 10 countries between 2002 and 2005. These surveys cover random samples of registered firms from each country and can be pooled easily because of the similarity of the survey instruments and design.[7]

Although such surveys are now available for over a 100 countries, the question forming the basis of our main variable of interest, providing information on firms' export destinations, was only asked in 10 countries. In the present case, the pooled data set includes 5,255 manufacturing firms from the following countries: Chile (2004), Egypt (2004), Malawi (2005), Mali (2003),

[6] See www.enterprisesurveys.org for detailed descriptions of the surveys.

[7] See Dethier, Hirn and Straub (2010) for more details on the enterprise surveys.

SouthAfrica (2003), Syria (2003), Tanzania (2003), Thailand (2004), Vietnam (2005), and Zambia (2002). A summary table is in the Appendix.

Country-level Characteristics

Country level of IPRs protection: we rely on the index developed by Park and Ginarte (1997). Park (2008) has updated this data to 2005, with coverage of about a 120 countries at 5 years intervals between 1960 and 2005.

Industry Characteristics

We want to make sure the results are not polluted by simple country-level or sector-level effects that are unobserved to the econometrician. This can be achieved by simply using sector and country fixed effects. However, this means we lose some potentially interesting insights. Therefore, to uncover significant variations within country and industry groups, we also define fundamental sector-level characteristics that can be interacted with country-level variables. These are defined and justified as in Sharma and Straub (2010).

Degree of industry innovativeness: Industry-level degree of innovativeness is measured as the value from the corresponding industry in the US. Our US industry measure, taken from COMPUSTAT, is the 5-year average over 1990-95 of the industry R&D expenditure to sales ratio.[8]

Degree of industry competition: We use a Herfindahl-Hirschman Index (HHI) from the corresponding industry in India. The choice of this country, rather than the US, responds to the fact that the countries in our sample are in the low income to upper-middle income range.

Firm-level Characteristics

The full sample covers 5,255 firms from 10 countries. For exporting firms, we know the percent of sales exported directly and indirectly. This variable is available for 5,226 firms, of which 2,097 export part of their sales directly, and 554 indirectly. We use this as a proxy of firms exporting intensity.

We also have information on firms' main exporting destinations. We use the three main export destinations, which cover respectively 1873 (destination 1), 1614 (destination 2) and 359 (destination 3) firms, and create a variable with the level of IPR (from Park, 2008) corresponding to each firm's export

[8] See Sharma and Straub (2010) for the rationale of this empirical strategy inspired by Rajan and Zingales (1998).

destination. Other variables (R&D/sales, introduction of a new technology in the last 3 years) are defined as in Sharma and Straub (2010).

Additionally, we have information on individual firms basic characteristics, such as age, size, foreign ownership, etc. These are used as control variables, but foreign ownership is of special interest as it might also be used as a proxy for FDI.

Estimations

We want to perform a firm-level analysis of the correlation between the level of IPR in the main destination countries and the share of firms' sales exported. To do so, we need to control for standard drivers of exporting behavior: proximity (distance and GDP as in the gravity model, but also common language, etc.), and any other sector or country-level determinants. We do that by including origin country-level fixed effects, sector-level fixed effects (at the isic4-level) and, more importantly, crossed origin-destination country pairs fixed effects. This last control can be thought of as a way to replicate a standard gravity effect, as it would capture any effects arising from the specific characteristics of each pair formed by the firm's country of origin and its export destination country.

Our main specification is the following:

$$Exports_{ijc} = \alpha_j + \alpha_c + \alpha_{cd} + \beta_1 * IPR_d + \beta_2 * (Ind\ charac.)_j * (IPR_d) + Y_i\beta_3 + \varepsilon_{ic} \quad (1)$$

where α_j, α_c and α_{cd} are industry, origin country and crossed origin-destination countries fixed effects respectively, $Exports_{ijc}$ is the percentage share of firm i sales that are exported, and Y_i is a vector of firms' controls (foreign ownership, age, size, etc.).

Industry characteristics and IPR are defined above. Note that in our standard regression, fixed effects absorb 120 isic4-level sectors, 214 origin-destination country pairs, and 10 origin countries. The results are in Tables 1 to 5. All standard errors are clustered at the country level.

In Table 1, the dependent variable is the share of sales exported directly, while the IPR measure is Park's 2008 index value for the main export destination. The results support strongly the importance of IPR protection in the destination country as a driver of exports. In columns 1, an increase of 1 point on the IPR index scale (that goes from 1 to 5) implies that an additional 5.5 percent of the firm's sales is exported directly, an effect significant at the 1% level. In column 2, we add interactions between sector characteristics and the IPR index, to see if the effect varies depending on sector-level

innovativeness or competition. While no effect is found for more innovative sector, the interaction term for competition indicates that the effect is significantly stronger in sector that have higher reference HHI values, i.e., in more concentrated sectors. The coefficients mean that for industries in the top decile of more concentrated sectors (those with an Indian HHI of more than 0.08), the effect of destination IPR is about 50% stronger. This appears to indicate that strong IPR in destinations countries matter disproportionately more for oligopolistic industries, as these are more sensitive to the risk of being imitated.

In columns 3 and 4, we add firm-level controls (foreign ownership, size as captured by the log number of employees, and age). The results are robust, except for the competition interaction that marginally loses significance. Note however that the IPR coefficient is now larger. Additionally, note that strong IPR in destinations countries matters disproportionately more for firms with foreign ownership, for larger firms and, somewhat surprisingly, for younger ones. This result may indicate, as already argued in Sharma and Straub (2010) that improvement in IPRs protection has been particularly important for new firms.

Table 1

	(1) Share of sales exported directly	(2) Share of sales exported directly	(3) Share of sales exported directly	(4) Share of sales exported directly
IPR05_main destination	5.521***	5.308**	8.311***	7.992***
	(1.546)	(1.768)	(1.799)	(1.862)
Ipr_d*innov		24.05		41.69
		(123.4)		(114.9)
Ipr_d*comp		32.88*		25.77
		(15.37)		(15.67)
Ownership			8.937***	8.883***
			(2.134)	(2.150)
Lnworkers			1.414*	1.409*
			(0.701)	(0.710)
Firmage			-0.224**	-0.226**
			(0.0838)	(0.0843)
Constant	-7.616	-12.87	-21.73*	-27.00*
	(7.755)	(12.35)	(10.03)	(14.42)
Sector FE	Yes	Yes	Yes	Yes
Origin country FE	Yes	Yes	Yes	Yes
Origin-dest FE	Yes	Yes	Yes	Yes
Observations	1861	1861	1854	1854
R-squared	0.449	0.450	0.466	0.466

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2 repeats the analysis in Table 1, with the dependent variable now being the sum of the firms' shares of sales exported directly and indirectly. Results

are strictly similar, except for the competition interaction that is again only marginally significant.

Table 2

	(1) Share of sales exported directly and indirectly	(2) Share of sales exported directly and indirectly	(3) Share of sales exported directly and indirectly	(4) Share of sales exported directly and indirectly
IPR05_main destination	5.644***	5.569**	8.135***	7.951***
	(1.663)	(1.721)	(1.732)	(1.663)
Ipr_d*innov		3.684		21.20
		(98.60)		(89.69)
Ipr_d*comp		28.07		22.78
		(17.88)		(16.76)
Ownership			6.674***	6.623***
			(1.695)	(1.707)
Lnworkers			1.503*	1.498*
			(0.756)	(0.762)
Firmage			-0.241**	-0.242**
			(0.0843)	(0.0844)
Constant	-5.828	-9.445	-19.06*	-22.89*
	(7.501)	(10.70)	(8.580)	(12.31)
Sector FE	Yes	Yes	Yes	Yes
Origin country FE	Yes	Yes	Yes	Yes
Origin-dest FE	Yes	Yes	Yes	Yes
Observations	1861	1861	1854	1854
R-squared	0.508	0.508	0.522	0.523

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In Table 3, we perform alternative tests, with the dependent variable being again the share of firms' sales exported directly, while the IPR measure is now the maximum Park's 2008 index value across the three main export destinations. Finally, in Table 4 we use instead as dependent variable the sum of firms' shares of sales exported directly and indirectly. Again, the results are strictly similar to those in Tables 1 and 2.

Table 3

	(1) Share of sales exported directly	(2) Share of sales exported directly	(3) Share of sales exported directly	(4) Share of sales exported directly
IPR_{max}destination	5.318**	4.788*	5.745**	5.275*
	(1.896)	(2.518)	(1.785)	(2.735)
Ipr_{max}*innov		10.07		9.100
		(148.9)		(141.4)
Ipr_{max}*comp		9.824		8.667
		(7.162)		(16.18)
Ownership			8.913***	8.889***
			(2.219)	(2.229)

Lnworkers			1.325*	1.324*
			(0.665)	(0.666)
Firmage			-0.231**	-0.231**
			(0.0836)	(0.0831)
Constant	4.127	4.553	13.87***	14.22**
	(6.551)	(8.269)	(3.751)	(5.490)
Sector FE	Yes	Yes	Yes	Yes
Origin country FE	Yes	Yes	Yes	Yes
Origin-dest FE	Yes	Yes	Yes	Yes
Observations	1861	1861	1854	1854
R-squared	0.451	0.451	0.467	0.467

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4

	(1) Share of sales exported directly and indirectly	(2) Share of sales exported directly and indirectly	(3) Share of sales exported directly and indirectly	(4) Share of sales exported directly and indirectly
IPR_{max}destination	5.861***	6.572**	6.261***	6.933**
	(1.074)	(2.557)	(1.213)	(2.954)
Ipr_{max}*innov		-33.16		-33.64
		(113.1)		(108.3)
Ipr_{max}*comp		0.931		2.418
		(6.243)		(15.01)
Ownership			6.648***	6.636***
			(1.783)	(1.794)
Lnworkers			1.406*	1.414*
			(0.719)	(0.707)
Firmage			-0.248**	-0.248**
			(0.0844)	(0.0835)
Constant	15.09**	-37.08***	22.55***	23.23***
	(5.075)	(11.11)	(3.302)	(3.481)
Sector FE	Yes	Yes	Yes	Yes
Origin country FE	Yes	Yes	Yes	Yes
Origin-dest FE	Yes	Yes	Yes	Yes
Observations	1861	1861	1854	1854
R-squared	0.510	0.510	0.524	0.524

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Finally, Table 5 presents a number of additional robustness tests. First, in columns 1 and 2, we add additional firm-level controls related to firms' innovating behavior, to assess whether firms using foreign licenses or doing more R&D have a different exporting behavior. The addition of these controls does not affect our main results, while the innovation proxies themselves are not significant.

In columns 3 and 4, we add the difference in IPR protection between the origin and destination countries as an additional regressor. Note that since our sample of origin countries is comprised only of developing economies, this variable is negative for 82% of our observations. The coefficient is positive

and significant at the 1% level in columns 4 when firm-level controls are included. One interpretation is that firms in our sample are more successful in increasing their exporting shares to countries with which they have less of a difference in IPR protection.

Finally, in columns 5 and 6, we use the change in IPR protection between 2000 and 2005 in the destination countries as our main explanatory variable instead of the 2005 index. The results support strongly the idea that firms are exporting more to countries that have improved their IPR protection in the recent past. A 1 point improvement on the IPR index scale between 2000 and 2005 translates into an additional 21 percent of sales exported directly (and 23% directly and indirectly), an effect significant at the 1% level.

Table 5

	(1) Share of sales exported directly	(2) Share of sales exported directly and indirectly	(3) Share of sales exported directly	(4) Share of sales exported directly and indirectly	(5) Share of sales exported directly	(6) Share of sales exported directly and indirectly
IPR05_main destination	8.337***	7.985***	11.47***	11.15***		
	(1.850)	(1.744)	(2.993)	(1.919)		
$IPR_{origin} - IPR_{dest}$			3.156	3.010***		
			(1.820)	(0.893)		
$IPR_{dest}05 - IPR_{dest}00$					23.13**	21.03**
					(9.060)	(8.567)
R&D/sales	-1.024	3.616				
	(4.728)	(5.207)				
Newtech	-0.205	-1.216				
	(1.677)	(1.918)				
Ownership	8.941***	6.658***	8.937***	6.674***	8.937***	6.674***
	(2.150)	(1.696)	(2.134)	(1.695)	(2.134)	(1.695)
Lnworkers	1.433*	1.598*	1.414*	1.503*	1.414*	1.503*
	(0.674)	(0.766)	(0.701)	(0.756)	(0.701)	(0.756)
Firmage	-0.225**	-0.241**	-0.224**	-0.241**	-0.224**	-0.241**
	(0.0843)	(0.0836)	(0.0838)	(0.0843)	(0.0838)	(0.0843)
Constant	-21.41*	-18.25*	-28.64**	-25.65**	29.86***	39.97***
	(10.51)	(8.770)	(12.42)	(8.796)	(3.444)	(2.845)
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Origin country FE	Yes	Yes	Yes	Yes	Yes	Yes
Origin-dest FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1848	1848	1854	1854	1854	1854
R-squared	0.466	0.523	0.466	0.522	0.466	0.522

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

4. Conclusion

Our firm-level analysis in ten countries (5 low income, 3 lower-middle income and 2 upper-middle income countries) has shown a strong correlation between the level of IPRs in the main destination countries and the share of firms' sales exported. This result may be interpreted as supporting the

hypothesis that stronger IPRs protection gives rise to a market expansion effect. Moreover, the nature of our sample indicates that this effect is also at play for exports from relatively underdeveloped countries, providing some support to a rather benign view of the process of IPRs strengthening initiated with the Uruguay round, in which both developing and developed countries around the world stand to gain.

Appendix

Country	Number of firms
Chile (2004)	695
Egypt(2004)	914
Malawi(2005)	154
Mali(2003)	93
South Africa(2003)	560
Syria(2003)	203
Tanzania(2003)	145
Thailand (2004)	1,385
Vietnam (2005)	1,022
Zambia (2002)	84
Total	5,255

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