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Intellectual Property Rights, Foreign Direct Investment and Economic Freedom

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Abstract:
The relationship between intellectual property rights (IPR) protection and foreign direct investment (FDI) continues to pose a challenging puzzle. While several studies have found that these two variables are positively correlated, others have not been able to find conclusive results. We contend that a partial explanation resides on institutional differences among host countries. We find that increases in IPR protection encourage FDI in countries in which the institutional environment, as proxied by indices of economic freedom, is efficient but not otherwise. We use threshold regression techniques on samples ranging from 81 to 102 countries during the 1990 - 2010 period.

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1 Introduction

The relationship between intellectual property rights (IPR) protection and foreign direct investment (FDI) continues to pose a challenging puzzle. While several studies have found that there is a positive correlation between these two variables (e.g. Park and Ginarte (1997) and Branstetter and Saggi (2011)), others have not been able to find conclusive results (e.g. Braga and Fink (1999) and Javorcik (2004)) or have found that the relationship is actually negative (e.g. Glass and Saggi (2002), Rose-Ackerman and Tobin (2005), and Winchell (2007)).

This contradictory evidence is not surprising when one considers that the relationship between IPR protection and FDI operates through multiple channels and is subject to regional, development and industry effects. Using data from transition economies, for example, Javorcik (2004) finds that weak IPR protection deters FDI in technology-intensive sectors but encourages FDI in distribution activities. Maskus (1998), in turn, finds that IPR protection encourages FDI when is accompanied by broader business-friendly policies which characterize developed countries but not their developing counterparts.

Another important example of this literature is that of Glass and Saggi (2002) who go one step further and argue that IPR protection may actually deter FDI in developing countries and innovation in developed countries. Using a product-cycle model, Glass and Saggi (2002) suggest that FDI is largely determined by the pool of domestic resources available to multinational corporations (MNCs) and that MNCs compete for these resources with domestic imitation activity. In their model, however, domestic imitation activity is characterized by technological restrictions (i.e. it is subject to fixed input ratios) and, so, as IPR protection increases more resources (and not less) are devoted to imitation activity. This last effect reduces the pool of domestic resources available to MNCs and discourages FDI inflows in developing countries and innovation in developed countries.

Conflicting arguments are also observed at the forefront of international trade negotiations. Developed countries and multilateral trade organizations continue to demand that developing countries adopt and enforce stricter IPR reforms. Developing countries typically negotiate for softer reforms and longer time horizons as they recognize that FDI depends on several other variables and the political economy of IPR reforms can be complex.

Our goal is to contribute to this discussion from an institutional economics perspective. As in Glass and Saggi (2002), we argue that the effect of IPR protection on FDI is largely determined by the pool of domestic resources available to MNCs. We depart from Glass and Saggi (2002), however, in that we propose that the competition for those resources may not only be determined by technological restrictions present in imitation activity but also by the efficiency or quality of the institutional environment.

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Our argument is as follows. Carrying productive activities in the formal economy (i.e. legally) can be very costly when the institutional environment is inefficient (i.e. characterized by high levels of bureaucracy, corruption, price controls, etc.). In this case, domestic firms and workers have incentives to shift their activities to the informal economy. Given that MNCs operate in the formal economy, this effect reduces the pool of domestic resources available to them and, therefore, discourages FDI.[1] This result is reinforced when one considers that a typical informal activity consists precisely on illegal imitation.[2]

In this framework, the role of IPR protection is to reduce illegal domestic imitation activity by implicitly increasing the cost of production of illegal copiers. In countries in which the institutional environment is otherwise relatively efficient, increases in IPR protection are, indeed, likely to encourage a large number of illegal copiers to abandon their informal imitation activities and return to the formal economy. As a result, MNCs not only benefit from an increase in the pool of domestic resources available to them in the formal economy, but also from a reduction in the illegal competition they face. Consequently, FDI is strongly encouraged. The same is not necessarily true, however, in countries in which the institutional environment is relatively inefficient. In this case, excessive bureaucracy, corruption, price controls, etc., impose too high a cost of switching back to the formal economy. While an increase in IPR protection increases their cost of production, illegal copiers may still find optimal to continue to imitate in the informal economy given their alternative. As a result, both the increase in the pool of resources available to MNCs and the reduction in the illegal competition they face, would tend to be much smaller than in the previous case.

Our argument depends crucially, of course, on how we define an "efficient institutional environment." A commonly used measure of institutional efficiency is provided by indices of economic freedom (most notably the Economic Freedom of the World Index (James Gwartney and Hall 2015) and the Index of Economic Freedom (Miller and Kim 2015). Both the EFWI and the IEF provide separate measures of the extent by which the institutional environment protects personal choice, voluntary exchange, freedom to enter and compete in markets, and protection of persons and their private property. Together, these elements tend to construe clear and stable institutions that generate productive incentives and respect for the rules of the game. We, therefore, use these indices as our proxy of the efficiency of the institutional environment.

But what is the cut-off point in the distribution of the economic freedom indices that demarcates relatively efficient and relatively inefficient institutional environments (and at which the relationship between IPR and FDI should suffer a structural break)? A possible empirical approach to this question consists on using the threshold regression methodology developed by Hansen (1999, 2000) . This methodology allows for the identification of a threshold point in a variable's distribution at which the relationship between two other variables suffers a structural break. The obvious advantage of this methodology is that it lets the sample data determine the location of the cut-off point or threshold (if there is one) rather than requiring the researcher to impose it arbitrarily.[3] We perform this analysis on samples of 81 to 102 countries with data for the 1990–2010 period. In our baseline regression model, we find that a statistically significant threshold exists, indeed, at a value of 7.349 (in a 0 to 10 scale) in the EFWI distribution. We find that IPR and FDI are positive and significantly correlated in countries presenting EFWI values above that level but that the same relationship is not significant for countries below it. We perform the same exercise using the IEF and find similar results. We also explore capturing the efficiency of the institutional environment by using the individual components of EFWI and IEF. This exercise allows us to identify the elements of the institutional environment that matter the most for the relationship between IPR and FDI.

In an effort to tests the robustness of our results we also proxy the efficiency of the institutional environment using a measure of the relative size of the informal or shadow economy as a percentage of GDP (Schneider, Buehn, and Montenegro 2010) and, alternatively, piracy rates as reported by the Alliance (2014) report. This last variable allows us to proxy the extent of illegal imitation activity within the informal economy. We find that a threshold in the distribution of the size of the informal economy exists at 18.47% and a threshold in the distribution of piracy rates exists at 37.9%. Similarly to our previous results, we find that the relationship between IPR and FDI is positive and significant below these thresholds (lower levels of informal economy and piracy rates indicate more efficient institutional environments) but it is not significant above them.

Several studies have analyzed the effects of institutional variables on FDI. To cite some examples, Wheeler and Mody (1992), Globerman and Shapiro (2002), Aizenman and Spiegel (2002), Bénassy-Quéré, Coupet, and Mayer (2005), and Hayakawa, Kimura, and Lee (2013) have all studied the relationship of FDI with several indices of institutional efficiency including easiness to create a company, transparency, tax system, corruption, contract law, security of property rights, efficiency of justice and political risk. Some others have focused on specific determinants (e.g. Wei (1997) and Habib and Zurawicki (2002) have studied the effects of corruption) or specific regions (e.g. Kinoshita and Campos (2003) have studied the relationship between FDI and institutional variables in transition economies and Méon and Sekkat (2004) have done the same for Middle Eastern and North African countries). As expected, most authors find that more efficient institutional environments tend to attract more FDI.

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We contribute to this literature by illustrating a particular channel through which the institutional environment affects FDI. We show that the efficiency of the institutional environment, as proxied by indices of economic freedom, conditions the relationship between IPR protection and FDI. In this sense, our paper is more closely related to Maskus (1998) who concludes that "while there are indications that strengthening intellectual property rights can be an effective means of inducing additional inward FDI, it is only a component of a far broader set of important influences" including "market liberalization and deregulation, technology development policies, and competition regimes." We take Maskus (1998) ' analysis one step further and estimate at what point of the institutional environment distribution, as proxied by indices of economic freedom, IPR protection becomes effective at attracting FDI.

The next section presents a simple theoretical framework that illustrates the competition for domestic resources between MNCs and illegal copiers as determined by the institutional environment. Section three presents the empirical strategy and results, and section four concludes.

2 Theoretical Framework

Assume a market for a given product being served by two types of firms: MNCs and illegal copiers.[4] MNCs establish themselves in the formal economy and produce original copies of the product. Illegal copiers establish themselves in the informal economy and produce illegal imitations of the original copies produced by MNCs. Original copies and imitation copies are deemed quality-adjusted substitutes (if imitation copies are only half as good as original copies then two units of the former are equivalent to one unit of the latter).

Assume that MNCs are monopolistically competitive firms subject to a constant marginal cost $c(r)$, where r represents the relative abundance of resources (e.g. labor) in the formal economy. An increase in r shifts the marginal cost for MNCs downwards. As we will see below, r increases if/when illegal copiers abandon the informal economy and switch to the formal economy as IPR protection increases.

We assume that illegal copiers operate in a market of competitive selection subject to a constant marginal cost $m(z)$, where z is an effective measure of IPR protection (i.e. it captures the degree of enforcement). An increase in z shifts the marginal cost for illegal copiers upwards. Economic profits for illegal copier j can be written as:

$$\Pi_j = [p - m_j(z)]y_j - O(w) = 0 \qquad [1]$$

where p is the price of a quality-adjusted imitation copy, y_j is illegal copier j's individual supply and $O(w)$ represents the opportunity cost faced by illegal copiers. This last variable is crucial for the model. The opportunity cost faced by illegal copiers is given by the utility or profits that illegal copiers could be earning in the formal economy. As argued in the previous section, $O(w)$ is a positive function of the efficiency of the institutional environment (captured by w).

A market of competitive selection illustrates the characteristics of the market for illegal copies more appropriately than a market of perfect competition. Contrary to what is often assumed, imitation is not perfectly non-rival but, in fact, costly, non-instantaneous and uncertain (see Levin et al. (1987) and Hwang, Wu, and Yu (2016)). The model of competitive selection captures this feature by assuming that, although firms are price takers and the product is homogeneous, there is no free entry and not all firms have access to the same technology. As a result, different firms earn different profit rates, positive profits can be sustained even in the long run, and there may be simultaneous entry and exit.[5]

It is straightforward to illustrate the effects of an increase in IPR protection in this framework. Consider two countries: D and U. Country D is characterized by a relatively efficient institutional environment and country U is characterized by a relatively inefficient institutional environment. That is, $w^D > w^U \Rightarrow O(w^D) > O(w^U)$. Other things equal, therefore, the size of the informal economy (and the production of illegal copies) in country U will be larger than that in country D. Starting from long run equilibrium, introduce now a shock whereby both countries experience an increase in IPR protection (z goes up). As a result, accounting profits for illegal copiers in both countries, $[p - m_j(z)]y_j$, decrease and a number of illegal copiers have incentives to quit their illegal imitation activities and move back to the formal economy. Given, however, that $O(w^D) > O(w^U)$, a relatively larger number of illegal copiers will exit the informal economy in country D than in country U. Hence, the pool of resources in the formal economy (r) will increase to a relatively larger extent in country D than in country U. This will, in turn, lower the marginal cost and the illegal competition faced by MNCs to a larger extent in country D than in country U. In fact, if the institutional environment is highly deteriorated in country U ($O(w^U)$ is small), the positive effects of IPR protection on MNCs in country U may be insignificant or null.

In summary, by increasing the resources available in the formal economy, and reducing the illegal competition faced by MNCs, an increase in IPR protection increases profits for MNCs in country D to a relatively larger

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extent than in country U. Higher profits for MNCs encourage, in turn, higher FDI. First, as existing MNCs turn more profitable, they are more likely to increase their investments in the domestic country. Second, given that MNCs operate in monopolistic competition, an increase in profits starting from long run equilibrium implies that new MNCs will enter the domestic market.[6]

3 Empirical Strategy

We test our hypothesis using samples that include unbalanced panels of 81 to 102 countries and data for the years 1990 to 2010. As we explain below, the period of study is largely determined by the availability of data on IPR protection.

3.1 Data

3.1.1 FDI

We use FDI net inflows as share of GDP from the World Development Indicators (WDI).

3.1.2 IPR Protection

Our measure of IPR protection is the commonly used index of patent rights published first by Ginarte and Park (1997) and then updated by Park (2008). This index is the unweighted sum of five scores measuring the following items: coverage (inventions that are patentable), membership in international treaties, duration of protection, enforcement mechanisms, and restrictions (for example, compulsory licensing in the event that a patented invention is not sufficiently exploited). Therefore, this index rates the strength of patent protection on a scale from 0 to 5. Currently, this index is available every five years from 1960 to 2010.

3.1.3 Economic Freedom

We use both the EFWI and the IEF to proxy the efficiency of the institutional environment. The EFWI is available every five years from 1970 to 2000 and yearly thereafter until 2013. The IEF is available yearly from 1995 to 2015. Both indices measure the degree to which the policies and institutions of countries are supportive of economic freedom either on a 0 to 10 scale (EFWI) or a 0 to 100 scale (IEF) (where 10 and 100 represent the highest levels of economic freedom).

The EFWI is composed of five different areas or subindices: size of government (EFWI 1), legal structure and security of property rights (EFWI 2), access to sound money (EFWI 3), freedom to trade internationally (EFWI 4), and regulation of credit, labor and business (EFWI 5). The IEF is composed of 10 different areas or subindices: property rights (IEF 1), freedom from corruption (IEF 2), fiscal freedom (IEF 3), government spending (IEF 4), business freedom (IEF 5), labor freedom (IEF 6), monetary freedom (IEF 7), trade freedom (IEF 8), investment freedom (IEF 9) and financial freedom (IEF 10). While our main regressions employ the overall or summary EFWI and IEF indices, we also explore proxying the efficiency of the institutional environment using each one of the individual subindices. This exercise allows us to identify the elements of economic freedom that matter the most for the relationship between IPR and FDI. Importantly, notice that the areas or subindices that measure the protection of property rights in both EFWI and the IEF, do not include a measure of IPR protection.

3.1.4 Informal Economy

To test the robustness of our results, we alternatively capture the efficiency of the institutional environment using the data provided by Schneider, Buehn, and Montenegro (2010) on the size of the informal or shadow economy as a percentage of GDP. The informal or shadow economy is defined as all unregistered economic activity that contributes to the officially calculated GDP. The characterization of the informal or shadow economy used by Schneider, Buehn, and Montenegro (2010) fits our institutional argument quite well. Indeed, according to Schneider, Buehn, and Montenegro (2010), some of the reasons for which a company or worker would operate in the informal or shadow economy include "avoiding having to meet certain legal labor market stan-

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dards such as minimum wages, maximum working hours, social security contributions, safety standards, etc., avoiding complying with certain administrative procedures, such as completing statistical questionnaires or other administrative forms, and avoiding payments of taxes." Schneider, Buehn, and Montenegro (2010) 's data includes 162 countries and is available from 1999 to 2007.

3.1.5 Piracy Rates

To further test the robustness of our results, we alternatively capture the efficiency of the institutional environment using piracy rates from the Alliance (2014) report. These data report the yearly percentage of unlicensed PC software installations in most countries from 2003 to 2013, allowing us to proxy the extent of illegal imitation activity within the informal economy.

3.1.6 Control Variables

The control variables we use are standard in empirical FDI studies (see, for example, Bénassy-Quéré, Coupet, and Mayer (2005), Vijayakumar, Perumal, and Rao (2010), and Blonigen and Piger (2011)). We control for GDP per capita (GDPpc), population, openness (imports plus exports divided by GDP), tariffs (weighted average), gross capital formation as share of GDP (GCF), inflation and a dummy for hyperinflation.[7]

The availability of data on IPR protection restricts our analysis to observations every five years. Coincidentally, this frequency matches the frequency of EFWI data up to the year 2000. After consolidating the rest of the data, our period of study is restricted to include observations for 1990, 1995, 2000, 2005 and 2010.

Our first observation is that the institutional environment is fairly stable over time. Indeed, institutions tend to change rather slowly and in marginal increments. Our data reflects this characteristic. The average change in the indices of economic freedom in our samples over the 1990–2010 period was only 1.6 points for the EFWI (0 to 10 scale) and 10.13 points for the IEF (0 to 100 scale). Therefore, we simply use the average EFWI and IEF ratings for each country over the aforementioned period. This approach smooths out potential outlying data and reduces multicolinearity concerns between EFWI or IEF and our measure of IPR protection which does vary from period to period. We take the same approach when alternatively using the size of the informal economy and piracy rates to capture the efficiency of the institutional environment.[8]

Table 1 reports the summary statistics and Table 2 the piecewise correlation matrix. Notice that FDI net inflows are positive but weakly correlated with the IPR protection index. This result is not surprising given the contradictory evidence mentioned in the previous section. Notice as well that the correlation between FDI net inflows and the indices of economic freedom is also positive and slightly stronger. Again, this result is consistent with previous literature.

Table 1: Summary statistics.

	N	Mean	Std Dev	Min	Max
FDI (% GDP)	319	3.61	5.22	−16.09	36.17
EFWI	308	6.87	0.73	5.11	9.18
IEF	319	63.75	7.95	35.35	89.36
IPR	319	3.34	0.96	0.2	4.88
Piracy rates	280	54.61	21.23	20.2	90.57
Informal economy	290	29.39	13.86	8.64	67.4
GDPpc	319	8.6	1.59	4.95	11.28
Population	319	16.65	1.49	12.67	21.01
Openness	319	78.51	54.94	15.16	432.95
Tariffs	319	7.2	8.55	0	112.57
GCF	319	22.59	6.11	1.12	51.88
Inflation	319	16.03	54.96	−4.68	400

Table 2: Correlation matrix.

	FDI	EFWI	IEF	IPR	PR	Inf	GDPpc	Pop	Open	Tariffs	GCF	Inflation
FDI	1											

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EFWI	0.28	1										
IEF	0.34	0.82	1									
IPR	0.26	0.48	0.50	1								
Piracy rates	−0.21	−0.57	−0.62	−0.66	1							
Informal economy	−0.18	−0.49	−0.44	−0.56	0.73	1						
GDPpc	0.23	0.61	0.65	0.73	−0.90	−0.72	1					
Population	−0.20	−0.17	−0.25	0.08	0.15	−0.07	−0.16	1				
Openness	0.57	0.40	0.38	0.13	−0.14	−0.18	0.22	−0.48	1			
Tariffs	−0.18	−0.41	−0.36	−0.46	0.36	0.31	−0.46	0.19	−0.21	1		
GCF	0.10	0.07	0.01	0.01	−0.03	−0.15	0.01	0.10	0.12	−0.10	1	
Inflation	−0.13	−0.19	−0.24	−0.28	0.14	0.15	−0.12	0.08	−0.07	0.11	−0.13	1

Table 2 also shows a strong positive correlation between the indices of economic freedom and GDP per capita. It has been largely shown, indeed, that institutions of economic freedom are a crucial determinant of development. Finally, notice that, as argued above, the size of the informal economy is strongly correlated with piracy rates.

3.2 Methodology

We use the threshold regression methodology developed by Hansen (1999, 2000) to identify thresholds or cut-off points in the distribution of the efficiency of the institutional environment (as measured principally by the indices of economic freedom) at which the relationship between IPR and FDI suffers a structural break.

This methodology uses a sample-splitting framework that allows endogenous identification and testing of changes in the slope when the threshold is not known a priori. The estimated threshold, provided it exists, is then interacted with the variable of interest and tested in a regression. Thus, our threshold regression takes the following form:

$$FDI_{it} = \beta_j X_{jit} + \alpha_1 IPR_{it} I(IE_i > \hat{\lambda}) + \alpha_2 IPR_{it} I(IE_i \leq \hat{\lambda}) + \mu_i + \nu_t + \epsilon_{it} \quad [2]$$

where X_{jit} is the vector of control variables, IE_i is the measure of the efficiency of the institutional environment in country i over the entire period, μ_i and v_t are country and time specific fixed effects, and ϵ_{it} is a well-behaved idiosyncratic error. Importantly, $\hat{\lambda}$ is the threshold or cut-off point in the distribution of the efficiency of the institutional environment measure.

The methodology divides the observations into two regimes depending on whether IE is smaller or larger than $\hat{\lambda}$. Thus, the effect of IPR on FDI will be given by α_1 for countries in the efficient institutional environment regime and by α_2 for countries in the inefficient institutional environment regime.

A grid search is used to determine the value of the threshold that minimizes the sum of squared errors of the model. More formally, we define the residual sum of squares of the model estimated for a threshold level as $S(\hat{\lambda}) = u(\hat{\lambda})' u(\hat{\lambda})$. Then the optimal threshold is given by $\hat{\lambda} = \arg\min S(\hat{\lambda})$. The grid search uses all the values within the 20th and 80th percentiles of the empirical distribution of the measure of the efficiency of the institutional environment to guarantee a minimum number of observations in the sample falling above and below the threshold.

Having identified a potential threshold, it is important to determine whether the threshold effect is statistically significant. To this aim we test the hypothesis of no threshold effects, Ho: $\alpha_1 = \alpha_2$. Given that the threshold value does not present a standard distribution, we follow Hansen (2000) and use a likelihood ratio statistic to test for the null hypothesis. The LR-statistic is defined as $LR_0 = (S_0 - S_1(\hat{\lambda}))/\sigma^2$ with $\sigma^2 = S_1(\hat{\lambda})/n(t-1)$. Where S_0 denotes the residual sum of squares for the model without a threshold and σ^2 is the estimated error variance in the presence of the threshold. The estimated value is compared to the critical values reported in Hansen (1999). The critical value is based on the asymptotic distribution of the LR-statistic which can be written as $\Pr(\zeta \leq x) = (1 - \exp(-x/2))^2$. The inverse of this formula can be used to obtain the critical values based on $c(\alpha) = -2\log(1 - \sqrt{(1-\alpha)})$.

3.3 Results

Table 3 presents our main results. The regressions in this table use the overall EFWI as our proxy of the efficiency of the institutional environment. For an initial comparison, column 1 presents a parsimonious linear regression without threshold effects. In this first specification, IPR is not significantly correlated to FDI. This result is consistent with the contradictory evidence found in the empirical studies mentioned above. We do

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find, however, that three of the control variables show a positive and significant correlation with FDI: GDPpc, GCF and Tariffs. These results are common in the literature. FDI is likely to be correlated with higher income per capita levels, which reflect higher productivity and purchasing power levels in the host country. Several studies have also shown that GCF or domestic investment is complementary to FDI (see, for example, Özkan-Günay (2011)). In the case of Tariffs, the result indicates that, at least for our samples and period of study, FDI can be thought of as a substitute for imports.[9][10]

Table 3: Main regression results – dependent variable FDI net inflows.

	(1)	(2)	(3)
IPR	0.208	−15.924***	
	(0.765)	(5.458)	
IPR * EFWI		2.443***	
		(0.838)	
IPR (EFWI >= $\hat{\lambda}$)			5.895***
			(1.163)
IPR (EFWI < $\hat{\lambda}$)			−0.119
			(0.691)
GDPpc	7.42*	5.953**	5.819**
	(3.764)	(2.852)	(2.716)
Population	3.760	7.305*	4.447
	(3.93)	(3.991)	(3.573)
Openness	−0.003	−0.007	−0.013
	(0.039)	(0.039)	(0.038)
Tariffs	0.049**	0.045**	0.042**
	(0.022)	(0.02)	(0.196)
GCF	0.107*	0.135**	0.126**
	(0.057)	(0.052)	(0.055)
Inflation	0.004	−0.002	0.000
	(0.019)	(0.016)	(0.152)
Hyperinflation	−1.080	−0.286	−1.240
	(7.145)	(6.244)	(5.78)
$\hat{\lambda}$			7.349
LR-statistic			20.52***
Observations	319	307	307

Standard errors in parenthesis
Statistical significance: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.001$
$\hat{\lambda}$ 95% confidence interval: [6.84, 7.84]
All regressions include country and year fixed effects

Column 2 presents the same regression but adding an interaction term between IPR and EFWI. The results here indicate that IPR is negative and significantly correlated to FDI but that such correlation decreases as EFWI increases. That is, IPR has less of a negative effect on FDI (which may even become positive) in countries showing higher levels of EFWI. As an illustration take the average case in the EFWI distribution (an EFWI value of 6.87). In this case, the total effect of IPR on FDI is small but actually positive. A unit increase in IPR generates a 0.843% increase in FDI. For the lowest value in the EFWI distribution (an EFWI value of 5.11), the total effect of IPR on FDI is -3.44%. The results of column 2 align with our hypothesis: IPR is more effective at attracting FDI in countries showing higher levels of EFWI.

We extend this analysis in column 3, by applying the threshold methodology specified in equation 2. The application of this methodology allows us to find a threshold value ($\hat{\lambda}$) of 7.349 in the EFWI distribution (located less than one standard deviation above the mean). At this specific value, the relationship between IPR and FDI suffers a structural break.[11] Our results are consistent with the theoretical intuition developed above. We find that IPR is positive and significantly correlated to FDI for countries above the threshold but not for countries below it. Indeed, for countries presenting relatively high levels of EFWI, a unit increase in IPR is associated with a 5.89% increase in FDI. This effect is sizable as it represents a relative increase of 163% with respect to the average level of FDI in the sample (3.61%).

Table 4 presents alternative regressions to test the robustness of our initial results. Columns 2, 3 and 4 show the results when using the IEF, the size of the informal economy and piracy rates to alternatively capture the efficiency of the institutional environment. We find that a statistically significant threshold in the distribution of these variables exists at 72.54, 18.47% and 37.9%, respectively. Not surprisingly, the results when using the IEF are almost identical to those when using the EFWI. The threshold takes almost the same value relative to the index scale and IPR is positive and significantly correlated to FDI for countries above the threshold but not for

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countries below it. For countries above the threshold, a unit increase in IPR is associated with a 6.19% increase in FDI, which represents a relative increase of 171% with respect to the average level of FDI in the sample.

Table 4: Robustness tests – dependent variable FDI net inflows.

	IEF	**Informal Econ**	**Piracy rates**
IPR (EF $> \hat{\lambda}$)	6.194***	−0.231	0.141
	(1.178)	(0.809)	(0.78)
IPR (EF $> \hat{\lambda}$)	−0.079	4.424***	5.642***
	(0.704)	(1.301)	(1.154)
GDPpc	5.22*	7.843**	9.112**
	(2.739)	(3.63)	(2.821)
Population	2.966	5.015	4.167
	(3.48)	(4.249)	(4.00)
Openness	−0.016	−0.009	−0.012
	(0.037)	(0.043)	(0.04)
Tariffs	0.038*	0.031	0.046**
	(0.02)	(0.057)	(0.018)
GCF	0.134**	0.111*	0.068
	(0.053)	(0.066)	(0.07)
Inflation	0.001	0.002	0.005
	(0.016)	(0.021)	(0.016)
Hyperinflation	−0.997	−2.743	−2.985
	(6.048)	(7.878)	(6.147)
$\hat{\lambda}$	72.54	18.47	37.9
95% Confidence Interval	[65.45, 79.04]	[13.21, 23.73]	[24.84, 50.95]
LR-statistic	18.8***	13.21***	17.38***
Observations	318	290	280

Standard errors in parenthesis
Statistical significance: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.001$
All regressions include country and year fixed effects

We find similar results when using the size of the informal economy and piracy rates. Notice that, when using these variables, countries showing lower informal economy levels and piracy rates are likely to enjoy relatively efficient institutional environments. As expected, we find that, in both cases, IPR is positive and significantly correlated to FDI for countries below the thresholds but not for countries above it. In the case of the informal economy, for countries below the threshold, a unit increase in IPR is associated with a 4.42% increase in FDI. In the case of piracy rates, for countries below the threshold, a unit increase in IPR is associated with a 5.64% increase in FDI.[12]

Table 5 illustrates these results using 5-year average changes in IPR and FDI. Interestingly, in average, countries below the EFWI and IEF thresholds improved their IPR indices to a larger extent than countries above the thresholds during the period of study. However, as the table shows, FDI increased to a much larger extent in countries above those thresholds. The exact symmetric results are found for informal economy and piracy rates.

Table 5: Five-year average changes in FDI and IPR.

		ΔFDI	**ΔIPR**
EFWI	Below $\hat{\lambda}$	0.67%	0.28
	Above $\hat{\lambda}$	3.49%	0.13
IEF	Below $\hat{\lambda}$	1.17%	0.27
	Above $\hat{\lambda}$	2.63%	0.13
Inf Economy	Below $\hat{\lambda}$	2.47%	0.2
	Above $\hat{\lambda}$	1.28%	0.27
Piracy	Below $\hat{\lambda}$	2.33%	0.14
	Above $\hat{\lambda}$	0.93%	0.32

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We turn our attention now to the different component areas or subindices of economic freedom. Table 6 presents the results when using the five different components areas of the EFWI and Table 7 the results when using the ten different component areas of IEF.

Table 6: EFWI component areas – dependent variable EFW 1 through EFW 5.

	EFW 1	EFW 2	EFW 3	EFW 4	EFW 5
IPR (EFWI >= $\hat{\lambda}$)	−0.728	5.78***	2.985*	6.738***	5.528***
	(0.761)	(0.873)	(1.55)	(1.427)	(1.193)
IPR (EFWI < $\hat{\lambda}$	1.587	−0.471	−0.171	−0.202	−0.236
	(1.166)	(0.634)	(0.71)	(0.708)	(0.723)
GDPpc	6.037*	4.4*	6.645**	5.057*	5.389*
	(3.195)	(2.623)	(3.062)	(2.724)	(2.761)
Population	6.256	4.237	5.125	2.776	2.730
	(4.185)	(3.406)	(3.999)	(3.578)	(3.515)
Openness	0.005	−0.003	−0.009	−0.016	−0.011
	(0.039)	(0.037)	(0.039)	(0.039)	(0.039)
Tariffs	0.045**	0.035*	0.044**	0.04**	0.042**
	(0.021)	(0.02)	(0.019)	(0.019)	(0.019)
GCF	0.123**	0.176***	0.123**	0.117**	0.116**
	(0.052)	(0.05)	(0.056)	(0.053)	(0.051)
Inflation	0.000	0.000	0.003	0.001	0.001
	(0.017)	(0.014)	(0.017)	(0.015)	(0.016)
Hyperinflation	−0.003	−1.739	−2.082	−1.003	−0.942
	(6.24)	(5.436)	(6.547)	(5.745)	(5.917)
$\hat{\lambda}$	5.486	7.787	8.868	8.369	7.387
95% Confidence Interval	[4.04, 6.93]	[7.1, 8.09]	[7.54, 10.19]	[7.39, 9.34]	[6.53, 8.22]
LR-statistic	7.77**	31.91***	7.84**	21.18***	14.54***
Observations	307	307	307	307	307

Standard errors in parenthesis
Statistical significance: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.001$
All regressions include country and year fixed effects

In the case of the EFWI areas, we find statistically significant thresholds in all five regressions. We also find that IPR and FDI are positive and significantly correlated for countries above the thresholds but not for countries below them. The notable exception is EFW 1 (size of government) for which the coefficients in both regimes are not significant. This last result suggests that the size of government (a variable construed using information on the extent of government consumption, transfers and subsidies, government enterprises and investment, and the top marginal tax rate) has no significant effect on the relationship between IPR and FDI. The presence of large or small governments are equally unlikely to affect the correlation between IPR and FDI. One could speculate the presence of two contradicting effects. On the one hand, large governments may hinder or restrict FDI through burdensome taxation and crowding out effects. On the other hand, large governments may allocate a bigger budget for infrastructure, which encourages FDI. The EFWI area that seems to have the largest impact (the largest coefficient) is EFWI 4 (freedom to trade internationally). In countries showing EFWI 4 values above 8.36, a unit increase in IPR is associated with a 6.73% increase in FDI (a 186% increase for the average FDI level).

Table 7 shows the results for IEF areas. The results are very similar. We find statistically significant thresholds in all areas except for IEF 3 (fiscal freedom) which is the equivalent to EFWI 1. Interestingly, in this case the area that seems to matter the most for the relationship between IPR and FDI (has the largest coefficient) is IEF 9 (investment freedom). In average, for countries above this variable's threshold (72.18 points) an increase in IPR by one unit is associated with a 6.61% increase in FDI net inflows (which represents a 183% increase for the average FDI level).[13] This results is not surprising when one considers that area IEF 9 is construed as a comprehensive index of freedom from investment restrictions that include: no national treatment or prescreening, transparency and no burdensome bureaucracy, no restriction on real estate purchases, no economic sectors restricted for investment, no expropriations, no restrictions or controls on foreign exchange, no restrictions on repatriation of profits, no security problems and presence of basic investment infrastructure.

Table 7: IEF component areas – dependent variable IEF 1 through IEF 10.

	IEF 1	IEF 2	IEF 3	IEF 4	IEF 5	IEF 6	IEF 7	IEF 8	IEF 9	IEF 10
IPR GP (EFWI >= $\hat{\lambda}$)	5.699***	6.486***	−0.688	−1.100	4.715***	3.689**	6.284***	4.56***	6.613***	5.226***

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	(0.897)	(1.199)	(0.744)	(0.784)	(1.383)	(1.338)	(1.189)	(1.62)	(1.272)	(1.5)
IPR GP (EFWI $< \hat{\lambda}$)	−0.239	0.007	1.136	1.541	−0.106	−0.274	0.045	0.033	−0.046	−0.197
	(0.633)	(0.695)	(1.001)	(1.076)	(0.722)	(0.691)	(0.693)	(0.725)	(0.709)	(0.719)
GDPpc	4.199	5.781**	7.194**	7.031**	5.772**	6.759**	5.9**	5.443**	5.318**	5.839**
	(2.749)	(2.679)	(3.479)	(3.283)	(2.83)	(2.905)	(2.703)	(2.815)	(2.685)	(2.782)
Population	4.791	4.568	6.921	8.434*	3.461	6.282	4.897	4.064	3.701	4.683
	(3.368)	(3.519)	(4.868)	(4.794)	(3.467)	(4.038)	(3.544)	(3.588)	(3.483)	(3.731)
Openness	−0.006	−0.020	0.001	0.000	−0.011	−0.007	−0.019	−0.014	−0.019	−0.018
	(0.036)	(0.037)	(0.038)	(0.038)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Tariffs	0.031	0.04*	0.042*	0.034	0.039*	0.05**	0.04*	0.04**	0.039*	0.043**
	(0.022)	(0.021)	(0.021)	(0.023)	(0.021)	(0.02)	(0.021)	(0.02)	(0.02)	(0.021)
GCF	0.197***	0.141**	0.107**	0.121**	0.157**	0.097**	0.148**	0.132**	0.144**	0.135**
	(0.053)	(0.057)	(0.049)	(0.047)	(0.055)	(0.042)	(0.058)	(0.053)	(0.055)	(0.055)
Inflation	0.002	0.002	0.005	0.021	0.005	0.002	0.003	0.003	0.003	0.001
	(0.015)	(0.016)	(0.02)	(0.027)	(0.017)	(0.019)	(0.016)	(0.017)	(0.016)	(0.016)
Hyperinflation	−2.230	−1.640	−1.463	−5.886	−2.128	−1.815	−2.057	−0.572	−1.705	−1.230
	(5.668)	(5.983)	(7.275)	(9.663)	(6.392)	(7.578)	(6.077)	(6.42)	(6.082)	(6.308)
$\hat{\lambda}$	74.33	73.56	70.15	69.04	80.68	74.36	82.98	80.8	72.18	71.87
95% Confidence	[61.37,	[62.04,	[54.66,	[38.81,	[69.33,	[58.13,	[79.91,	[71.81,	[63.99,	[51.54,
Interval	87.29]	85.08]	83.63]	102.31]	92.03]	90.6]	86.92]	89.97]	80.38]	92.2]
LR-statistic	29.34***	24.32***	5.17	8.4**	13.99***	13.15***	22.35***	11.8***	21.73***	17.72***
Observations	318	318	318	318	318	317	318	318	318	318

Standard errors in parenthesis
Statistical significance: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.001$
All regressions include country and year fixed effects

4 Conclusion

The relationship between IPR protection and FDI continues to pose a challenging puzzle at both the academic and public policy forefronts. We contribute to this discussion from an institutional economics perspective. We argue that the effect of IPR protection on FDI is largely determined by the pool of domestic resources available to MNCs in the host country, which is determined, in turn, by the efficiency of the institutional environment.

The argument is as follows. Carrying productive activities in the formal economy can be very costly when the institutional environment is inefficient (i.e. characterized by high levels of bureaucracy, corruption, price controls, etc.). In this case, domestic firms and workers have incentives to shift their activities to the informal economy. Given that MNCs operate in the formal economy, this effect reduces the pool of domestic resources available to them and, therefore, discourages FDI. This result is reinforced when one considers that, in most countries characterized by inefficient institutional environments and large informal economies, an important informal activity consists precisely on illegal imitation.

In this framework, the role of IPR protection is to reduce illegal domestic imitation activity by implicitly increasing the cost of production of illegal copiers. In countries in which the institutional environment is otherwise relatively efficient, increases in IPR protection are, indeed, likely to encourage a large number of illegal copiers to abandon their informal imitation activities and return to the formal economy. As a result, MNCs not only benefit from an increase in the pool of domestic resources available to them in the formal economy, but also from a reduction in the illegal competition they face. Consequently, FDI is strongly encouraged. The same is not necessarily true, however, in countries in which the institutional environment is relatively inefficient.

Empirically, we proxy and measure the efficiency of the institutional environment using indices of economic freedom. Using threshold regression techniques, we find a significant threshold or cut-off point at a level of 7.349 in the EFWI distribution at which the relationship between IPR protection and FDI suffers a structural break. Consistent with the argument above, we find that IPR and FDI are significant and positively correlated for countries above that threshold but not for countries below it. In countries above the threshold, a unit increase in IPR protection is associated with a 5.89% increase in FDI. To test the robustness of our main results, we alternatively use the IEF, the size of the informal economy and piracy rates as proxies of the efficiency of the institutional environment. In all cases we find similar results to the ones mentioned above.

We also explore proxying the efficiency of the institutional environment using each one of the component areas of the EFWI and the IEF. In most cases, the results are very similar to the ones found when using the overall indices. An interesting exception is the case of the size of government (captured by EFWI 1 and IEF 3). In this case, the results indicate that the aggregate effect of individual components such as government

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consumption, government enterprises and investment, and the level of taxation, does not significantly affect the relationship between IPR and FDI.

We also find that IEF 9, investment freedom, is the area that matters the most in terms of the relationship between IPR and FDI. In average, for countries above this variable's threshold (72.18 points) an increase in IPR by one unit is associated with a 6.61% increase in FDI net inflows (which represents a 183% increase for the average FDI level).

Notes

[1]It has been well documented that countries characterized by inefficient institutional environments are also characterized by large informal or shadow economies (see, for example, Schneider, Buehn, and Montenegro 2010).

[2]As we will see below, the correlation between the size of the informal economy and piracy rates in our samples is approximately 73%. This type of correlation is fairly common. Various surveys have shown that illegal imitation activity is larger in developing countries where the institutional environment tends to be inefficient and the informal economy large. Olsen (2005), for example, reports that illegal copies of pharmaceuticals, motion pictures, records, business and entertainment software in developing countries represented 60%, 56%, 63%, 64%, and 73% of the respective total number of copies sold in these countries during the early 2000s (the period covered by our empirical section).

[3]In a related paper, Falvey, Foster, and Greenaway (2006) use threshold regression analysis to study the effects of IPR protection on economic growth.

[4]This framework is based on the model of copyright protection developed by Landes and Posner (2003) .

[5]The model of competitive selection was first proposed by Jovanovic (1982) .

[6]The derivation of profits for MNCs and the analysis of changes in those profits as IPR protection increases is presented in Appendix A.

[7]GDPpc is used in logarithms and measured in constant 2005 dollars (source: WDI), population is used in logarithms (source: The World Bank), openness is taken from The World Bank, and tariffs, GFC and inlfation are taken from the WDI. Hyperinflation identifies periods with inflation rates above 400% per year.

[8]Most empirical studies on institutions recognize this feature and use long time horizons to capture significant changes in this variable. To cite one example, on a study relating democracy and institutions of economic freedom, De Haan and Sturm (2003), capture changes in the EFWI over two decades.

[9]The complementarity or substitutability of FDI and imports has been largely discussed in the literature of international trade. See, for example, Brainard (1993) and Helpman, Melitz, and Yeaple (2004) .

[10]Notice that, because we use the average EFWI over the relevant period, we cannot include this variable in the right-hand side of the equation as it is collinear with country fixed effects. While we also estimated the model using random fixed effects (results available upon request), such model specification was rejected by the Hausman test.

[11]The threshold value found is strongly significant and splits the sample into two groups. Approximately, 25% of the countries lie above the threshold and 75% of the countries lie below it. The upper regime includes mostly developed countries such as the U.S., the U.K., Switzerland and Germany, and the lower regime includes mostly developing countries such as Algeria, Bolivia, Egypt and Nigeria.

[12]Given that we use the average piracy rate for the entire period, by construction, there is no within country correlation between this variable and IPR. While these variables do show a −66% cross-section correlation (which may be overestimating the standard errors in the model) such correlation does not invalidate our results.

[13]The threshold value for IEF 9 is located 0.85 standard deviations below the mean for that variable.

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Appendix: Profits for MNCs

Profits for a representative MNC, i, are given by:

$$\Pi_i = [p - c_i(z)][q(p) - y(p,z)]$$

where p is the price of a copy (original or quality-adjusted imitation), y the aggregate supply of illegal imitation copies, and $q(p)$ the total market demand for copies.[14]

The price level that maximizes profits for the MNC solves:

$$[q(p) - y(p,z)] + [p - c_i(z)]\left(\frac{dq}{dp} - \frac{dy}{dp}\right) = 0$$

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which can be re-written as:

$$p\left[1 - \frac{G}{|\epsilon^d| + \epsilon^s(1-G)}\right] = c(z)$$

where G is the fraction of original copies out of total copies produced and ϵ^d and ϵ^s are the elasticities of demand and illegal copiers' supply, respectively.[15]

The change in Π_i as IPR protection increases is:

$$\frac{d\Pi_i}{dz} = \left[\frac{dp}{dz} - \frac{dc}{dz}\right][q(p) - y(p,z)] + [p - c(z)]\left[\frac{dq}{dp}\frac{dp}{dz} - \left(\frac{dy}{dp}\frac{dp}{dz} + \frac{dy}{dz}\right)\right]$$

Assuming the first-order profit maximizing condition:

$$\frac{d\Pi_i}{dz} = -\left[p - c(z)\right]\frac{dy}{dz} - \frac{dc}{dz}\left[q(p) - y(p,z)\right] > 0$$

Thus, the size of $d\Pi_i/dz$ is determined by the absolute values of dy/dz and dc/dz. In countries with relatively efficient institutional environments, these two expressions are bigger than in countries with relatively inefficient institutional environments.

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