The role of Intellectual Property Rights in the relation between Foreign Direct Investment and Growth*

Mila Kashcheeva†
Clemson University

November, 2011

Abstract

The existing theoretical literature predicts that the welfare implications of intellectual property rights (IPR) reform are ambiguous, and depend on the extent of foreign direct investment (FDI) in the IPR-reforming country. However, both firm- and industry-level analyses find that stricter IPR laws increase industrial development, especially among multinational firms in technology-intensive industries. In this paper I examine whether the impact of tighter IPR on GDP and TFP growth is different for countries with different levels of FDI, because general equilibrium considerations might offset or even reverse the partial equilibrium effects found by the micro literature. Using dynamic panel data techniques and a sample of 103 countries over 1970-2009, I find that although FDI and IPR have positive effects on economic growth, stronger IPR mitigates the growth effect of FDI. Moreover, at the highest observed levels of FDI, it appears that more lax IPR increases the growth rate. The mitigating effect of IPR on growth effect of FDI works through capital accumulation as well as improvements in TFP.

JEL Classification: O34, O43, O47, F21, F43

Keywords: Intellectual Property Rights, Foreign Direct Investment, Economic Growth

* I would like to express my gratitude to Ralph Heinrich at the United Nations Economic Commission for Europe (UNECE) and thank him in abundance for his helpful comments. I would also like to thank Walter Park at American University for data support and comments, and extend my sincere thanks to Kevin Tsui, Michael Maloney, Michal Jerzmanowski, Scott Baier, William Dougan, and all the participants of the public workshop and the international/macro workshop at Clemson University for their valuable suggestions. I also received helpful comments from the participants of the 6th Annual European Policy for Intellectual Property (EPIP) Conference in Brussels (September, 2011) and the Southern Economic Association (SEA) Conference in Washington, DC (November, 2011).

† John E. Walker Department of Economics, Clemson University, 222 Sirrine Hall, Clemson, SC 29634, USA. E-mail: kashcheeva.mila@gmail.com. Web page: http://people.clemson.edu/~lkashch

1 Introduction

This empirical study is motivated by the long-standing policy debate about the role of intellectual property rights (IPR) protection in economic development. An extensive body of theoretical literature has emerged to tackle this question, but the predictions that follow from this literature are ambiguous. The recent endogenous growth models by Helpman (1993) and Lai (1998), among others, argue that the extent of foreign direct investment (FDI) attracted by an economy under a certain set of conditions determines the economic impact of IPR reform.

In this paper I measure the general equilibrium effect of IPR policy on country growth, using a composite index of IPR protection (i.e., the Ginarte and Park (2008) index) and a sample of 103 countries (developed as well as developing) over the period of 1970-2009. As shown by Ginarte and Park (1997), IPR affects growth indirectly by stimulating the accumulation of physical and intellectual (research) capital. Building on their result, I further explore the total factor productivity (TFP) channel through which IPR might affect growth. However, Ginarte and Park (1997) do not investigate whether welfare implications of IPR reform are different for countries with different levels of FDI. Guided by the theory that stresses the importance of FDI in measuring the total welfare effect of stronger IPR, my empirical growth model includes FDI inflows. To account for the heterogeneous effect of IPR reform on realized growth due to different levels of FDI, I interact IPR with FDI. Estimation is performed with the Arellano-Bond Dynamic Panel GMM estimator (Arellano, 1991) to control for possible endogeneity of FDI and IPR.

The current paper complements the empirical findings by Branstetter et al (2006, 2007, and 2010) and by Hu and Png (2010). These papers argue that stronger IPR protection stimulates industrial development. Branstetter et al. (2006, 2007, and 2010) use confidential firm-level data for US multinational enterprises (MNEs) and analyze 16 distinct episodes of shifts in IPR regimes to find that, as a result of IPR reform, production by MNEs increases, industry-level value added increases and the production of new goods shifts toward the reforming countries. Hu and Png (2010) use a composite index of IPR protection (i.e., the Ginarte and Park (2008) index) and a sample of 72 countries to show that more patent-intensive industries grow faster than less-patent intensive industries in countries with stronger patent rights.

While these and other firm- and industry-level studies are important for revealing the channels through which stronger IPR protection influences production, micro-level studies do

not account for general equilibrium considerations, which might offset or even reverse the partial equilibrium effects (Acemoglu, 2010). In particular, the movement of capital between industries as a result of IPR reform is not accounted for in the firm- and industry-level studies discussed above. Also, for a fair policy-maker the interest likely lies in promoting growth for the economy as a whole, but not to the benefit of certain industries. Thus, guided by the theoretical literature on the welfare implications of IPR protection and with respect to the gaps in the existing empirical literature, I measure the general equilibrium effect of stronger IPR protection for countries with differing levels of FDI.

Empirical evidence shows that a 10 percentage point increase in a country's ratio of FDI to GDP leads to an approximately 3 percentage point increase in growth and that a one standard deviation increase in IPR is associated with a 1 percentage point increase in growth. However, FDI and IPR have offsetting impacts on growth and at the highest levels of FDI, it appears that more lax IPR can in fact increase the growth rate. The mitigating impact of IPR on the growth effect of FDI is revealed in both GDP and TFP growth regressions, which means that the effect works through factor accumulation as well as through the improvements in TFP.

My findings are consistent with the theory in terms of punctuating the importance of the level of FDI in determining the general equilibrium effect of IPR reform. However, it might first appear that my results contradict the prediction of the theory that the larger is the FDI channel of international technology diffusion, the more likely it is that stronger IPR laws increase production in the IPR-reforming country. While the models by Helpman (1993) and Lai (1998) predict that stronger IPR laws encourage FDI, there can be other exogenous factors that attract additional FDI, and these factors are not considered by these models. At the same time, the theory predicts that stronger IPR protection increases the cost of acquiring knowledge from all attracted FDI. Hence, if a country is able to attract a significant amount of FDI without appealing to the IPR policy tool, by relaxing the IPR protection the total production in that country might be increased. This result does not contradict the main theory and is supported by the empirical findings of this paper.

Section 2 reviews the most relevant literature on FDI, IPR and economic growth. Section 3 discusses data sources and their limitations. The empirical analysis is carried out in Section 4. Robustness checks are executed in Section 5. Section 6 concludes the discussion.

2 Why might stronger IPR hurt growth?

The role of IPR policy in economic development is the focus of many theoretical studies.[3] Nordhaus (1969) and Scherer (1972) are among the earliest theoretical contributions on the economic impact of IPR policy. A strengthened patent system stimulates incentives for firms to innovate (i.e., a positive dynamic effect), but also increases the cost of acquiring knowledge and that of technology diffusion into the public domain (i.e., a negative static effect). The tradeoff between these opposing effects from strengthening IPR protection, as this theory argues, should be the rationale for an optimal IPR policy. However, this theory assumes a closed economy.

More recent general equilibrium models by Helpman (1993) contribute to the long-standing debate on optimal IPR policy and aim to capture the non-monotonicity of the IPR effect on growth in a North-South framework (assuming that innovation occurs predominantly in the North, while imitation is prevalent in the South). The study finds that tighter IPR is never in the interest of the South and can even hurt both regions under certain policy conditions. When the rate of imitation in the South is high to begin with, conflict between the South and the North arises over the desired level of IPR protection. However, in Helpman (1993) overall welfare implications of tighter IPR protection for the North and the South might change if FDI is made endogenous in the models (i.e., the incentives of foreign firms to activate the FDI channels for technology transfer and incentives to innovate may respond to changes in IPR protection).[4] Thus, the paper calls for more elaborate analysis of the total welfare effects of IPR reform, where the impact of IPR protection on FDI is accounted for.

Indeed, Lai (1998) finds that the channel of technology transfer (i.e., FDI versus imitation) determines the overall welfare effect of a tighter IPR regime for the South. So, the growth models, where FDI does not respond endogenously to shifts in IPR policy (i.e., only the imitation channel of production transfer is considered), may render misleading conclusions. Lai (1998) finds that stronger IPR in the South may benefit the South if the FDI channel of international

[3] The theoretical works on IPR and economic growth are part of the endogenous growth theory, which unites under the category a vast number of studies which stress the role of policy measures in explaining long-run country growth.

[4] While the theory posits that stronger IPR encourages FDI, empirical studies that analyze the impact of IPR on the volume of FDI do not find a robust relationship. Later studies (Javorcik, 2004, Nunnenkamp and Spatz, 2003, among others) suggest that the composition of FDI sectors, the types of FDI projects (i.e., distribution versus manufacturing), and (anecdotally) the type of FDI technology (new versus old) change when the IPR regime varies. In general, these changes rather are attributable to the quality shift in FDI inflow - not necessarily the quantity shift - as technological intensity and/or human capital intensity of FDI varies.

production transfer is sufficiently large compared to the imitation channel.[5] But later, Lai (2008) analyzes the global IPR system and finds that the South is likely to be disadvantaged by efficient harmonization of IPR laws, while the gains of the North outweigh the losses of the South, resulting in an increase in global welfare.

Branstetter, Fisman, Foley and Saggi (2007) also make FDI endogenous to IPR in their model, and further extend Lai (1998) by treating imitation as a costly activity. In their model stronger IPR increases the cost of imitation, which leads to reallocation of capital between imitation and other economic activities. Under reasonable parameterization, the increase in investments by multinational firms in the South offsets the decrease in Southern imitation, so overall production in the South increases. The North should also benefit in the long run because production shifting to the South frees up Northern resources for investment in innovation; however, Branstetter et al. (2007) do not estimate this long-run general equilibrium effect.

It appears that current theoretical models give ambiguous predictions about the welfare effects of IPR reform. But in fact, the common conclusion from the theory is that the total impact of IPR reform on production growth likely depends on the extent of FDI in the IPR-reforming economy. While the empirical evidence from firm- and industry-level studies suggest that tighter IPR protection stimulates industrial development, especially among multinational enterprises in technology intensive industries, it is not clear from these studies what the general equilibrium effect of IPR reform is. Also, there is no evidence from cross-country studies about the impact of the level of attracted FDI on the total welfare effect of stronger IPR.

By estimating a general equilibrium effect of IPR reform in countries with different levels of FDI, the current paper contributes empirically to the policy debate on the economic benefits of tighter IPR protection. In addition, this paper contributes to the literature on FDI knowledge spillovers, which finds surprisingly little robust evidence of the beneficial effect of FDI on economic growth of the recipient economy on both macro[6] and micro[7] levels. It might be that the

[5] The finding that with a sufficiently high rate of imitation the South might be disadvantaged by IPR reform is similar to that of Helpman (1993) despite FDI being exogenous in the model by Helpman (1993).

[6] There is some evidence of a positive effect of FDI when host economies are sufficiently developed to interact with foreign firms. Borenzstein et al. (1998) find that only the countries with a minimum threshold of human capital can benefit from FDI spillovers. Similarly, Blomstrom (1994) suggests that only high-income developing countries, but not low-income ones, enjoy growth benefits from FDI. Also, the ability of the recipient economies to take advantage of potential FDI spillovers depends on the level of development of financial markets (Alfaro, et al., 2004) and trade policy (Balasubramanyam, 1996) of a recipient economy. However, Carcovic and Levin (2002) question the validity of cross-section findings of the four above mentioned papers by pointing to the methodological problems peculiar to

inconclusive results in the FDI knowledge diffusion literature can (at least partly) be explained by the differences in the IPR regimes among the countries.

3 Data

This section describes the data used in the empirical analysis, specifically the measures of FDI, IPR protection, GDP and TFP growth rates. For the complete list of variables, their definitions and the sources of data, as well as more detailed discussion of certain covariates, see the Appendix.

The source of FDI data is United Nations Conference on Trade and Development's *UNCTADstat* data dissemination platform[8], which reports annual inward and outward FDI flows for the period of 1970-2009 and FDI stocks for the period of 1980-2009. Since this study analyzes the impact of IPR policy on an FDI-recipient economy, *inward* FDI are chosen for estimation[9], and 1970 is the starting year in the final panel. To account for the size of the domestic market and to follow the growth literature, FDI is included in the regressions as a share of GDP.

The literature widely uses the Ginarte and Park (1997) index of patent rights (GP) to study various economic effects of IPR protection.[10] The updated GP index covers 122 countries over the period 1960-2005 (Park, 2008). The index relates to patent rights only and not to overall IPR. It ranges from 0 to 5 and is the unweighted sum of five separate components: coverage (inventions that are patentable); membership in international treaties[11]; duration of protection; enforcement mechanisms; and restrictions (for example, compulsory licensing in the event that that a patented invention is not sufficiently exploited).

---

cross-section analysis. They do not find that the exogenous component of FDI exerts a robust, independent influence on growth.

[7] The empirical evidence from industry- and firm-level studies on the economic effects of FDI is also mixed. Results are not robust to changes in methodology, countries and samples. Cross-sectional studies tend to find a positive effect of FDI on productivity, especially if industry rather than firm data are used. When panel techniques are applied the estimated spillover effect is either negative or undetermined. For further discussion, see Navaretti and Venables (chapter 7, 2004).

[8] The new data dissemination platform was launched in 2010 and is aimed to harmonize and integrate all UNCTAD's statistical databases. *UNCTADstat* platform is chosen as a major source of data to minimize possible discrepancies in the data coming from separate sources.

[9] For the discussion of FDI data, see Section III of the Appendix.

[10] See for example Nunnenkamp and Spatz (2003), Hu and Png (2010), among many other studies.

[11] The GP index reflects the membership in Paris convention and revisions, Patent cooperation treaty (PCT), Protection of new varieties (UPOV), Budapest treaty (microorganism deposits), and Trade-related Intellectual property rights (TRIPS).

For the purpose of econometric analysis the GP index is the best available option.[12] The index covers a large sample of countries over a long time period, so not only cross-country, but also within-country variation in IPR protection can be analyzed with the use of panel techniques. Also, the availability of five components of the GP index[13] makes it possible to study the independent influence and relative importance of separate aspects of a given IPR regime. Given that the GP index is available at 5-year intervals for 122 countries over the period of 1960-2005, the sample of countries for the analysis is initially restricted by the availability of the GP index.

Most other variables used in the analysis are available annually, so the choice between extrapolating the GP index versus averaging other variables has to be made. After a country amends its IPR laws (which is necessarily reflected in the 5-year GP score of a reforming country), it will certainly take some time to enforce these laws. So, extrapolating can potentially be a good idea if an enforcement function behaves monotonically between two consecutive periods. However, it is uncertain exactly how enforcement of IPR laws associates with the *de jure* laws, and this relation cannot be accurately measured. Also, because FDI inflows may fluctuate on a yearly basis, by averaging annual FDI over 5-year period a major trend in FDI can be traced. Thus, I decide to average FDI inflows and other explanatory variables, and work with the 5-year-lagged sample of observations.

Other covariates include Government Consumption, Schooling, Inflation, Openness, and Institutions.[14] I use GDP in current prices and current exchange rates to normalize Openness (i.e., imports plus exports), Government Consumption, FDI and Domestic Investment, because these variables are available from *UNCTADstat* in current prices and current exchange rates. I first divide a given annual statistic by the same year GDP to get a ratio, so the relative importance of a certain covariate in overall economic activity of a country in a given year is measured. Then, I calculate 5-year average values of the resulting annual ratios to smooth out yearly fluctuations. If one or more of per annum observations are missing in a 5-year block of observations, the average is calculated for the available years. So, the value for a 5-year interval is missing in the final sample only if observations for every year in a 5-year block are missing.

The measures of IPR, Schooling and log of Initial GDP capture the initial values for every 5-year interval. To calculate the log of Initial GDP I use the measure of GDP per capita, PPP

[12] For the discussion of other available IPR indexes, see Section III of the Appendix.
[13] Thank you to Walter Park for providing the data on the components of the GP index.
[14] Please see Section III of the Appendix for the discussion of all the covariates.

adjusted, to account for the differences in countries' development in every given period, so that the concept of convergence is captured by the panel regressions.

Growth is measured by the change in the real GDP per capita. Three alternative measures of the GDP growth rates are used. The growth rate of GDP per capita measured in 1990 prices is from *UNCTADstat* and the other two growth rates, measured in 2005 prices by two different methods (chain and Laspeyres), are from Penn World Tables (PWT) (Heston & Summers, 2009).

In order to unmask the role of total factor productivity (TFP) improvements versus capital accumulation in a country's growth, the TFP growth rate is used as an alternative dependent variable with the same set of explanatory variables. The source of TFP data is Bosworth and Collins (2003). The original TFP dataset includes 84 countries over the period of 1960-2000. TFP is the residual, A, in the assumed production function of the form: $Y = AK^{a}(HL)^{1-a}$, where $a = 0.35$, K is the capital stock, H is the education measure, used to adjust the workforce, L, for the quality change.[15]

4 Empirical analysis

Table 1 presents the descriptive statistics for the variables used in the analysis. The final panel where the GDP growth rate is used as a dependent variable includes 103 countries (1 to 8 observations per country) and the final TFP panel covers 79 countries (1 to 7 observations per country).[16] Table 1 shows that the 5-year average GDP growth rate ranges from negative 13% for Sierra Leone in 1995-1999[17] to positive 11% for China in 2005-2009. There is also considerable variation in the 5-year average values of FDI as a share of GDP.[18] For Gabon in 1995-99 FDI is negative 5% and for Congo in 2005-2009 FDI is positive 26%. The TFP growth rate ranges from negative 8% for Zimbabwe in 2000-2004 to positive 14% for Sierra Leone in 2000-2004.[19]

[15] The capital stock, K is derived from a perpetual inventory model with a 0.05 rate of annual depreciation: $K_t = 0.95 * K_{t-1} + I_t$. The education measure, H is an average of the estimates from Barro-Lee (2000) and Cohen-Soto (2001), and it incorporates a 7 percent rate of return to each year of education (see Bosworth and Collins, 2003 for further details).

[16] Luxembourg was dropped from both final samples due to the specificity of its FDI data (Luxembourg is a tax haven and Europe's major financial center over the last several decades).

[17] Negative growth rate is the reflection of 11-year civil war in Sierra Leone which began in 1991 when the Revolutionary United Front (RUF) intervened with an attempt to overthrow the Momoh government.

[18] Since FDI is measured on a net basis (i.e., capital transactions' credits less debits between direct investors and their foreign affiliates), the FDI/GDP ratio is negative when FDI is negative due to equity capital, reinvested earnings or intra-company loans transactions being net negative.

[19] In 2002 the civil war in Sierra Leone was officially over.

For the detailed properties of the distributions for the two variables of major interest, FDI and IPR, see Table 13 of the Appendix. Also, Figures 1 and 2 show the dynamics in the world IPR protection. After the ratification of TRIPS agreement in 1994 when the developing nations speed up the process of strengthening their IPR regimes, the growth of the mean value of the GP index accelerates while the variance declines. Table 14 of the Appendix shows the GP index for the relevant countries.

The purpose of the empirical analysis is to estimate the growth effect of IPR, specifically to examine the role of FDI in determining the overall growth effect of IPR reform. Panel estimation makes it possible to control for time-invariant unobserved country specific effects, therefore eliminating a potential source of omitted variable bias peculiar to cross-country growth regressions.

4.1. GDP growth, FDI and IPR

The base model (1) examines the joint effect of the IPR regime and FDI inflows on growth. FDI is interacted with the measure of IPR protection and is used as a regressor. To ensure that the interaction term does not proxy for FDI or IPR, both of the latter variables are also included in the regression independently. Thus, the following specification is estimated:

(1) $Growth_{i,t} = \beta_0 + \beta_1 FDI_{i,t} + \beta_2 IPR_{i,t} + \beta_3 \left(FDI_{i,t} * IPR_{i,t}\right) + \beta_4 Controls_{i,t} + \varepsilon_{it}.$

where i represents each country and t represents each 5-year time period, $t = 1, 2 \ldots T$; $Growth_{i,t}$ is the 5-year average per annum growth rate of real GDP per capita for a country i in a period t; $GDP_{i,t}$ is a logarithm of the initial real GDP per capita, PPP adjusted, for country i in a period t; $FDI_{i,t}$ is the 5-year average net FDI inflows as a share of GDP in the period t; $Controls_{i,t}$ include human capital measured as a percentage of secondary school enrollment in total population, government consumption as a share of GDP, market distortions, as proxied by the Fraser Institute's Index of Legal Structure and Security of Property Rights, inflation, and the openness of a country, measured as a share of imports plus exports in GDP in period t. The error term, ε_{it}, is a composite of unobserved country- and time-specific heterogeneity, and an idiosyncratic component, $u_{i,t}$, such that $\varepsilon_{it} = \alpha_i + \eta_t + u_{i,t}$. In order to hedge against the

interacted model (1) spuriously capturing country-varying slopes, the country-specific means are subtracted from FDI and IPR in the interaction term (Ozer-Balli and Sorensen, 2010).

Table 2 presents the results of the model (1). As a preliminary exercise, I estimate the equation without the interaction term, so the direct growth effects of FDI and IPR are measured. In column (1), equation (1) is estimated without the interaction term and without fixed effects. In column (2) the same specification includes fixed effects, so unobserved heterogeneity between the countries as well as the existent time trends of explanatory variables are controlled for.

The coefficient of IPR is positive, significant, and robust to the inclusion of fixed effects or FDI.[20] Given that the model controls for the overall quality of institutions, these preliminary results suggest that IPR protection is an independent source of growth.[21] Also, in contrast to a number of cross-country growth studies which do not find an independent growth effect of FDI (Carkovic and Levine, 2002 among others), the preliminary results of Table 2 show that FDI positively relates to GDP growth. The magnitude and significance of the FDI coefficient do not depend on the inclusion of fixed effects or IPR in the model. I explain the significance of FDI in growth regressions of Table 2 by the new source of FDI data, bigger sample of countries and longer time period. Possible endogeneity of FDI, IPR and other variables as well as the robustness of this preliminary result are addressed shortly.

Other specifications in Table 2 estimate the full model with the interaction of FDI and IPR included, because based on the discussed theoretical literature, the extent of attracted FDI likely influences the final outcome of IPR reform on a country's production. The OLS specifications in columns (3) and (4) of Table 2 with the interaction of FDI and IPR included capture the nonmonotonic impact of IPR reform and the joint impact of IPR and attracted FDI on the domestic economy is estimated.

The primary interest lies in the sign of β_3. If β_3 is positive and significant, then a stronger IPR regime augments the positive growth effect of FDI (i.e., an increase in foreign activity outweighs a decrease in imitative activity). If β_3 is negatively significant, stronger IPR

[20] The significance and the magnitude of the estimated coefficient on FDI (IPR) do not depend on the inclusion of IPR (FDI) into the regression, or the inclusion of fixed effects.

[21] Also, in Table 8 of the Appendix I include all five components of the GP index in the regression independently. Only Membership component stays significant, suggesting that it likely drives the results of Table 2. Indeed, Membership in international IP treaties sets the minimum standards on duration of protection, industries covered by the IPR laws and other important aspects of the IPR regime. While the Membership component seems to convey the major part of information contained in the GP index, the other four components are essential to reflect additional variation in countries' IPR regimes.

protection mitigates the growth effect of attracted FDI (i.e., a decrease in imitative activity outweighs an increase in foreign activity). Columns (3) and (4) of Table 2 report the OLS estimates for equation (1). The estimated coefficient on the interaction term, β_3, is negative and significant in both OLS specifications, suggesting that while separately FDI and IPR positively relate to GDP growth, they also have offsetting growth effects.

The signs and the magnitude of other coefficients are consistent with the growth literature. In particular, countries with relatively low levels of initial GDP per capita grow faster, suggesting convergence of living standards across the world. Property rights' protection is essential for growth, which is also higher if an economy actively participates in international trade. However, big government is detrimental to growth, as well as high inflation. Also, human capital promotes growth, which is shown in columns (1) and (3). When fixed effects are included in columns (2) and (4), they pick up the impact of Schooling and it becomes insignificant, pointing at a slow pace of human capital accumulation for any particular country. These results are robust to different measures of growth, initial GDP, and openness.

However, the fixed-effects OLS regressions can produce inconsistent estimates because: (i) causality may run in either direction for FDI, IPR or other variables (i.e., endogeneity may be an issue); (ii) the lagged dependent variable gives rise to autocorrelation; (iii) panel dataset has a short time dimension and a large country dimension. To cope with these problems and obtain consistent parameter estimates, I estimate the interacted model (2) using the Arellano-Bond (AB) GMM technique.[22] The GMM results are presented in columns (5) and (6) of Table 2.

I choose to treat the log of Initial GDP, Institutions, FDI, IPR and the interaction term as endogenous. FDI may be endogenous to growth if a growing economy attracts additional FDI because MNEs are lured by high profit opportunities. IPR can be endogenous to growth if a country adopts stronger IPR protection because grown-up domestic industries accumulated their own IP and lobby to protect it.

In column (5) I use the "Difference" GMM estimator and instrument endogenous variables with their lags up to the 3rd period. The crucial assumptions for the validity of GMM estimators

[22] For the technical summary of the Arellano-Bond Dynamic Panel GMM estimators see Section II of the Appendix. Note that many empirical papers apply an instrumental variable (IV) approach instead of AB GMM technique to deal with endogenous variables, often using the same instruments for different variables. However, as pointed out in Bazzi and Clemens (2009), an instrument that is plausibly valid in one setting can be shown invalid when used in another setting. Because of a lack of original instruments for FDI or IPR and a reason why some of the popular cross-country instruments are valid in my regressions only, I choose to use the AB GMM estimator instead of the IV technique.

are (i) error terms are correlated only within individuals, not across them; (ii) the instruments are exogenous. Both assumptions are tested and the results of the tests are shown at the bottom of Table 2. The AB test shows no serial correlation. The AB test says that AR (2) coefficient is informative because first order autocorrelation is generated by the inclusion of a lagged dependent variable in the regression (*p*-value for AR (2) is reported in the bottom of the Table 2). The Hansen J test fails to reject that the instruments as a group are exogenous. Also, Difference-in-Hansen statistics (not reported) show that all five separate groups of instruments for five endogenous variables are exogenous.

The "System" GMM requires an additional assumption of no correlation between the differences of instrumental variables and country-specific effects. However, the validity of this assumption may be questioned. For instance, if the amplitude of fluctuations of FDI inflows are related to the off-shore status of a country (i.e., time-invariant country-specific effect), and such fluctuations depend on the economic climate in the countries where FDI originates, then the assumption of no correlation between the differences of variables (difference in FDI in this case) and country-specific effects might be violated. Nevertheless, I report the results of the regression (2), estimated with the "System" GMM in column (6) of Table 2. In the next tables I prefer to use the "Difference" GMM because (i) the tests fail to reject the null hypothesis that the instruments are exogenous in my sample; (ii) to keep the number of instruments less than the number of countries; (iii) the validity of an extra assumption for the "System" GMM is questionable.

As shown in columns (5) and (6) of Table 2, both GMM estimators as well as pooled OLS and fixed-effects OLS produce similar qualitative results, suggesting that possible endogeneity of FDI or IPR do not drive the results of the OLS regressions. However, since the magnitude of the estimated FDI coefficient fluctuates depending on the method used, endogeneity of FDI is likely present, so I prefer the results of the "Difference" GMM estimation.

The results of the "Difference" GMM estimation, in Column (5) of Table 2, suggest that a 10 percentage point increase in a country's ratio of FDI to GDP leads to approximately 3 percentage point increase in growth. The estimates also say that a one standard deviation increase in the IPR would increase the growth rate by 1 percentage point. However, FDI and IPR have offsetting effects on growth.

A graph of the coefficient estimates in the three-space of growth, IPR, and FDI is shown in Figure 3. This figure is constructed for the full sample using the "Difference" GMM estimates from column (1) of Table 10 of the Appendix, where in the regressions the variables in the interaction term are not demeaned. In column (2), observations that might be considered outliers are excluded from the sample as a sensitivity check (i.e., the 99th percentile of FDI distribution is dropped). The estimates from column (2) produce a nearly identical picture.

Figure 3 shows that there appears to be ranges over which IPR has both positive and negative effects on growth. This stands out plainly in the U-shape of growth relative to IPR shown in the graph. It can be seen how the slope with respect to one variable changes while moving across the contour in the direction of the other variable. Notice that for both IPR and FDI, the slope diminishes as the other variable increases. The same idea is captured by the estimates in Table 2, where IPR and FDI show positive, but offsetting growth effects.

As a robustness check for the results of Table 2, in Table 9 of the Appendix, I estimate the regression (1) with the errors clustered by country. If the observations for a country are correlated in an unknown way, inducing correlation of standard errors, OLS estimates are still unbiased, but standard errors might be miscalculated, causing incorrect inferences. Columns (1) and (2) of Table 9 in the Appendix report the results of OLS regressions with cluster-robust *t*-statistics in parentheses. The conclusions of Table 2 are unchanged.[23]

4.2. Factor Accumulation versus Total Factor Productivity

In Table 3 to see whether the positive, but offsetting growth effects of FDI and IPR work through accumulation of capital or through improvements in total factor productivity (TFP), the TFP growth rate is used instead of GDP growth rate with the same set of explanatory variables.

The significance of the FDI coefficient in the regressions of Table 3 suggests that FDI contributes to TFP development directly. Foreign technology, know-how and business models

[23] All the regressions in Table 2 were also repeated for: growth rate of real GDP per capita in 2005 prices, constructed by chain method, and for the growth rate of real GDP per capita in 2005 prices, constructed by Laspeyres method. Also, as an alternative measure of openness, the Fraser Institute's index of Freedom to Trade Internationally, was used. The same qualitative results were produced. When schooling is measured as average years of schooling in total population, the variable is always insignificant. When FDI is measured as a stock as a share of GDP, it is insignificant. Finally, all the regressions were repeated for the average values of FDI, government consumption as a share of GDP, and exports plus imports as a share of GDP, constructed as the ratios of averages, not as the averages of ratios as in the original set of regressions. The same qualitative results were produced.

embedded in FDI improve productivity of domestic firms (as shown by the TFP growth regressions in Table 3). Improved productivity contributes to the increase in domestic production together with the direct capital accumulation via FDI (as shown by the GDP growth regressions in Table 2).

While IPR is not significant by itself at conditional levels, the F-test of joint significance of FDI, IPR and their interaction (not reported) strongly rejects the hypothesis that the three variables together are not significant. As suggested by the endogenous growth models by Helpman (1993), Lai (1998) and others, and as discussed in the previous section, the extent of FDI likely influences the total effect of IPR reform on domestic production. So, as the theory says and as it is supported by the F-test of joint significance, all three variables should be included in the regression.

Finally, the central result of Table 2 that the interaction of IPR and FDI is negative significant also holds in the TFP growth regressions of Table 3. It means that the mitigating effect of IPR on the growth effect of FDI works through the TFP channel, i.e., a stronger IPR regime limits the adoption by domestic firms of new technologies brought via FDI. Columns (3) and (4) of Table 9 of the Appendix report the estimates of TFP regressions calculated with standard errors clustered by country. The results of Table 3 are unchanged.

5 Sensitivity analysis

In this section various robustness checks are performed to challenge the major result of the previous section that the interaction of FDI and IPR is negatively significant. First, I look at FDI versus Domestic Investment. Next, I consider Finance instead of IPR. Finally, I address a common critique of the GP index that it does not include enforcement measures. Further robustness checks are presented in the Appendix.

5.1. Domestic investment versus FDI

While the results of TFP growth regressions point at FDI as the channel through which the mitigating IPR effect on growth works, it can still be argued that FDI simply captures the effect of total domestic investment, which is not included as a regressor in the previous tables. To address this concern, in Table 4 I show the regressions with the overall domestic investment

included. Also, I include the interaction of Domestic Investment and IPR to see whether the negative interaction effect, shown in the previous tables, works for a broader category of investment (i.e., total domestic investment including FDI).

The estimates of Table 4 suggest that while domestic investment contributes to GDP growth, FDI (often being a small portion of total domestic investment) has an independent growth impact. The significance of FDI in the regression with overall domestic investment included is likely explained by the qualitative differences (i.e., richer human capital and/or technological content) of FDI over other categories of domestic investment. Also, because the interaction of Domestic investment and IPR is not significant, stronger IPR protection seems to diminish the growth effect of foreign investment only, but not of other investment categories, suggesting that among other types of domestic investment FDI is especially sensitive to IPR.

5.2. Finance versus IPR

Table 5 addresses another concern which arises because of the results found in Alfaro et al. (2004, 2009). The authors include a finance variable[24] as well as the interaction of FDI and Finance in cross-country GDP and TFP growth regressions (one observation per country). They find that the interaction of FDI and Finance is positively significant and robust to various sensitivity checks, while FDI independently is not significant. The authors' main conclusion is that developed financial markets are crucial for the beneficial effects of FDI to be realized.

It is possible that by not including Finance in growth regressions, IPR picks up the positive growth effect of Finance (especially given that the correlation between IPR and Finance in my sample is 0.48). Moreover, it may be that the negative significant interaction of FDI and IPR is the result of a misspecified model that should include the interaction of Finance and FDI. These concerns are addressed in Table 5. The growth regressions of Table 5 show that neither Finance nor the interaction of Finance and FDI are significant, while IPR and its interaction with FDI are significant and robust to the inclusion of additional Finance terms.

My results contrast with those by Alfaro et al. (2004, 2009), who find that the joint effect of Finance and FDI is positive. Note that in the studies by Alfaro et al. (2004, 2009) the analysis of

[24] Finance is measured by (i) credit by deposit money banks to the private sector as a share of GDP; (ii) ratio of commercial bank domestic assets divided by central bank plus commercial bank assets; (iii) liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of the financial intermediaries and non-bank financial intermediaries); (iv) the value of credits by financial intermediaries to the private sector divided by GDP.

the joint effect of Finance and FDI on growth is based on cross-country regressions with one observation per country, but my analysis is conducted in a panel setting. My results are consistent with Carkovic and Levine (2002) in terms of the interaction of Finance and FDI, but unlike all these authors I find a significant effect of FDI on its own. Moreover, my results are robust to specification questions raised by Carkovic and Levine (2002), concerning the Alfaro et al. (2004) model. For further analysis of the joint effect of Finance and FDI on growth in a cross-sectional setting, see Section IV and Table 7 of the Appendix.

5.3. IPR Enforcement

A common critique of the GP Index is that it does not include enforcement measures. In Table 6, I interact the GP index with the Fraser Institute's Index of Legal Structure and Security of Property Rights, in the same manner as in Hu and Png (2010).[25] The Fraser Institute's Index measures the quality of institutions. By interacting the GP index of patent protection with the measure of overall institutional quality, I account for the enforcement of IPR laws. This assumes that the extent of IPR laws' enforcement approximately follows that of overall law enforcement.[26]

If a country has a strict IPR policy, but zero enforcement of the laws in practice, the interacted index will reflect the absence of *de facto* IPR laws working in a country. Thus, the interaction of FDI, IPR (measured by the GP Index), and the enforcement measure (proxied by the Fraser index) are included in the regression together with all the cross-products of its components, as well as all the components independently.

In the previous tables I found that FDI and IPR have positive, but offsetting growth effects. Table 6 shows that these results are robust to the inclusion of new terms with the Institutions variable. In addition, the regressions of Table 6 show that the enforced IPR laws augment the positive growth effect of *de jure* laws (the coefficient on the interaction of IPR and Institutions is

[25] The authors use two different methods to change the GP index, so it reflects *de facto* patent laws: (i) the product of the GP index and the measure of the overall laws' enforcement, proxied by the Fraser Institute's index of Legal Structure and Security of Property Rights, and (ii) the weighted average of the GP index and the Fraser index.

[26] The validity of this assumption can certainly be questioned. The best example is probably China, where currently the IPR laws are poorly enforced, while other laws' enforcement is strong. Whether interacting the GP index with the measure of the quality of institutions introduces more noise to the IPR measure or makes the GP index a better measure of the *de facto* differences in the IPR regimes, is hard to say. So, as a robustness check of the results in the previous tables, I show the regressions where the GP index is interacted with the measure of the quality of institutions to account for the enforcement of IPR laws.

positively significant in both OLS regressions). Also, it was previously found by Coe et al. (2009) that countries with relatively high institutional quality benefit more from R&D spillovers. In Column (3) of Table 6, the interaction of FDI and Institutions is positive and significant, which means that Institutions also enhance a country's ability to benefit from FDI. Although the triple interaction is insignificant[27], it is negative in two out of three regressions and the effect gets more pronounced when endogeneity is controlled for in GMM regression. While it is harder to capture any effect when additional interactions are included, the triple interaction of FDI, IPR and Institutions in GMM regressions is negative, and if interpreted literally, suggests that the mediating effect of IPR gets bigger with stricter law enforcement.

6 Conclusion

The theory argues that by strengthening IPR protection, dynamic efficiency (i.e., flows of innovation and international technology transfer) can be enhanced. However, strengthening IPR necessarily reduces static efficiency because it raises the marginal cost of knowledge diffusion into the public domain. This paper empirically investigates this paradox of the offsetting effects from strengthening the IPR regime by looking at the relation between FDI and growth. The paper finds that a 10 percentage point increase in a country's ratio of FDI to GDP leads to an approximately 3 percentage point increase in growth and that a one standard deviation increase in IPR is associated with a 1 percentage point increase in growth. However, FDI and IPR have offsetting impacts on growth, and at the highest levels of FDI, it appears that more lax IPR can in fact increase the growth rate. While more work needs to be done, these estimates extend our understanding of the relation between IPR and FDI and their effect on growth.

[27] The F-test of joint significance fails to reject that FDI, IPR, Institutions and all their interactions are not significant together.

Table 1: Descriptive statistics

Variable	Mean	Standard deviation	Min	Max
Sample 1: 103 countries (652 observations, 1970-2009)				
GDP Growth	0.02	0.03	-0.13	0.11
FDI	0.02	0.03	-0.05	0.26
Schooling	0.33	0.18	0.02	0.88
Government Consumption	0.16	0.05	0.04	0.41
Inflation	0.48	3.50	-0.06	69.63
Openness	0.71	0.51	0.09	4.29
Institutions	5.64	2.18	1.19	9.89
Domestic Investment	0.23	0.07	0.004	0.56
IPR	2.55	1.09	0	4.88
Sample 2: 79 countries (458 observations, 1970-2000)				
TFP Growth	0.004	0.02	-0.08	0.14
FDI	0.02	0.02	-0.03	0.16
Schooling	0.31	0.16	0.02	0.69
Government Consumption	0.16	0.05	0.04	0.41
Inflation	0.47	2.62	-0.06	38.59
Openness	0.63	0.46	0.09	3.87
Institutions	5.73	2.33	1.19	9.89
Domestic Investment	0.23	0.07	0.004	0.56
IPR	2.40	1.07	0.13	4.88

Notes: GDP Growth is the growth rate of real GDP per capita measured in 1990 prices. TFP Growth is the growth rate of total factor productivity, measured as a the residual, A, in the assumed production function: $Y = AK^{a}(HL)^{1-a}$, where $a = 0.35$. Sample 1 refers to the countries used in the regressions where the GDP growth rate is the dependent variable, while sample 2 refers to the countries used in the regressions where TFP growth rate is the dependent variable. For the list of countries see Section I of the Appendix. FDI is measured as a share in GDP. Schooling is measured as the percentage of secondary school enrollment in total population. Government consumption is measured as a share in GDP. Inflation is measured as a percentage change in GDP deflator. Openness is measured as imports plus exports as a share in GDP. IPR is measured by the GP index of patent protection. The quality of institutions is measured by the Fraser Institute's index of Legal Structure and Security of Property Rights. The growth rate, FDI, government consumption, inflation, and openness are averages over 5-year intervals; if one or more of yearly observations are missing in a 5-year block of observations, the average is calculated for the available years; thus, the final value for the 5-year interval is missing only if observations for every year in a 5-year block are missing. Fraser Institute's index is available every 5 years starting in 1970, and annually starting 2000; thus, for the years 1970-1999 the index is given by the initial values for every 5-year interval and starting in 2000 the index is averaged over 5-year intervals. IPR, Schooling and log (Initial GDP) capture the initial values for every 5-year interval.

Table 2: GDP growth, FDI, and IPR

Dependent variable – 5-year average annual per capita GDP growth rate

	(1) OLS	(2) OLS-FE	(3) OLS	(4) OLS-FE	(5) GMM (difference)	(6) GMM (system)
FDI	0.10	0.10	0.16	0.21	0.30	0.18
	(2.78)	(1.91)	(2.98)	(3.26)	(2.39)	(2.33)
IPR	0.004	0.01	0.004	0.01	0.01	0.01
	(2.34)	(3.04)	(2.41)	(3.32)	(4.31)	(3.23)
FDI*IPR	-	-	-0.09	-0.16	-0.24	-0.15
	-	-	(-1.71)	(-2.64)	(-2.54)	(-2.14)
log (Initial GDP)	-0.01	-0.04	-0.01	-0.04	-0.03	-0.01
	(-6.28)	(-7.68)	(-6.29)	(-7.41)	(-4.40)	(-4.05)
Schooling	0.02	-0.01	0.02	-0.01	0.02	0.02
	(2.17)	(-0.95)	(2.07)	(-0.91)	(0.54)	(1.05)
Government Consumption	-0.06	-0.07	-0.06	-0.07	-0.09	-0.07
	(-2.95)	(-1.81)	(-2.82)	(-1.77)	(-1.95)	(-2.38)
Institutions	0.004	0.004	0.004	0.004	0.004	0.003
	(5.95)	(3.44)	(5.94)	(3.50)	(2.61)	(3.14)
Inflation	-0.002	-0.001	-0.002	-0.001	-0.001	-0.002
	(-13.16)	(-5.97)	(-12.81)	(-5.78)	(-3.52)	(-8.53)
Openness	0.01	0.02	0.01	0.02	0.01	0.01
	(2.50)	(2.80)	(2.12)	(2.36)	(1.18)	(2.11)
African Dummy	-0.02	0.01	-0.02	0.01	-	-0.02
	(-5.86)	(0.27)	(-5.89)	(0.40)	-	(-2.79)
R^2	0.24	0.56	0.25	0.57		
Country fixed effects	No	Yes	No	Yes		
Year fixed effects	No	Yes	No	Yes		
Hansen test (p-level)					0.11	0.28
Arellano-Bond test (p-level)					0.51	0.33
Number of instruments					79	102
Observations	652	652	652	652	549	652

Notes: All regressions have a constant term. Robust t-values are in parentheses. The sample consists of 103 countries. For the list of countries and the detailed definitions of the variables see the Appendix and the notes to Table 1. The country-specific means are subtracted from IPR and FDI variables before constructing the FDI*IPR interaction term. In GMM regressions log (Initial GDP), FDI, IPR, Institutions and the FDI*IPR interaction term are treated as endogenous with the lags up to the 4th period used as the instruments for all the endogenous variables, except for the log (Initial GDP) and Institutions variables in the "System" GMM regression, which are instrumented with the lags up to the 3rd period to keep the total number of instruments less than or equal to the number of countries in the sample; two-step estimation is implemented with Windmeijer's finite sample correction for the two-step covariance matrix. The results are reported for the forward-orthogonal transform, with similar qualitative results for the first-differencing transform.

Table 3: TFP Growth, FDI and IPR

Dependent variable – 5-year average annual TFP growth rate

	(1) OLS	(2) OLS-FE	(3) OLS	(4) OLS-FE	(5) GMM (difference)
FDI	0.21	0.22	0.24	0.25	0.31
	(4.45)	(3.26)	(4.86)	(3.67)	(3.19)
IPR	0.001	-0.002	0.001	-0.001	0.004
	(0.58)	(-0.93)	(0.81)	(-0.38)	(1.24)
FDI*IPR	-	-	-0.18	-0.22	-0.46
	-	-	(-2.17)	(-2.50)	(-2.94)
log (Initial GDP)	-0.01	-0.03	-0.01	-0.03	-0.01
	(-4.80)	(-3.54)	(-4.91)	(-3.39)	(-2.35)
Schooling	0.002	-0.02	0.001	-0.02	-0.001
	(0.18)	(-1.22)	(0.09)	(-1.23)	(-0.06)
Government Consumption	-0.02	0.004	-0.01	0.002	-0.04
	(-0.83)	(0.08)	(-0.62)	(0.03)	(-0.79)
Institutions	0.004	0.001	0.004	0.001	0.003
	(5.96)	(1.28)	(5.89)	(1.11)	(2.13)
Inflation	-0.001	-0.001	-0.001	-0.001	-0.004
	(-3.25)	(-2.30)	(-2.99)	(-2.27)	(-0.96)
Openness	-0.004	0.03	-0.003	0.03	0.02
	(-1.62)	(3.44)	(-1.42)	(3.35)	(1.66)
African Dummy	-0.003	0.02	-0.004	0.02	-
	(-0.66)	(0.65)	(-0.86)	(0.73)	-
R^2	0.15	0.45	0.16	0.45	
Country fixed effects	No	Yes	No	Yes	
Year fixed effects	No	Yes	No	Yes	
Hansen test (p-level)					0.27
Arellano-Bond test (p-level)					0.29
Number of instruments					65
Observations	458	458	458	458	379

Notes: All regressions have a constant term. Robust t-values are in parentheses. The sample consists of 79 countries. For the list of countries and the detailed definitions of the variables see the Appendix and the notes to Table 1. The country-specific means are subtracted from FDI and IPR variables before constructing the FDI*IPR interaction term. In GMM regressions log (Initial GDP), FDI, IPR, Institutions and the FDI*IPR interaction term are treated as endogenous with the lags up to the 4^{th} period used as the instruments; two-step estimation is implemented with Windmeijer's finite sample correction for the two-step covariance matrix. The results are reported for the forward-orthogonal transform, with similar qualitative results for the first-differencing transform.

Table 4: Robustness checks: Domestic investment versus FDI

Dependent variable – 5-year average annual per capita GDP growth rate

	(1) OLS	(2) OLS-FE	(3) OLS	(4) OLS-FE	(5) OLS-FE	(6) GMM (difference)
FDI	0.17	0.17	0.10	0.07	0.16	0.16
	(3.43)	(2.68)	(2.69)	(1.62)	(2.59)	(1.41)
IPR	0.01	0.01	0.01	0.01	0.01	0.01
	(3.62)	(3.64)	(3.55)	(3.36)	(3.58)	(5.62)
FDI*IPR	-0.11	-0.14	-	-	-0.13	-0.18
	(-2.29)	(2.35)	-	-	(-2.14)	(-2.22)
Domestic Investment	0.15	0.15	0.15	0.16	0.16	0.05
	(7.91)	(6.72)	(7.87)	(6.76)	(6.62)	(1.12)
Domestic Investment*IPR	-	-	0.01	-0.04	-0.02	-0.01
	-	-	(0.36)	(-1.20)	(-0.78)	(-0.18)
log (Initial GDP)	-0.01	-0.04	-0.01	-0.04	-0.04	-0.02
	(-6.16)	(-7.40)	(-6.06)	(-7.65)	(-7.42)	(-3.94)
Schooling	0.02	-0.01	0.01	-0.01	-0.01	-0.001
	(2.02)	(-0.93)	(2.12)	(-1.04)	(-0.99)	(-0.02)
Government Consumption	-0.07	-0.06	-0.07	-0.06	-0.06	-0.11
	(-3.48)	(-1.72)	(-3.64)	(-1.63)	(-1.64)	(-3.14)
Institutions	0.003	0.002	0.003	0.002	0.002	0.01
	(4.80)	(2.55)	(4.85)	(2.58)	(2.61)	(2.76)
Inflation	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-8.35)	(-5.36)	(-8.77)	(-5.64)	(-5.46)	(-3.63)
Openness	0.001	0.01	0.002	0.01	0.01	0.01
	(0.22)	(1.63)	(0.71)	(1.87)	(1.54)	(1.03)
African Dummy	-0.01	0.03	-0.01	0.03	0.03	-
	(-4.04)	(1.40)	(-3.98)	(1.34)	(1.39)	-
R^2	0.34	0.61	0.34	0.61	0.61	
Country fixed effects	No	Yes	No	Yes	Yes	
Year fixed effects	No	Yes	No	Yes	Yes	
Hansen test (p-level)						0.21
Arellano-Bond test (p-level)						0.49
Number of instruments						81
Observations	652	652	652	652	652	549

Notes: All regressions have a constant term. Robust t-values are in parentheses. The sample consists of 103 countries. Domestic investment is measured as gross capital formation as a share of GDP. For the list of countries and the detailed definitions of the variables see the Appendix and the notes to Table 1. The country-specific means are subtracted from FDI, IPR and Domestic Investment variables before constructing the interaction terms. In GMM regression log (Initial GDP), FDI, IPR, Institutions, Domestic Investment, and the interaction terms are treated as endogenous with the lags up to the 3rd period used as the instruments; two-step estimation is implemented with Windmeijer's finite sample correction for the two-step covariance matrix. The results are reported for the forward-orthogonal transform, with similar qualitative results for the first-differencing transform.

Table 5: Robustness checks: Financial market development versus IPR

Dependent variable – 5-year average annual GDP growth rate

	(1) OLS-FE	(2) OLS-FE	(3) OLS-FE	(4) GMM (difference)
FDI	0.27	0.16	0.27	0.34
	(3.73)	(3.31)	(3.75)	(2.42)
IPR	0.01	0.01	0.01	0.01
	(2.38)	(2.01)	(2.30)	(3.47)
FDI*IPR	-0.16	-	-0.15	-0.21
	(-2.51)	-	(-2.20)	(-2.51)
Finance	-0.004	-0.003	-0.003	-0.001
	(-1.57)	(-1.24)	(-1.42)	(-0.19)
FDI*Finance	-	-0.12	-0.08	-0.21
	-	(-1.87)	(-1.29)	(-1.25)
log (Initial GDP)	-0.04	-0.05	-0.04	-0.03
	(-7.54)	(-7.77)	(-7.58)	(-4.30)
Schooling	0.001	0.001	0.002	0.02
	(0.10)	(0.07)	(0.12)	(0.66)
Government Consumption	-0.10	-0.09	-0.09	-0.10
	(-2.61)	(-2.24)	(-2.38)	(-2.18)
Institutions	0.003	0.003	0.003	0.01
	(3.22)	(3.08)	(3.14)	(3.09)
Inflation	-0.001	-0.001	-0.001	-0.001
	(-1.56)	(-1.71)	(-1.53)	(-1.04)
Openness	0.02	0.02	0.02	0.01
	(2.39)	(2.67)	(2.35)	(1.52)
African Dummy	-0.15	-0.14	-0.15	-
	(-8.04)	(-7.31)	(-7.65)	-
R^2	0.56	0.55	0.56	
Country fixed effects	Yes	Yes	Yes	
Year fixed effects	Yes	Yes	Yes	
Hansen test (p-level)				0.17
Arellano-Bond test (p-level)				0.60
Number of instruments				82
Observations	596	596	596	497

Notes: All regressions have a constant term. Robust t-values are in parentheses. The sample consists of 99 countries (data on Financial Market development are not available for China, Nicaragua, Ukraine, and Zimbabwe, which are present in the full GDP sample with 103 countries). For the list of countries and the detailed definitions of the variables see the Appendix and the notes to Table 1. The country-specific means are subtracted from all the variables in all the interaction terms. In GMM regression log (Initial GDP), FDI, IPR, Institutions, Financial Market, and the interaction terms are treated as endogenous with the lags up to the 3rd period used as the instruments; two-step estimation is implemented with Windmeijer's finite sample correction for the two-step covariance matrix. The results are reported for the forward-orthogonal transform, with similar qualitative results for the first-differencing transform.

Table 6: Robustness checks: IPR enforcement

Dependent variable - 5-year average annual per capita GDP growth rate

	(1) OLS	(2) OLS-FE	(3) GMM (Difference)
FDI	0.17	0.21	0.35
	(3.20)	(3.22)	(2.95)
IPR	0.003	0.01	0.01
	(2.21)	(3.11)	(3.91)
FDI*IPR	-0.11	-0.17	-0.25
	(-1.97)	(-2.62)	(-2.75)
IPR*Institutions	0.003	0.003	-0.002
	(2.33)	(1.92)	(-0.84)
FDI*Institutions	-0.06	-0.05	0.19
	(-0.80)	(-0.75)	(2.24)
FDI*IPR*Institutions	0.001	-0.02	-0.10
	(0.03)	(-0.39)	(-1.40)
log (Initial GDP)	-0.01	-0.04	-0.03
	(-6.14)	(-7.51)	(-4.64)
Schooling	0.02	-0.01	0.03
	(2.09)	(-0.88)	(-4.64)
Government Consumption	-0.06	-0.07	-0.10
	(-2.71)	(-1.76)	(-2.05)
Institutions	0.004	0.004	0.01
	(5.70)	(3.24)	(2.80)
Inflation	-0.002	-0.001	-0.001
	(-12.62)	(-5.68)	(-3.75)
Openness	0.01	0.02	0.01
	(2.08)	(2.46)	(1.10)
African Dummy	-0.02	0.01	-
	(-5.72)	(0.34)	-
R^2	0.25	0.57	
Country fixed effects	No	Yes	
Year fixed effects	No	Yes	
Hansen test (p-level)			0.23
Arellano-Bond test (p-level)			0.31
Number of instruments			96
Observations	652	652	549

Notes: All regressions have a constant term. Robust t-values are in parentheses. The sample consists of 103 countries. The country-specific means are subtracted from all the variables in all the interaction terms. In GMM regression log (Initial GDP), FDI, IPR, Institutions, and all the interaction terms are treated as endogenous with the lags up to the 3rd period used as the instruments. The results are reported for the forward-orthogonal transform.

Figure 1. Mean value of the GP index

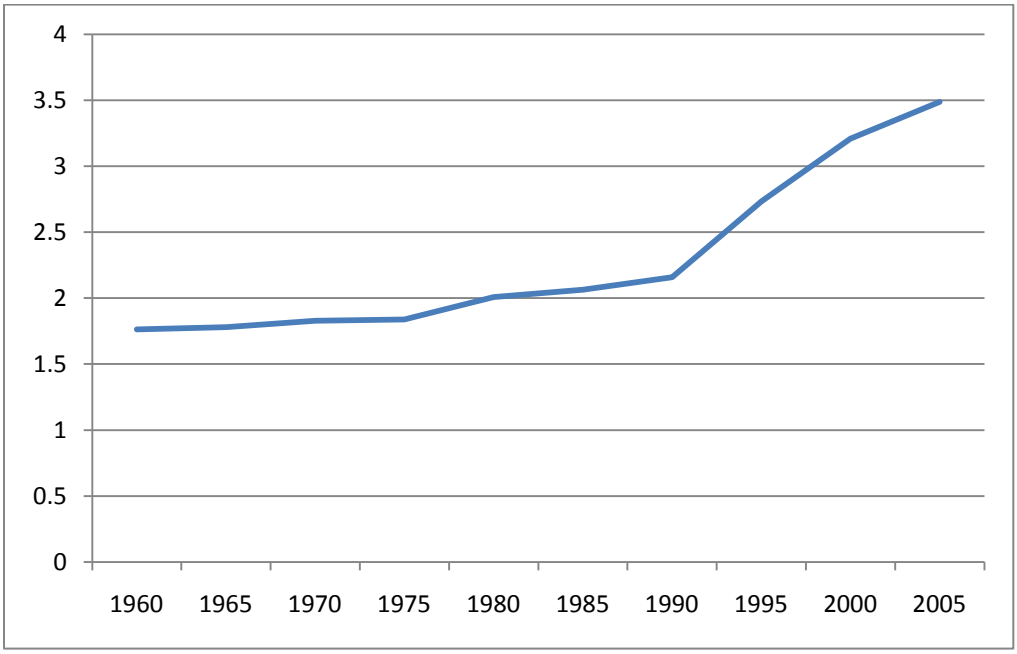


Figure 2. Standard deviation of the GP index

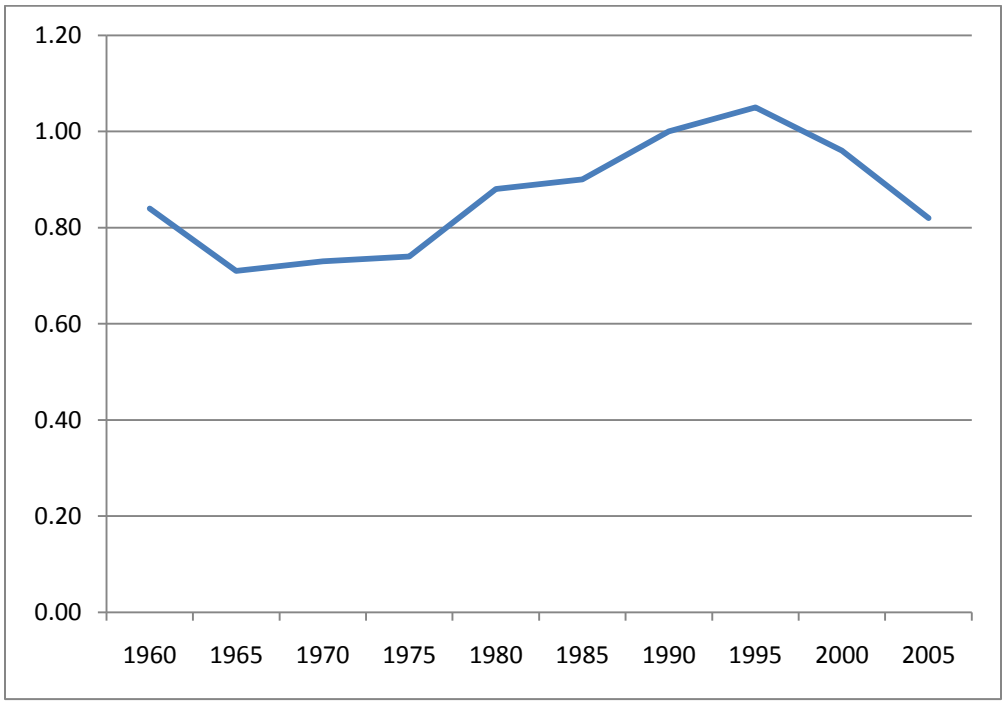
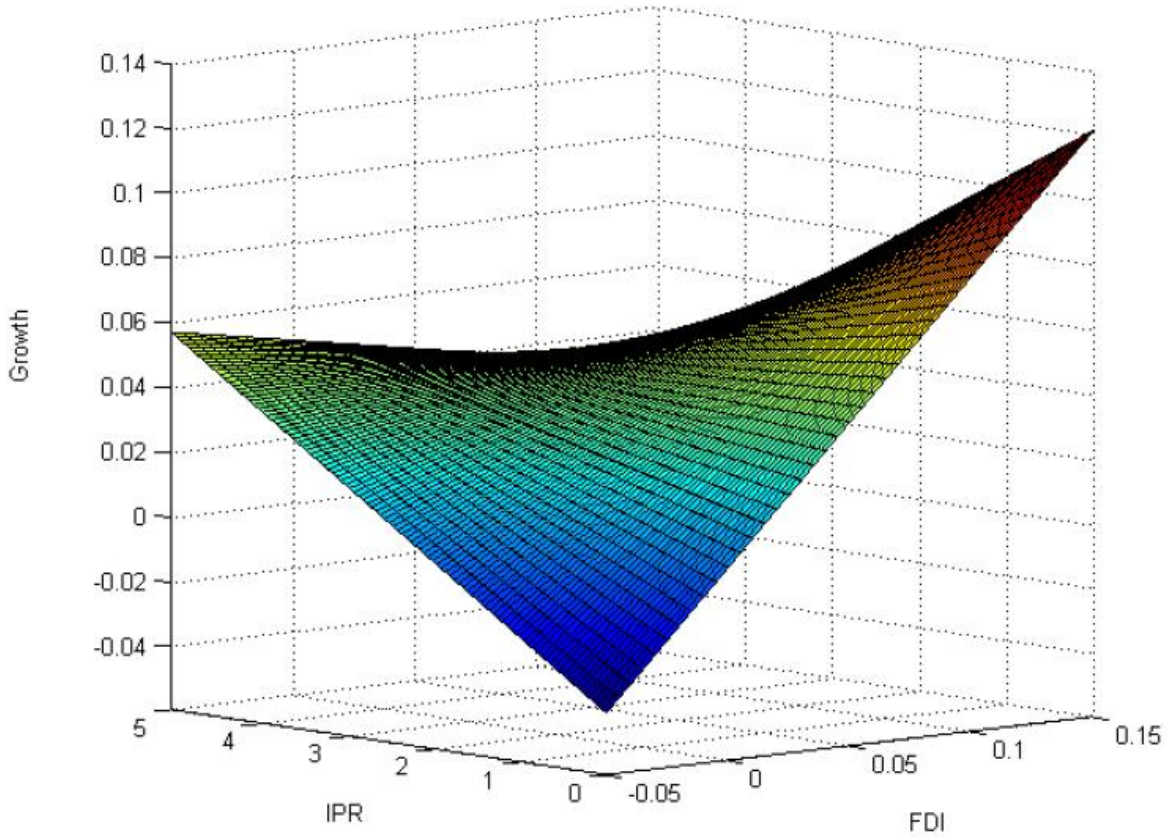


Figure 3. The joint effect of IPR and FDI on growth



Appendix

Section I

Sample 1 (103 countries) and sample 2 (79 countries):

Algeria (1, 2), Argentina (1, 2), Australia (1, 2), Austria (1, 2), Bangladesh (1, 2), Belgium (1, 2), Benin (1), Bolivia (1, 2), Botswana (1), Brazil (1, 2), Bulgaria (1), Burundi (1), Cameroon (1, 2), Canada (1, 2), Central African Rep. (1), Chile (1, 2), China (1, 2), Colombia (1, 2), Congo (1), Costa Rica (1, 2), Cyprus (1, 2), Czech Republic (1), Denmark (1, 2), Dominican Rep. (1, 2), Ecuador (1, 2), Egypt (1, 2), El Salvador (1, 2), Fiji (1), Finland (1, 2), France (1, 2), Gabon (1), Germany (1, 2), Ghana (1, 2), Greece (1, 2), Guatemala (1, 2), Guyana (1, 2), Haiti (1, 2), Honduras (1, 2), Hong Kong (1), Hungary (1), Iceland (1, 2), India (1, 2), Indonesia (1, 2), Iran (1, 2), Ireland (1, 2), Israel (1, 2), Italy (1, 2), Ivory Coast (1, 2), Jamaica (1, 2), Japan (1, 2), Jordan (1, 2), Kenya (1, 2), Korea (South) (1, 2), Lithuania (1), Malawi (1, 2), Malaysia (1, 2), Mali (1, 2), Malta (1), Mauritius (1, 2), Mexico (1, 2), Morocco (1, 2), Nepal (1), Netherlands (1, 2), New Zealand (1, 2), Nicaragua (1, 2), Niger (1), Norway (1, 2), Pakistan (1, 2), Panama (1, 2), Papua New Guinea (1), Paraguay (1, 2), Peru (1, 2), Philippines (1, 2), Poland (1), Portugal (1, 2), Romania (1), Russian Fed. (1), Rwanda (1, 2), Senegal (1, 2), Sierra Leone (1, 2), Singapore (1, 2), Slovak Republic (1), South Africa (1, 2), Spain (1, 2), Sri Lanka (1, 2), Sweden (1, 2), Switzerland (1, 2), Syria (1), Tanzania (1, 2), Thailand (1, 2), Togo (1), Trinidad & Tobago (1, 2), Tunisia (1, 2), Turkey (1, 2), Uganda (1, 2), Ukraine (1), United Kingdom (1, 2), United States (1, 2), Uruguay (1, 2), Venezuela (1, 2), Zaire (Dem Rep Congo) (1), Zambia (1, 2), Zimbabwe (1, 2).

Data Sources and descriptions:

Foreign direct investment: Inward FDI flows (US Dollars at current prices and current exchange rates in millions). *Source: UNCTAD.*

Output levels: GDP (US Dollars at current prices and current exchange rates in millions). *Source: UNCTAD.*

GDP growth rate: (i) Growth rate of real GDP per capita (constant 1990 US dollars); (ii) Growth rate of real GDP per capita (constant 2005 prices, constructed using chain method); (iii) Growth rate of real GDP per capita (constant 2005 prices, constructed using Laspeyres method). *Source: UNCTAD, PWT 6.3.*

TFP growth rate: Growth rate of total factor productivity, measured as the residual, A, in the assumed production function: $Y = AK^{a}(HL)^{1-a}$, where $a = 0.35$. *Source: Bosworth and Collins (2003).*

Government consumption: General Government final consumption expenditure (US Dollars at current prices and current exchange rates in millions). *Source: UNCTAD.*

Domestic investment: Gross capital formation (US Dollars at current prices and current exchange rates in millions). *Source: UNCTAD.*

Openness: (i) Exports plus imports as a share of GDP (US Dollars at current prices and current exchange rates in millions); (ii) Fraser Institute's Index of Freedom to trade internationally (area 4 of Economic Freedom of the World (EFW) index*). Source: UNCTAD, Fraser Institute.*

Schooling: (i) Percentage of Secondary schooling attained in population; (ii) Average years of schooling attained. *Source: Barro and Lee (2010).*

Inflation: Percentage change in the GDP deflator. *Source: World Bank.*

Population: Total population. *Source: UNCTAD.*

Institutions: Index of legal system and property rights (area 2 of Economic Freedom of the World (EFW) index). *Source: Fraser Institute.*

Finance: Credit by deposit money banks to the private sector as a share of GDP. *Source: World Bank Financial Structure Database.*

Section II

The Arellano-Bond GMM technique

The original Arellano-Bond (1991) estimator, also called the "Difference" GMM estimator, is designed for the fixed-effects (FE) models where (i) a lagged dependent variable is included as a regressor; (ii) some other regressors may be endogenous, and (iii) the time dimension for the panel of data is short. Any of these features of the model can lead to inconsistent parameter estimates if results are obtained by the standard OLS technique. Consistent parameter estimates can be obtained for dynamic panel-data models by implementing the Arellano-Bond estimator. If the original equation is of the following form:

$$(1) \qquad Y_{it} = \beta_1 Y_{i,t-1} + \beta_2 X_{it} + \varepsilon_{it}$$

where the error term, ε_{it}, is a composite of unobserved country and time specific heterogeneity, and an idiosyncratic component u, such that $\varepsilon_{it} = \alpha_i + \eta_t + u_{i,t}$. First, fixed effects need to be eliminated. Two techniques of dealing with fixed effects can be applied: first-differencing and forward orthogonal-deviations. Proposed by Arellano and Bover (1995), the orthogonal-deviations transform subtracts the average of all available future observations, and can be computed for every complete observation except the last for each individual.[28] Like differencing, taking orthogonal deviations removes fixed effects. Thus, the following equation is constructed:

$$(2) \qquad \Delta Y_{it} = \beta_1 \Delta Y_{i,t-1} + \beta_2 \Delta X_{it} + \Delta \varepsilon_{it}$$

[28] "Difference" GMM is still called that even if orthogonal deviations are implemented.

where ΔY_{it}, $\Delta Y_{i,t-1}$ and $\Delta \varepsilon_{it}$ are the original regressors, transformed by either first-differencing or forward orthogonal-deviations. Then, the instrumental variable (IV) estimation of the first-difference model (2), using appropriate lags of regressors as the instruments, is applied.

If the lagged levels of the regressors are poor instruments for the first-differenced regressors, the Arellano-Bond "System" GMM estimator should be used, where the original equation in levels is used together with the first-differenced equation to obtain additional instruments. Thus, the system of equations (1) and (2) is estimated.

To test whether the instruments as a group are exogenous the Sargan test or Hansen J test should be implemented. Also, the AB test for autocorrelation should be done because if present, it can render some lags invalid as instruments.

Section III

IPR

The GP index does not incorporate IP enforcement measures and, as noted in Park (2008), the index is "an indicator of the strength of patent protection, not the quality of patent system". It explains why, for instance, according to the GP index (see Table 3) China has the superior IPR regime compared to Hong Kong (the relationship seems implausible if enforcement of patent protection is measured).[29]

Several other measures of IPR protection exist as separate indexes or as parts of more broad indexes of economic freedom and property rights.[30] For instance, according to the Fraser Institute's index of Intellectual Property Protection[31] assembled based on World Economic Forum (WEF) Executive Opinion Survey, which polls around 13,000 business executives worldwide, Hong Kong has a higher score for IPR protection compared to that of China for all the years between 2000 and 2005. In the WEF Executive Opinion Survey business executives score the countries based on their subjective judgment about how well IPRs are protected, thus enforcement of IPR laws together with *de jure* laws are assessed.

It seems that at least for China and Hong Kong in 2000-2005, the GP index does not show the true state of the IPR laws. However, it is not clear that over a longer period and for more

[29] China's admission to the World Trade Organization (WTO) in 2001 and the adoption of the second amendment of China's Patent Law brought the IP law into compliance with the Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement. The amended Patent law of China is reflected in coverage, enforcement, and membership components of the GP index, so the components, and the resulted GP index, have higher scores in 2005 compared with their values in 2001. There were no changes in Hong Kong patent law, and therefore, no changes in GP score for Hong Kong in 2005.

[30] I was able to collect data for: (i) the IP index from the Global Competitiveness Report (GCR) of World Economic Forum (WEF), publicly available for 2008-2010; (ii) Protection of IPR index from the Fraser Institute, available as an average for 1995-2000 and annually for 2001-2004; (iii) Intellectual Property Rights (IPR) from the Property Rights Alliance, available annually for 2007-2010.

[31] Protection of Intellectual Property index was one of the subcomponents of Fraser Institute' Legal System and Property Rights index, which is in turn the component of the Economic Freedom of the World (EFW) index. However, the computation of the IP component of EFW index was terminated in 2004, and substituted for the Protection of Property Rights index component.

countries other IPR indexes would better reflect the differences in IPR protection than the GP index. Because other indexes use subjective judgments of the questionnaires' respondents in their construction, it may be hard to keep them comparable across time and countries. Instead, the GP index is constructed in a way which makes it as objective as possible. Moreover, it is likely that the strength of patent law is correlated with its quality, especially if some time lag is allowed. The error in the measured quality of IPR protection is not necessarily bigger if enforcement is not measured compared with the error if enforcement is measured subjectively.

Ideally, I would do the correlation analysis of the GP index with other indexes of IPR protection and see whether the empirical results of this paper hold if other measures of IPR are applied. Unfortunately, no other IPR index is publicly available for a sufficient number of countries and a long enough period to test my hypothesis in panel regressions. Thus, I use the GP index and leave for further investigation whether my results hold if different measures of IPR protection are used.

FDI

UNCTAD defines FDI as an investment involving a long-term relationship and reflecting a lasting interest (10 percent or more of voting stock) in and control by a resident entity in one economy (foreign direct investor or parent enterprise) of an enterprise resident in a different economy (FDI enterprise or affiliate enterprise or foreign affiliate). Such investment involves both the initial transaction between the two entities and all subsequent transactions between them and among foreign affiliates. FDI includes equity capital, reinvested earnings and intra-company loans.

FDI inflows are reported in *UNCTADstat* on a net basis[32] (capital transactions' credits less debits between direct investors and their foreign affiliates), thus, the flows attracted to the economy, and those that remain in the economy are analyzed.

Foreign investment stocks, reported in *UNCTADstat*, are the value of the share of the capital and reserves (including retained profits) attributable to the parent enterprise, plus the net indebtedness of affiliates to the parent enterprises.

Inflows of FDI are chosen over inward FDI stocks because flow reflects MNE's investment activity over a certain period. If the investment behavior of a foreign firm depends on the strength of IPR protection, the regression analysis will be able to capture the change in the growth effect of FDI inflow in a domestic economy as the strength of the IPR regime varies. However, it is not clear what the exact time lag is for the FDI externalities to be realized by a host economy. Moreover, it is likely that these time lags vary between the countries because of the differences in the absorptive capacities, developed by the economies. To account for these considerations, FDI stocks are used to complement the regression analysis of the investment inflows.

[32] Therefore, negative FDI flows can result if one of the components of FDI (i.e., equity capital, reinvested earnings or intra-company loans) is net negative.

Other controlling variables

Crespo and Fontoura (2007) surveyed the literature on the determining factors of FDI spillovers and concluded that absorptive capacity of domestic firms and regions is "a precondition for incorporating the benefits of FDI spillovers", and that it produces the most robust empirical results. Since aggregated to a country level FDI data are used in this study, absorptive capacity at the macroeconomic level, usually associated with the development level of a particular country, is controlled for in the growth regressions.

The development level of an economy is often measured by the stock of human capital, which is usually proxied by the percentage of secondary school enrollment in total population. As a robustness check, schooling, measured as average years of schooling in total population, is also used in the empirical analysis. Both variables are available for the years 1950-2010 with 5-years lag from Barro and Lee (2010).

Another element of the capacity of an economy to absorb technology is the legal environment of the country. The Fraser Institute's index of Legal System and Security of Property Rights, which major components are rule of law, security of property rights, an independent judiciary, and an impartial court system, is used to control for the quality of institutions.

Also, a country's openness to trade and investments is essential for the FDI to enter the economy. Openness, measured as exports plus imports in the share of GDP, and constructed using *UNCTADstat* data, is included in the regressions. As a robustness check, openness measured by the Fraser Institute's Index of Freedom to Trade Internationally, is also used.

The data on government consumption, imports and exports are obtained from *UNCTADstat.* Since FDI stocks and inflows, government consumption, exports and imports are measured in current prices and current exchange rates, GDP in current prices and current exchange rates from *UNCTADstat* is used to construct the FDI/GDP, government consumption as a share of GDP, and exports plus imports as a share of GDP variables. Population data is also from *UNCTADstat*.

Finally, inflation, measured as an annual percentage change in the GDP deflator, is obtained from World Bank.

Section IV

Further robustness checks

In columns (1)-(3) of Table 7 of the Appendix I estimate cross-country regressions (one observation per country), using my full sample.

Similarly to the panel regressions shown in Table 7, for the full sample of countries I do not find the positive and significant interaction of FDI and Finance, showed in Alfaro et al. (2004, 2009). However, when I restrict my sample to be as close as possible to Alfaro et al. (2009) in terms of the coverage of countries and the time period, the interaction of FDI and Finance as well

as Finance independently become significant (see columns (4)-(6) of Table 9). This suggests the sensitivity of Alfaro's (2004, 2009) results to the selection of countries, time period and the estimation method (i.e., panel versus cross-section).

As for the major finding of this study that the interaction of FDI and IPR is negative and significant, this result is not found in cross-country regressions. As I argue in the main text, simple cross-country regressions are subject to several econometric problems, which might lead to inconsistent estimates. Panel analysis, presented in the main sections, is chosen instead (and the Arellano-Bond GMM estimator in particular) to elicit consistent estimates of the parameters of explanatory variables, including FDI, IPR and the interaction of FDI and IPR.

As an additional robustness check, in Table 11 of the Appendix I show the results of estimation where I include four dummy variables for different levels of the IPR index because IPR might have a heterogeneous impact on growth depending on its level. The main results are unchanged.

Finally, the concern might arise that a 5-year period is too short to reveal the dynamic of the model and instead the regressions pick up the effect of business cycles. In Table 12 of the Appendix I address this point by estimating GDP regressions where all the variables are 10-year averages. The findings of the previous tables are unchanged.

Appendix - Table 7: Further robustness checks: Cross-sectional setting

Dependent variable – 5-year average annual per capita GDP growth rate

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
FDI	-0.14	-0.06	-0.13	-0.18	-0.19	-0.35
	(-1.10)	(-0.57)	(-1.03)	(-0.54)	(-0.82)	(-0.94)
IP	-0.002	-	-0.002	-0.001	-	-0.004
	(-0.71)	-	(-0.68)	(-0.17)	-	(-0.97)
IP*FDI	0.09	-	0.14	0.13	-	-0.07
	(0.97)	-	(1.48)	(0.54)	-	(-0.24)
Finance	-	0.004	0.004	-	0.01	0.01
	-	(1.56)	(1.83)	-	(3.75)	(3.31)
Finance*FDI	-	-0.09	-0.13	-	0.46	0.61
	-	(-0.73)	(-1.01)	-	(1.88)	(1.54)
log (Initial GDP)	-0.01	-0.01	-0.01	-0.01	-0.02	-0.01
	(-3.07)	(-3.73)	(-3.52)	(-2.87)	(-3.62)	(-2.92)
Schooling	0.04	0.03	0.04	0.03	0.04	0.05
	(2.46)	(2.40)	(2.66)	(1.55)	(2.17)	(2.29)
Government Consumption	-0.03	-0.04	-0.03	-0.06	-0.05	-0.04
	(-1.10)	(-1.17)	(-1.08)	(-1.29)	(-1.13)	(-1.00)
Institutions	0.01	0.004	0.004	0.01	0.003	0.003
	(3.45)	(2.81)	(2.73)	(3.33)	(2.30)	(2.37)
Inflation	-0.003	-0.002	-0.001	-0.001	-0.001	-0.001
	(-3.07)	(-1.66)	(-1.56)	(-1.35)	(-0.59)	(-1.08)
Openness	0.01	0.01	0.01	0.01	0.01	0.004
	(2.53)	(1.78)	(1.90)	(1.34)	(0.60)	(0.45)
African Dummy	-0.01	-0.01	-0.01	-0.03	-0.03	-0.02
	(-3.08)	(-2.68)	(-2.56)	(-4.15)	(-4.14)	(-3.40)
R^2	0.55	0.56	0.58	0.50	0.56	0.57
Observations	95	95	95	66	66	66

Notes: All regressions have a constant term. Robust t-values are in parentheses. The sample consists of 95 countries and covers the period of 1970-2009 (in addition to China, Nicaragua, Ukraine and Zimbabwe, for which Finance variable is not available, Czech Republic, Lithuania, Russia and Slovakia are not in the sample because for the year 1970 the log (Initial GDP) variable is not available). In the columns (4), (5) and (6) the sample is further restricted to closely follow that of Alfaro et al. (2009); the restricted sample covers the period of 1975-95 and due to data limitations does not include Belgium, Gambia, Indonesia, Nicaragua, Sudan and Zimbabwe, which are present in the original sample of Alfaro et al. (2009).

Appendix - Table 8: Further robustness checks: Components of the GP index

Dependent variable - 5-year average annual per capita GDP growth rate

	(1) OLS	(2) OLS-FE
FDI	0.09	0.09
	(2.33)	(1.98)
Coverage	-0.01	0.003
	(-1.22)	(0.40)
Duration	0.01	0.003
	(0.76)	(0.25)
Enforcement	0.01	0.003
	(1.69)	(0.64)
Loss of Rights	-0.002	-0.004
	(-0.45)	(0.49)
Membership	0.01	0.03
	(2.48)	(3.34)
log (Initial GDP)	-0.01	-0.04
	(-6.12)	(-7.95)
Schooling	0.02	-0.01
	(2.55)	(-0.89)
Government Consumption	-0.06	-0.08
	(-3.01)	(-2.01)
Institutions	0.004	0.004
	(5.54)	(3.58)
Inflation	-0.002	-0.001
	(-13.66)	(-5.73)
Openness	0.01	0.02
	(2.74)	(2.63)
African Dummy	-0.02	-0.11
	(-5.37)	(-5.60)
R^2	0.25	0.57
Country fixed effects	No	Yes
Year fixed effects	No	Yes
Observations	652	652

Notes: All regressions have a constant term. Robust t-values are in parentheses. The sample consists of 103 countries. For the list of countries and the detailed definitions of the variables see the Appendix and the notes to Table 1. Coverage, Duration, Enforcement, Loss of Rights and Membership are the components of the GP index.

Appendix - Table 9: Further robustness checks: Standard errors clustered by country

	GDP Growth		TFP Growth	
	(1)	(2)	(3)	(4)
	OLS	OLS-FE	OLS	OLS-FE
FDI	0.16	0.21	0.24	0.25
	(2.50)	(2.94)	(4.69)	(3.69)
IPR	0.004	0.01	0.001	-0.001
	(1.82)	(3.04)	(0.75)	(-0.37)
FDI*IPR	-0.09	-0.16	-0.18	-0.22
	(-1.66)	(-2.53)	(-1.86)	(-2.29)
log (Initial GDP)	-0.01	-0.04	-0.01	-0.03
	(-4.43)	(-6.40)	(-3.74)	(-2.60)
Schooling	0.02	-0.01	0.001	-0.02
	(1.50)	(-0.71)	(0.09)	(-1.05)
Government Consumption	-0.06	-0.07	-0.01	0.002
	(-2.12)	(-1.39)	(-0.54)	(0.03)
Institutions	0.004	0.004	0.004	0.001
	(5.42)	(3.41)	(6.20)	(1.19)
Inflation	-0.002	-0.001	-0.001	-0.001
	(-11.99)	(-7.00)	(-3.30)	(-2.67)
Openness	0.01	0.02	-0.002	0.03
	(2.29)	(1.90)	(-1.49)	(3.03)
African Dummy	-0.02	0.01	-0.004	0.03
	(-3.93)	(0.72)	(-0.80)	(1.14)
R^2	0.25	0.57	0.16	0.45
Country fixed effects	No	Yes	No	Yes
Year fixed effects	No	Yes	No	Yes
Observations	652	652	652	652

Notes: All regressions have a constant term. Robust t-values, calculated with standard errors clustered by country are in parentheses. The GDP sample consists of 103 countries and TFP sample consists of 79 countries. For the list of countries and the detailed definitions of the variables see Section 1 of the Appendix and the notes to Table 1. The country-specific means are subtracted from FDI and IPR variables before constructing the FDI*IPR interaction term.

Appendix - Table 10: Exploring the Offsetting Effects between FDI and IPR

Dependent variable - 5-year average annual per capita GDP growth rate

	(1) GMM (Difference)	(2) GMM (Difference)
FDI	0.81	0.73
	(3.93)	(3.14)
IPR	0.01	0.01
	(4.49)	(3.93)
FDI*IPR	-0.19	-0.16
	(-3.61)	(-2.38)
log (Initial GDP)	-0.02	-0.02
	(-3.81)	(-3.78)
Schooling	0.02	0.03
	(0.67)	(0.94)
Government Consumption	-0.10	-0.11
	(-2.28)	(-2.19)
Institutions	0.01	0.002
	(0.81)	(0.96)
Inflation	-0.001	-0.001
	(-3.69)	(-3.51)
Openness	0.01	0.01
	(1.22)	(1.34)
Hansen test (p-level)	0.15	0.16
Arellano-Bond test (p-level)	0.26	0.34
Number of instruments	79	79
Observations	549	544

Notes: All regressions have a constant term. Robust t-values are in parentheses. In column (2) the observations which might be considered the outliers (the 99th percentile of the distribution of FDI) are dropped as a sensitivity check.

Appendix - Table 11: Further robustness checks: Discrete levels of IPR

Dependent variable – 5-year average annual per capita GDP growth rate

	(1) OLS	(2) OLS-FE	(3) OLS-FE (IPR(1-2))	(4) OLS-FE (IPR(2-3))	(5) OLS-FE (IPR(3-4))	(6) OLS-FE (IPR(4-5))
FDI	0.11	0.10	0.09	0.08	0.18	0.10
	(2.94)	(1.91)	(1.78)	(1.55)	(3.28)	(1.58)
IPR (1-2)	0.01	0.003	0.0004	0.003	0.003	0.003
	(2.11)	(0.50)	(0.05)	(0.52)	(0.50)	(0.50)
IPR (2-3)	0.01	0.01	0.01	0.002	0.004	0.01
	(2.51)	(0.67)	(0.72)	(0.27)	(0.57)	(0.66)
IPR (3-4)	0.02	0.01	0.01	0.01	0.02	0.01
	(3.10)	(1.72)	(1.85)	(1.79)	(2.31)	(1.72)
IPR (4-5)	0.02	0.02	0.02	0.02	0.02	0.02
	(2.57)	(1.86)	(2.04)	(1.95)	(1.77)	(1.77)
FDI*IPR	-	-	0.17	0.13	-0.18	0.02
	-	-	(1.57)	(1.70)	(-2.90)	(0.28)
log (Initial GDP)	-0.01	-0.04	-0.04	-0.04	-0.04	-0.04
	(-5.80)	(-7.50)	(-6.99)	(-7.48)	(-7.04)	(-7.47)
Schooling	0.02	-0.01	-0.01	-0.01	-0.01	-0.01
	(2.01)	(-0.74)	(-0.71)	(-0.68)	(-0.75)	(-0.75)
Government Consumption	-0.05	-0.06	-0.06	-0.06	-0.06	-0.06
	(-2.44)	(-1.61)	(-1.69)	(-1.70)	(-1.63)	(-1.60)
Institutions	0.004	0.004	0.003	0.004	0.004	0.004
	(5.65)	(3.31)	(3.08)	(3.30)	(3.27)	(3.31)
Inflation	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001
	(-10.51)	(-6.07)	(-6.07)	(-5.67)	(-5.79)	(-6.06)
Openness	0.01	0.02	0.02	0.02	0.02	0.02
	(2.45)	(2.87)	(2.86)	(3.05)	(3.12)	(2.86)
African Dummy	-0.02	0.002	0.01	0.002	0.01	0.001
	(-5.95)	(0.09)	(0.29)	(0.11)	(0.28)	(0.07)
R^2	0.25	0.56	0.56	0.56	0.57	0.56
Country fixed effects	No	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	Yes	Yes	Yes
Observations	652	652	652	652	652	652

Notes: All regressions have a constant term. Robust t-values are in parentheses. All regressions include four dummy variables for different levels of the IPR index (the values are shown in the parentheses). In columns (3) - (6) FDI is interacted with an IPR dummy variable for a certain level of the IPR index.

Appendix - Table 12: Further robustness checks: 10-year analysis

Dependent variable – 10-year average annual per capita GDP growth rate

	(1) OLS-FE	(2) OLS-FE	(3) OLS-FE
FDI	0.26	0.23	0.33
	(2.79)	(2.74)	(3.17)
IPR	0.01	0.01	0.01
	(2.90)	(3.39)	(2.53)
FDI*IPR	-0.28	-0.22	-0.29
	(-2.23)	(-1.92)	(-2.29)
Finance	-	-	-0.003
	-	-	(-1.27)
Domestic Investment	-	0.14	-
	-	(4.25)	-
log (Initial GDP)	-0.02	-0.02	-0.02
	(-2.10)	(-2.67)	(-2.95)
Schooling	-0.03	-0.03	-0.01
	(-1.47)	(-1.50)	(-0.54)
Government Consumption	-0.10	-0.09	-0.12
	(-2.12)	(-2.22)	(-2.69)
Institutions	0.01	0.004	0.004
	(3.30)	(2.59)	(2.77)
Inflation	-0.002	-0.002	-0.002
	(-5.60)	(-4.63)	(-5.55)
Openness	-0.003	-0.01	0.002
	(-0.40)	(-1.21)	(0.18)
African Dummy	-0.03	-0.01	0.04
	(-1.39)	(-0.68)	(3.56)
R^2	0.68	0.71	0.68
Country fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	334	334	310

Notes: All regressions have a constant term. Robust t-values are in parentheses.

Appendix - Table 13: Detailed statistics for FDI and IPR

FDI

	Percentiles	Smallest		
1%	-0.01	-0.05		
5%	0.0003	-0.03		
10%	0.001	-0.02	Obs	652
25%	0.004	-0.01		
50%	0.01		Mean	0.02
		Largest	Std. Dev.	0.03
75%	0.03	0.20		
90%	0.06	0.22	Variance	0.001
95%	0.08	0.24	Skewness	3.15
99%	0.16	0.26	Kurtosis	16.87

IPR

	Percentiles	Smallest		
1%	0.59	0		
5%	1.03	0		
10%	1.2	0	Obs	652
25%	1.7	0.13		
50%	2.39		Mean	2.55
		Largest	Std. Dev.	1.09
75%	3.37	4.675		
90%	4.18	4.675	Variance	1.19
95%	4.5	4.675	Skewness	0.28
99%	4.67	4.675	Kurtosis	2.15

Notes: The sample consists of 103 countries. For the list of countries and the detailed definitions of the variables see the Appendix and the notes to Table 1.

Appendix - Table 14: Ginarte-Park index

Country	Average 1960-90	1995	2000	2005
Algeria	2.74	2.74	3.07	3.07
Argentina	1.60	2.73	3.98	3.98
Australia	2.35	4.17	4.17	4.17
Austria	2.96	4.21	4.33	4.33
Bangladesh	1.34	1.87	1.87	1.87
Belgium	3.39	4.54	4.67	4.67
Benin	1.64	1.78	2.10	2.93
Bolivia	1.38	2.37	3.43	3.43
Botswana	1.59	2.08	3.32	3.52
Brazil	1.22	1.48	3.59	3.59
Bulgaria	1.83	3.23	4.42	4.54
Burundi	1.98	2.15	2.15	2.15
Cameroon	1.74	2.10	2.23	3.06
Canada	3.00	4.34	4.67	4.67
Central African Rep.	1.74	1.98	2.10	2.93
Chile	2.04	3.91	4.28	4.28
China	1.33	2.12	3.09	4.08
Colombia	1.05	2.74	3.59	3.72
Congo	1.74	1.90	2.23	3.06
Costa Rica	1.07	1.56	2.89	2.89
Cyprus	2.52	2.78	3.48	3.48
Czech Republic	-	2.96	3.21	4.33
Denmark	2.88	4.54	4.67	4.67
Dominican Rep.	2.12	2.32	2.45	2.82
Ecuador	1.16	2.04	3.73	3.73
Egypt	1.41	1.73	1.86	2.77
El Salvador	1.71	3.23	3.36	3.48
Fiji	2.20	2.20	2.40	2.40
Finland	2.64	4.42	4.54	4.67
France	3.29	4.54	4.67	4.67
Gabon	1.74	2.10	2.23	3.06
Germany	3.24	4.17	4.50	4.50
Ghana	1.47	2.83	3.15	3.35
Greece	2.40	3.47	3.97	4.30
Guatemala	0.77	1.08	1.28	3.15
Guyana	0.82	1.13	1.33	1.78
Haiti	2.58	2.58	2.90	2.90
Honduras	1.25	1.90	2.86	2.98
Hong Kong	2.44	2.90	3.81	3.81
Hungary	2.20	4.04	4.04	4.50
Iceland	1.67	2.68	3.38	3.51
India	1.03	1.23	2.27	3.76
Indonesia	0.00	1.56	2.47	2.77
Iran	1.91	1.91	1.91	1.91
Ireland	2.15	4.14	4.67	4.67
Israel	2.76	3.14	4.13	4.13
Italy	3.16	4.33	4.67	4.67
Ivory Coast	1.64	1.90	2.36	3.06
Jamaica	2.66	2.86	3.06	3.36
Japan	2.93	4.42	4.67	4.67

Table 14 (continued)

Jordan	0.66	1.08	3.03	3.43
Kenya	1.55	2.43	2.88	3.22
Korea (South)	2.55	3.89	4.13	4.33
Lithuania	-	2.69	3.48	4.00
Malawi	1.35	2.03	2.15	2.15
Malaysia	1.70	2.70	3.03	3.48
Mali	1.78	1.98	2.10	2.93
Malta	1.34	1.60	3.18	3.48
Mauritius	1.62	1.93	1.93	2.57
Mexico	1.19	3.14	3.68	3.88
Morocco	1.58	1.78	3.06	3.52
Nepal	1.79	1.79	1.79	2.19
Netherlands	3.43	4.54	4.67	4.67
New Zealand	2.67	4.01	4.01	4.01
Nicaragua	0.92	1.12	2.16	2.97
Niger	1.64	1.78	2.10	2.93
Norway	2.75	3.88	4.00	4.17
Pakistan	1.09	1.38	2.20	2.40
Panama	1.34	1.46	3.64	3.64
Papua New Guinea	0.00	0.00	1.40	1.60
Paraguay	1.13	1.53	2.39	2.89
Peru	0.59	2.73	3.32	3.32
Philippines	2.19	2.56	3.98	4.18
Poland	1.38	3.46	3.92	4.21
Portugal	1.48	3.35	4.01	4.38
Romania	1.50	3.52	3.72	4.17
Russian Fed.	-	3.48	3.68	3.68
Rwanda	1.94	1.95	2.28	2.28
Senegal	1.70	1.98	2.10	2.93
Sierra Leone	2.38	2.45	2.98	2.98
Singapore	1.64	3.88	4.01	4.21
Slovak Republic	-	2.96	2.76	4.21
South Africa	2.94	3.39	4.25	4.25
Spain	2.74	4.21	4.33	4.33
Sri Lanka	2.27	2.98	3.11	3.11
Sweden	2.86	4.42	4.54	4.54
Switzerland	3.04	4.21	4.33	4.33
Syria	1.68	1.87	1.99	2.19
Tanzania	1.84	2.32	2.64	2.64
Thailand	0.95	2.41	2.53	2.66
Togo	1.60	1.98	2.10	2.93
Trinidad & Tobago	1.78	2.33	3.63	3.75
Tunisia	1.45	1.65	2.32	3.25
Turkey	1.16	2.65	4.01	4.01
Uganda	1.77	2.85	2.98	2.98
Ukraine	-	3.68	3.68	3.68
United Kingdom	3.20	4.54	4.54	4.54
United States	4.14	4.88	4.88	4.88
Uruguay	1.54	2.07	3.27	3.39
Venezuela	0.92	2.82	3.32	3.32
Zaire	1.49	1.58	1.78	2.23
Zambia	1.54	1.62	1.74	1.94
Zimbabwe	1.61	2.28	2.60	2.60
Average	1.88	2.71	3.21	3.49

References

Acemoglu, Daron. 2010. "Theory, General Equilibrium, and Political Economy in Development economics", *Journal of Economic Perspectives*, 24:17-32.

Alfaro, Laura, Chanda, Areendam, Kalemli-Ozcan, Sebnem, Sayek, Selin. 2004. "FDI and economic growth: the role of local financial markets", *Journal of International Economics* 64: 89–112.

Alfaro, Laura, Charlton, Andrew. 2009. "Intra-industry Foreign Direct Investment." *American Economic Review*, 99(5): 2096–2119.

Alfaro, Laura, Kalemni-Ozcan, Sebnem, Sayek, Selin. 2009, "FDI, Productivity and Financial Development", *The World Economy* (U.K.), 32 (1): 111–35.

Alfaro, Laura, Kalemni-Ozcan, Sebnem, Volosovych, Vadim. 2008. "Why doesn't capital flow from reach to poor countries?", *The review of Economics and Statistics*, 90 (2): 347-368.

Arellano, Manuel, Bond, Stephen. 1991. "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations", *Review of Economic Studies*, 58(2), 277-97.

Arellano, Manuel, Bover, Olympia. 1995. "Another look at the instrumental variable estimation of error-components models". *Journal of Econometrics*, 68: 29-51.

Arora, Ashish, 2007. Intellectual Property Rights and the International Transfer of Technology: Setting Out an Agenda for Empirical Research in Developing Countries. *WIPO Conference*.

Ozer-Balli, Hatice, Sorensen, Bent E. 2010. Interaction Effects in Econometrics. *CEPR* Discussion Paper No. DP7929.

Barro, Robert J, Lee, Jong-Wha. 2000. "International Data on Educational Attainment, Updates and Implications." NBER Working paper 7911.

Barro, Robert J, Lee, Jong-Wha. 2010, "A New Data Set of Educational Attainment in the World, 1950-2010", *NBER* Working Paper 15902.

Balasubramanyam, V.N., Salisu, Dapsoford D. 1996. "Foreign direct investment and growth in EP and IS countries", *Economic Journal*, 106:92-105.

Bazzi, Samuel, Clemens, Michael. 2010. "Blunt instruments: A Cautionary Note on Estalishing the Causes of Economic Growth", *Center for Global Development* Working Paper 171.

Beck, Thortsen, Demirgüç-Kunt, Asli. 2009. "Financial Institutions and Markets Across Countries and over Time: Data and Analysis", *World Bank Policy Research Working Paper* No. 4943.

Blomström, Magnus, Kokko, Ari, Zejan, Mario. 1994. "Host country competition and technology transfer by multinationals". *Weltwirtschaftliches Archiv*, 130: 521-533.

Borensztein, Eduardo, De Gregorio, Jose, Lee, J-W. 1998. "How does foreign direct investment affect economic growth?", *Journal of International Economics*, 45(1): 115-135.

Bosworth, Barry, Collins, Susan M. 2003. "The Empirics of Growth: An Update", *Brookings Papers on Economic Activity*, 2: 113-206

Branstetter, Lee G, Fisman, Raymond, Foley, Fritz C. 2006. "Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from U. S. Firm-Level Panel Data", *The Quarterly Journal of Economics*, 121(1): 321–349.

Branstetter, Lee G, Fisman, Raymond, Foley, Fritz C, Saggi, Kamal. 2007. "Intellectual Property Rights, Imitation, and Foreign Direct Investment: Theory and Evidence", NBER Working Paper 13033.

Branstetter, Lee G, Fisman, Raymond, Foley, Fritz C, Saggi, Kamal. 2010. "Does Intellectual Property Rights Reform Spur Industrial Development?". *Journal of International Economics*, 83 (1): 97-112.

Carkovic, Maria V, Levine, Ross. 2002. "Does Foreign Direct Investment Accelerate Economic Growth?", *University of Minnesota Department of Finance Working Paper.*

Coe, David T, Helpman, Elhanan, Hoffmaister, Alexander W. 2009. "International R&D spillovers and Institutions", *European Economic Review*, 53: 723-741.

Cohen, Daniel, Soto, Marcelo. 2001. "Growth and Human Capital: Good Data, Good Results", *OECD Technical paper* 179.

Crespo, N. and Fontoura, M. P., 2007. "Determinant Factors of FDI Spillovers - What Do We Really Know?", *World Development*, 35(3): 410-425.

Foley, C. Fritz, Branstetter, Lee, Saggi, Kamal. 2010. "Has the Shift to Stronger Intellectual Property Rights Promoted Technology Transfer, FDI, and Industrial Development?" The WIPO Journal: Analysis and Debate of Intellectual Property Issues, 2 (1): 93-98.

Foray, Dominique. 2009. "Technology Transfer in the TRIPS Age: the Need for New Types of Partnerships between the Least Developed and Most Advanced Economies". *ICTSD Programme on IPRs and Sustainable Development, Issue Paper No. 23, International Centre for Trade and Sustainable Development, Geneva, Switzerland.*

Ginarte, Juan Carlos., Park Walter. 1997. "Determinants of patent rights: Cross-National Study", *Research Policy*, 26.

Gwartney, James D, Hall, Joshua C, Lawson, Robert. 2010. "2010 Economic Freedom Dataset", *Economic Freedom Network.*

Hassan, Emmanuel, Yagub Ohid, Diepeveen Stephanie. 2010. "Intellectual Property and Developing Countries: A review of the literature", RAND Corporation Technical Reports.

Hauk, William R. Jr., Wacziarg, Romain. 2009. "A Monte Carlo Study of growth regressions", *Journal of Economic Growth*, 14(2): 103-147.

Helpman, Elhanan. 1993. "Innovation, Imitation and Intellectual Property Rights", *Econometrica*, 61(6): 1247-1280

Heston, Alan, Summers, Robert, Aten, Bettina. 2009. Penn World Table Version 6.3, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania.

Holtz-Eakin, Douglas, Newey, Whitney, Rosen, Harvey S. 1988 "Estimating Vector Autoregressions with Panel Data", *Econometrica,* 56(6), 1371-1395.

Hu, Albert G. Z, Png, Ivan P. L. 2009. "Patent Rights and Economic Growth: Cross-Country Evidence", CELS 2009 4th Annual Conference on Empirical Legal Studies Paper.

IMF.1993. Balance of payments manual, 5 edn. Washington, DC: International Monetary Fund.

Javorcik, Smarzyanska B. 2004 "The Composition of Foreign Direct Investment and Protection of Intellectual Property Rights: Evidence from Transition Economies", *European Economic Review*, 48: 39-62.

Keller, Wolfgang. 2004. "International Technology Diffusion", *Journal of Economic Literature,* 42 (3): 752-782.

Kwan, Yum K., Lai Edwin L.-C. 2003. "Intellectual property rights protection and endogenous economic growth", *Journal of Economic Dynamics and Control,* 27: 853-873.

Lai, Edwin L.-C. 1998. "International Intellectual Property Rights Protection and the Rate of Product Inoovation", *Journal of Development Economics,* 55: 133-153.

Lai, Edwin L.-C. 2009. "The Theory of International Policy Coordination in the Protection of Ideas", *Frontiers of Economics and Globalization, 2:* 357-389.

Lipsey R. 2002. "Home and host country effects of FDI", ISIT Conference on Challenges to Globalization.

Markusen, James R, 2001. "Contracts, intellectual property rights, and multinational investment in developing countries", *Journal of International Economics,* 53: 189-204.

Markusen, James R, 2004. "Multinational firms and the theory of International Trade", *First MIT Press paperback edition.*

Maskus, Keith E, "The role of intellectual property rights in encouraging foreign direct investment and technology transfer", *the Duke Journal of Comparative International law* 9 (1): 109-62.

Maskus, Keith E, 2002. "Intellectual Property Rights in the Global Economy", Institute for International Economics.

Matsubara K., 2009. "FDI spillovers and Intellectual property rights", College of Commerce, Nihon University.

Navaretti B., Venables A. 2004. "Multinational Firms in the World Economy", Princeton University Press.

Nordhaus, William, D. 1969. "Invention, growth and welfare: A theoretical treatment of technological change", Cambridge, MA: MIT Press, 1969.

Nicholson, Michael, W. 2007. "The Impact of Industry Characteristics and IPR Policy on Foreign Direct Investment", *Review of World Economics (Weltwirtschaftliches Archiv),* 143 (1): 27-54.

Nicolini, M., & Resmini, L. 2010. FDI spillovers in new EU member states. *Economics of Transition: 1-25.*

Nunnenkamp, Peter, Spatz, Julius. 2003. "Intellectual Property Rights and Foreign Direct Investment: The Role of Industry and Host-Country Characteristics", *Kiel Working Papers 1167, Kiel Institute for the World Economy*.

OECD. 1996. Benchmark definition of foreign direct investment, 3rd edn. Paris: OECD.

Ozer-Balli, Hatice, Sorensen, Bent, E. 2010. "Interaction Effects in Econometrics", *Working Paper No 7929, CEPR.*

Park, Walter G. 2008. "International Patent Protection: 1960-2005", *Research Policy*, 37(4): 761-766.

Raian, Raghuram, Zingales, Luigi. 1998. "Financial dependence and growth", *American Economic Review*, 88: 559-86.

Rajan, Raghuram. 2010. "Fault lines: How Hidden Fractures Still Threaten the World Economy", *Princeton University Press.*

Roodman, David. 2009. "How to Do xtabond2: An Introduction to Difference and System GMM in Stata", *StataCorp LP*, 9(1): 86-136.

Scherer, F.M., 1972. "Nordhaus' Theory of Optimal Patent Life: A geometric Reinterpretation", American Economic Review, 62: 422-427.

Sherwood, Robert M. 1990. "Intellectual Property and Economic Development", Westview Press, Boulder.

UNCTAD. 2010. "UNCTADstat Data Dissemination Platform", *UNCTAD*.

World Bank. 2010. "World Development Indicators", *World Bank.*