Intellectual Property Rights and Economic Growth: Theory and Empiric

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Abstract

The divergence for the effect of strengthening intellectual property rights (IPRs) on economic growth between developed and developing countries has widened in recent years. Advanced countries often contend that stronger IPRs have a positive impact on economic growth through stimulating more domestic innovations, while developing countries argue that an extension of international IPRs would harm their technological progress and economic growth. Does a stronger IPRs protection really induce a higher rate of economic growth? This article investigates how the strength of IPRs affects economic growth. Using the detection probability to capture the strength of IPRs, our model shows that a country with stronger IPRs will induce a lower economic growth. This result indicates that stronger IPRs stimulate economic growth in developed countries, but has negative effect in developing countries. Based on a panel data of 41 countries over the 1997-2003 period and employing the IPRs indices of IMD, the empirical results find a significantly positive coefficient for the IPRs variable in advanced countries, lending supportive evidence to our theoretical prediction, but the influence of IPRs protection for developing countries is still unclear.

Key worlds: Intellectual Property Rights, Innovation, Economic growth
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1. Introduction

The endogenous growth literature, such as Romer (1990), Grossman and Helpman (1991), and Aghion and Howitt (1992) and semi-endogenous growth model posed by Jones (1995) have emphasized the role played by innovation in promoting economic growth and this argument is widely supported in previous empirical studies.[1] Therefore, how to utilize the system of intellectual property rights (hereafter IPRs) protection to create an environment conductive to the increase of innovations is an important topic in both R&D and macroeconomic policies. Indeed, the IPRs agenda have stimulated wide attention in the arena of international economic policy over the past couple decades. To strengthen and harmonize the means for protecting IPRs, industrial nations placed IPRs at the center of the agenda during the negotiations covering the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), and finally it did reach an overarching achievement to the conclusion of the Agreement of Trade-Related Intellectual Property Rights (TRIPs),[2] a foundation of the World Trade Organization (WTO).

However, whether a more stringent IPRs protection spurs economic growth? Advanced countries believe that a stronger IPRs protection can promote economic growth, because it can stimulate innovations and protect their trade benefits if South countries strengthen IPRs protections. They also contend that stronger IPRs protection would be good for developing countries, through stimulating more domestic innovations, as well as by attracting more foreign direct investment to them. Alternatively, some developing countries argue that an extension of IPRs would harm their technological progress and economic growth. They would like to establish weaker regimes favoring technological diffusion through imitation and acquisition from abroad. The divergence for the effect of strengthening IPRs on economic growth between developed and developing countries seems to widen in recent years.

Given the emerging importance of the IPRs-growth agenda and the contemporary policy debate, there are limited theoretical and empirical studies exploring the macroeconomic effects of IPRs on growth. Indeed, the role of IPR in economic growth is not clear in recent theory. Horowitz and Lai (1996) demonstrated that a duration of patent rights that maximizes the rate of innovation is greater than the duration that maximizes the welfare of consumers. They found a countervailing effect

[1] See for a comprehensive survey.

of patent length upon size and frequency of innovation, whereby longer patents increase the size, but decrease the frequency, of innovation. Laussel and Nyssen (1999) indicated that limiting the duration of patent rights might yield cases of multiple equilibriums that differ from those of cases of infinite duration. Iwaisako and Futagami (2003) showed that the patent length that maximizes the social welfare is finite. Moreover, by introducing compulsory licensing, they indicated that maximizes the social welfare is not finite even if the royalty rate can be controlled. Their model indicated that the rate of economic growth will rise when the patent protection is strengthened by extending the duration of patent rights. Osumi and Noda (2005) provided a model to include the patent renewal fee to examine the relationship between patent duration and economic growth and found that the human capital plays an important role in the patent duration -economic growth nexus.

Concerning the empirical studies, Gould and Gruben (1996) utilized cross-country data on overall levels of patent protection, trade regime, and country-specific characteristics to investigate the role of IPR in economic growth. Employing the technique of instrumental variables to control for the problems with measurement error of IPRs protection, their study empirically found that stronger IPRs protection corresponds to higher economic growth rates. Thompson and Rushing (1996) regress the average growth of real GDP per capita on the IPRs index developed by Rapp and Rozek (1992) and other control variables, and they found that IPRs protection has a positive impact on growth only in countries that reached a certain initial level of GDP per capita. In a later paper, Thompson and Rushing (1999) use SUR techniques for 55 developed and developing countries, they found that IPRs protection has a positive impact on TFP in relatively rich countries, which in turn impacts positively upon output growth. Park and Ginarte (1997) adopted the IPRs index developed by Ginarte and Park (1997) to investigate the role of IPRs in economic growth. They concluded that IPRs protection has no direct impact on growth, but has an indirect positive impact on geowth through physical capital investment and R&D in the most advanced countries. Osumi and Noda (2005) also adopted the IPRs index developed by Ginarte and Park (1997) to test the IPRs-economic growth nexus predicted in their model. The empirical evidence showed that the degree of IPRs protection exhibits a negative impact on economic growth, while the coefficient for the interactive term between

[2] The TRIPs Agreement has been extensively analyzed by Maskus (1998).

IPRs and human is significantly positive as expected in theoretical prediction. Falvey, Foster and Greenaway (2006) investigate the impact of IPRs protection on economic growth in a panel of 79 countries using threshold regression analysis. They show that whilst the effect of IPRs protection on growth depeds upon the level of development, it is positively and significantly related to growth for low- and high-income countries, but not for middle-income countries.

There is a common oversight among the theoretical literature that they derive theoretical argument by assuming that the patent duration serves as the variable for IPRs protection. As is well known, law is one thing and enforcement is another. The enforcement of existing IPRs laws differ widely across countries due to national differences in economic development and trade policy. Moreover, under the current patent system, most countries issue patents for a 20-year life, in order to bring it in line with the agreement of TRIPs. Therefore, if IPRs indeed affect economic growth, it should appear in the form of “strength” rather than “duration”. Alternative, the limited empirical studies use cross-sectional data to investigate the relationship between patent protection and economic growth. Indeed, the protection of IPRs and economic growth are inherently a dynamic process, involving both a secular evolution within one country over time. It implies that a panel data study might be favored, in order to provide more insightful portrayal on the IPRs-growth nexus.

This article examines the relationship between IPRs and economic growth in the context of theoretical arguments and empirical work. Unlike previous theoretical works, we build a model to include the strength of IPRs enforcement and then derive the effect of IPRs protection on economic growth. Furthermore, the study attempts to contribute in line with the empirical literature by providing new evidence of a panel data study. The result shows that IPRs protection has a significantly positive impact on economic growth in developed countries, but has no significant impact in developed countries.

The paper is organized as follows. Section 2 lays out the basic features of the model and then derives the equilibrium, in order to examine the effect of strengthening IPRs protection on economic growth. Section 3 describes the empirical framework and data. Section 4 reports and discusses the empirical findings. Concluding remarks and policy implication are provided in the final section.

2. The Model

The model consists of three types of agents: final good producers and intermediate good firms, and the representative household. In the final good sector, goods are homogeneous and are produced from the set of intermediate goods and labor. The intermediate good producers devote resources to invent new products. Once a product has been invented, the innovating R&D firm obtains a perpetual patent, which allows the firm to sell the good at whatever price it chooses.[3] The representative household derives utility from consumption.

2.1 Firms

Suppose that there are patented intermediate goods and non-patented goods at each point in time.

The final good market

There is a continuum of competitive firms (of mass one) producing the final good y_i, $i \in (0,1)$ using a continuum of intermediate inputs x_{ij}, and labor h_i as inputs. Specifically, the production function is given by:

$$y_i = Ah_i^{1-\alpha} \int_0^N x_{ij}^{\alpha} dj; \quad \alpha \in (0,1), \tag{1}$$

where N is the number of intermediate goods and A is a given factor productivity.

Suppose that the firms may illegally produce intermediate goods and that the unauthorized copy will be a perfect substitute for the legal copy. In order to simplify the analysis, we assume that the firms use only a fixed fraction ϕ of the legal copy (i.e., the piracy rate is $1-\phi$).[4] Given that θ is the detection probability and f (>1) is the fine imposing on the firm. Moreover, assume that perfect competition prevails in the final goods market and that the final good is viewed as the numeraire. Under the assumption that factor markets are perfectly competitive and maximize its expectative profit:

$$Max\ \pi_i = Ah_i^{1-\alpha} \int_0^N x_{ij}^{\alpha} dj - wh_i - \int_0^N \phi p_j x_{ij} dj - \int_0^N (1-\phi)(1+\theta f) x_{ij} dj, \tag{2}$$

where w is the real wage and p_j is the relative price of the j-th intermediate good. Equation (2) implies that the final good producers can convert one unit of the final goods into one unit of intermediate good. This is same as the intermediate good firm's

[3] In order to sharpen the role of the strength of IRPs, we neglect the role of patent length. In fact, it is easy to show that our main result will hold if the patent length is finite.

[4] Appendix A shows that a negative relationship between the detection probability (fine) and the

technology. Based on (2), the demand function of labor and intermediate inputs are given by:

$$w=(1-\alpha)\frac{y_i}{h_i}, \quad (3)$$

$$\phi p_j+(1-\phi)(1+\theta f)=\alpha A h_i^{1-\alpha}x_{ij}^{\alpha-1}, \quad (4)$$

The intermediate good market

The intermediate good firms face a two-stage decision process. In the first stage, the producers must decide whether to devote resources to invent a new design. And the firms must determine the optimal price at the second stage. We proceed by solving the model backward.

Stage 2 The optimal price

Assume that every intermediate good is produced by using one unit of the final goods into one unit of intermediate goods when the new design has already been invented. Then the profit function of the *j*-th intermediate firm is given by:

$$\pi_j=(p_j-1)x_j, \quad (5)$$

where $x_j=\int_0^1 x_{ij}di$, which is the aggregate quantity demanded over the final good producers.

Given that the intermediate goods are patented, firms behave monopoly position. As a result, the price of the patented intermediate good p^m charged by the intermediate firms is given by:

$$p^m=\frac{\phi+(1-\alpha)(1-\phi)(1+\theta f)}{\alpha\phi}>1. \quad (6)$$

The output level and the profit of the patented intermediate good x^m and π^m are:

$$x^m=[\frac{\alpha^2 A}{1+\theta f(1-\phi)}]^{1/(1-\alpha)}h, \quad (7)$$

$$\pi^m=\frac{(1-\alpha)\{\alpha^{1+\alpha}A[1+\theta f(1-\phi)]^{-\alpha}\}^{1/(1-\alpha)}}{\phi}h, \quad (8)$$

By using (1) and (7), the aggregate output is given by:

$$y=[\frac{\alpha^2 A^{1/\alpha}}{1+\theta f(1-\phi)}]^{\alpha/(1-\alpha)}hN, \quad (9)$$

Stage 1 The decision in R&D activities

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economic growth rate is still held when the piracy rate is endogenous determined.

In order to simplify the analysis, we assume that the inventor retains a perpetual patent protection and that there is no patent fee. Let V denoted the innovator's net present value of returns, that is:

$$V = \int_0^\infty \pi^m e^{-rt} dt, \tag{10}$$

where r is the interest rate.

Suppose that R&D firms can invent one unit of intermediate good by using η unit of the final good and that there is free entry into the business of being an inventor. We focus the main discussion on an equilibrium with positive R&D. We hence have:

$$V = \eta. \tag{11}$$

Using (10) and (11), the interest rate is given by:

$$r = \frac{\pi^m}{V} + \frac{\dot{V}}{V}. \tag{12}$$

As a result, the interest rate is given by:

$$r = \frac{\pi^m}{\eta} = \frac{(1-\alpha)(\alpha^{1+\alpha} A)^{1/(1-\alpha)}[1+\theta f(1-\phi)]^{-\alpha/(1-\alpha)} h}{\phi\eta} = \frac{\alpha(1-\alpha) y}{\phi\eta N}. \tag{13}$$

2.3 The representative household

The economy is populated by a unit measure of identical and infinitely-lived households. The representative household derives positive utility from consumption c. Accordingly, the representative household's discounted lifetime utility is given by:

$$\int_0^\infty \ln c e^{-\rho t} dt; \tag{14}$$

where $\rho\,(>0)$ is the subjective rate of time preference.

The household is constrained by its budget. Specifically, the household is bound by a flow budget constraint linking assets accumulation to any difference between its income and expenditure at each instant of time, that is:

$$\dot{a} = wh + ra - c. \tag{15}$$

where a is assets. It should be noted that the total household assets equals the market value of firms, that is $a = \eta N$ in equilibrium,.

The household chooses c so as to mximize the discounted sum of utility (14), subject to (15), and given the initial capital k_0. The optimal change in consumption can be expressed as:

$$\frac{\dot{c}}{c} = r - \rho. \tag{16}$$

2.4 Symmetric equilibrium and balanced growth path

The symmetric market equilibrium is defined as a set of market clearing prices and quantities such that:

i. the final good firms maximize profits, i.e., (3) and (4);

ii. the intermediate producers maximize profits, i.e., (6)-(9) and (13);

iii. the representative household maximize his/her lifetime utility, i.e., (15) and (16).

Let γ be the balanced growth rate of output. It easily derives some results related to the parameters from (13) and (16) on the output growth rate:

$$\frac{\partial\gamma}{\partial\theta} = -\frac{(1-\phi)(\alpha^2 A)^{1/(1-\alpha)} fh}{\phi\eta[1+\theta f(1-\phi)]^{1/(1-\alpha)}} < 0, \tag{17}$$

$$\frac{\partial\gamma}{\partial f} = -\frac{(1-\phi)(\alpha^2 A)^{1/(1-\alpha)} \theta h}{\phi\eta[1+\theta f(1-\phi)]^{1/(1-\alpha)}} < 0, \tag{18}$$

$$\frac{\partial\gamma}{\partial\phi} = -\frac{[(1-\alpha)(1+\theta f)-\phi\theta f](\alpha^{1+\alpha} A)^{1/(1-\alpha)} h}{\phi^2\eta[1+\theta f(1-\phi)]^{1/(1-\alpha)}} \gtrless 0; \quad if \quad \phi \gtrless \frac{(1-\alpha)(1+\theta f)}{\theta f}. \tag{19}$$

Equations (17) and (18) show that IPRs protection (i.e., a rise in the detection probability θ and fine *f*) will deter economic growth. The economic intuition is quite obvious. Given that a rise in the detection probability and fine will increase the demand for the patented intermediate good (inferred from (4)); this will lead a rise in the patented intermediate goods' price (see (6)). It is easily inferred from (8) to obtain that the profit of the intermediate good firms fall. This will lower the interest rate, and hence deter the economic growth rate (inferred from (13) and (16).

Equation (19) indicates that the impact of the piracy rate on the economic growth rate is ambiguous. Intuitively, on the one hand, a lower in the piracy rate (i.e., a rise in ϕ) directly increases the marginal cost the patented intermediate good, and hence decreases the intermediate goods demand. On the other hand, a lower in the piracy rate will decrease the marginal cost of the final good producers, leading to an increase in the patented intermediate good demand. As a result, the impact of lower in the piracy rate on the intermediate good demand is ambiguous. This implies that the piracy rate has an ambiguous impact on the final intermediate good producer's profit as well. And hence, an ambiguous relationship between the piracy rate and the economic growth rate can be found in (19). The net effect depends on the relative strength of those two channels. Figure 1 is helpful to our understanding of the relationship between the piracy rate and economic growth. Obviously, a piratical policy can enhances economic growth only when the initial piracy rate is smaller enough (those are usually advanced countries). This result confirms the advanced countries' belief that a stronger IPRs protection can promote economic growth.

[Insert Figure 1 about Here]

From (19), we can find a critical value of ϕ, namely ϕ^*, which maximizes the balanced growth rate:

$$\phi^* = \frac{(1-\alpha)(1+\theta f)}{\theta f}. \tag{20}$$

It is clear from (20) that the optimal piracy rate, $1-\phi^*$, is negatively related to the detection probability and the fine.

3. Empirical Specification and Data

To examine the role of IPR protection in economic growth, most of cross-country empirical studies, using cross-sectional data, utilized a growth equation derived from the empirical framework proposed by Barro (1991), modified to reflect the influence of IPR on growth.[5] In this paper, using cross-country panel data, the model specification follows Shujie Yao (2006). Assuming a Cobb-Douglas technology, output (*Y*) is essentially determined by two physical inputs, labor (*L*) and capital (*K*) as shown in (21).

$$Y = AL^{\alpha} K^{\beta} e^{e} \text{……………………………………………}(21)$$

The model can be expanded to include other variables that may have an effect on *Y*. For instant, the multiplier *A* may not be a constant. It may be influenced by a set of non-physical input varables, such as human capital, R&D expenditure and the degree of IPRs protection. Based on this argument, the empirical regression model can be expressed as

$$\begin{aligned} \ln(GDP)_{it} &= \beta_0 + \beta_1 \ln(labor)_{it} + \beta_2 \ln(capital)_{it} + \beta_3 \ln(RD)_{it} \\ &+ \beta_4 (human\ capital)_{it} + \beta_5 (IPR)_{it} + \varepsilon_{\text{it}} \end{aligned} \tag{22}$$

where GDP_{it} is the annual real gross domestic product (GDP) of country *i* in year *t*, $labor_{it}$ is the total labor force of country *i* in year *t*. Term $capital_{it}$ is the capital stock of country *i* in year *t*. In this paper, capital stock is calculated using the flows of capital investments according to (23).

$$K_{it} = \sum_{s=0}^{1/\delta}(1 - s\delta)I_{i,t-s} \quad (23)$$

Where K is physical capital stock, I is flows of capital investments, δ is depreciation rate. δ is assumed to be 10%.

According to the endogenous growth theories and our theoretical argument, terms *RD*, *human capital* and *IPR* are included as explanatory variables, serving as the benchmark model. Term RD_{it} denotes i country's R&D expenditure and it is expected to exert a positive impact on growth. Term IPR_{it} represents i country's strength of IPRs protection. It is the main factor we concern that it might stimulate or retard economic growth, depending on the contradicting forces of market expansion and market power effects.

How does one measure the notional differences in IPRs? Ginarte and Park (1997) developed indices to measure the degree of patent protection. Unfortunately, this index cannot be adopted in this study, because the dataset we use is the 1997-2003 period, while these indices are only available as late as in 1990 and for years 1995 and 2000. The lack of a consecutive and consistent IPRs index prevents the insightful analyses on the dynamic relation between IPRs and economic growth. The IPRs protection index measured by International Institute for Management Development (IMD) serves as excellent alternative indices, because this comprehensive index of IPRs is a consecutive and consistent index for a larger pool of countries. The IMD survey is related IPRs protection in general. The question of their survey is that whether IPRs protection "is not enforced in your country" (score1) or "is enforced in your country" (score 10). Thus, this index ranges from 1 to 10 for IMD. A higher value of the index indicates a stronger level of protection. In order to investigate whether North countries' standard on IPRs protection is really suitable for South countries, equation 22 can be estimated for developed and developing countries, separately.

Human capital is widely recognized as one major influence of economic growth, we therefore include a proxy of human capital saving that is measured as the secondary-school enrollment rate. A positive sign is expected.

In order to capture the role of IPR protection in economic growth, especially after

[5] See, for example, Mankiw et al. (1992) and Gould and Gruben (1996).

the implementation of TRIPs, the object of this study comprises 41 countries[6], including 21 developed countries and 20 developing countries, during 1997-2003. As for the definition, basis statistics, and data sources of the variables used in this paper, they are summarized in Table 1.

[Insert Table 1 about Here]

On exploring the relationship between IPRs protection and economic growth, we allow for the existence of individual effects which are potentially correlated with the right-hand side of regressors, such that

$$\varepsilon_{it} = v_{it} + u_i . \tag{21}$$

Here, u is a country-specific effect that varies across countries but within a country over time, and v is a "white noise" error term. Using a "within firm" panel estimator, fixed effect (FE) or a random effect (RE) technique, to eliminate the individual effect is a standard estimation method. As is well known, FE is less efficient than RE, because it uses only a variation in the data within each firm through time (Hsiao, 1986). However, this country-specific component in the error term may be quite plausibly correlated with a firm's innovation strategy, implying that the RE estimators are inconsistent when the assumption of zero correlation between the error term and right-hand side regressors is violated. Therefore, we employ the Huasman test to judge which model is more appropriate.

4. Empirical Results

Table 2 shows the results of basic panel data estimate. The within-firm estimations can be separated into a random effect model and a fixed effect model. The χ^2 values of Hausman tests are significant at the 1% statistical level, implying that the FE model is more appropriate. Due to the fact that both RE and FE models have their potential bias, we report both these estimates while focus on discussing the FE estimates. The results from the estimation of Equation (22) indicate that IPRs protection has positive impact on economic growth in whole countries. As to developed countries, the sign and impact of the estimated coefficient of IPRs protection are similar to total countries, and both are significant at the 1% statistical level. But at the same time, the effects of IPRs protection on economic growth is quite different in developing countries, the coefficient of IPRs protection is positive but not significant. The results show that the

[6] The countries selected in this paper fit in with the countries included in IMD index.

impacts of IPRs protection on economic growth are really different between developed and developing countries.

[Insert Table 2 about Here]

It is noteworthy that the estimates for the impact of IPRs protection might be inconsistent when the IPRs protection is assumed to be an exogenous rather than endogenous variable. The enforcement of IPRs is probably influenced by other factors such as economic development and technological specialization. It means that national regimes of IPRs protection may strongly depend on level of economic development (Maskus, 2000).

Endogeneity causes inconsistency of usual OLS estimates and requires instrumental variable methods like two-stage least squares (2SLS) to obtain consistent parameter estimates (Baltagi, 2000). Adopting the error component two-stage least squares (EC2SLS) derived by Baltagi (1981), and using the lag value of IPRs protection as instruments, we can resolve the problem of endogeneity. The results of panel IV estimate show in Table 3. The χ^2 values of Hausman tests are significant at the 1% statistical level in total and developed countries but not significant in developing countries, so we focus on the results of FE estimate and RE estimate respectively. Although the significant level of IPRs protection on economic growth reduce from 1% to 10% in developed countries, the result of panel IV estimate are similar to basic panel data estimate. In total countries and developed countries, the impacts of IPRs protection on economic growth are still significantly positive, and the coefficient of IPRs protection is positive but not significant in developing countries.

[Insert Table 3 about Here]

The empirical results support the theoretical predict only in developed countries, and we find no evidence of negative impact of IPRs protection on economic growth in developing countries after the enforcement of TRIPs Agreement. Although the negative relation do not be found in developing countries, the different impact of IPRs protection on economic growth between developed and developing countries has be proved both in theoretical predict and empirical result.

5. Conclusion and Policy Implications

There is a common oversight among the theoretical literature that they derive theoretical argument by assuming that the patent duration serves as the variable for

IPRs protection. As is well known, law is one thing and enforcement is another. The enforcement of existing IPRs laws differ widely across countries due to national differences in economic development and trade policy. Therefore, if IPRs indeed affect economic growth, it should appear in the form of “strength” rather than “duration”.

In the theoretical model of this paper, piracy rate is introduced to represent the enforcement of IPR protection. A lower in the piracy rate means intensification in IPRs protection. The result shows that the impact of the piracy rate on the economic growth rate is ambiguous. On the one hand, a lower in the piracy rate directly increases the marginal cost the patented intermediate good, and hence decreases the intermediate goods demand. On the other hand, a lower in the piracy rate will decrease the marginal cost of the final good producers, leading to an increase in the patented intermediate good demand. As a result, the impact of lower in the piracy rate on the intermediate good demand is ambiguous. This implies that the piracy rate has an ambiguous impact on the final intermediate good producer’s profit as well. The net effect depends on the relative strength of those two channels. From figure 1, it is obvious that a piratical policy can enhances economic growth only when the initial piracy rate is smaller enough (those are usually advanced countries). This result confirms the advanced countries’ belief that a stronger IPRs protection can promote economic growth. On the contrary, the developing countries with higher piracy rate will be harmed by the intensification in IPRs protection.

To prove the different impact of IPRs protection between north countries and south countries, and to show the dynamic process of IPRs protection, this paper estimates the IPRs-growth nexus base on a panel data of 41 countries over the 1997-2003 period and employing the IPRs indices of IMD, while estimates for developed and developing countries separately. In the base model of panel data approach, the IPRs variable has a significantly positive impact on economic growth in developed countries, lending supportive evidence to our theoretical prediction. However, we can not find a negative impact of IPRs variable on economic growth in developing countries, as the theoretical model predict. In developing countries, the empirical result shows a positive but not significant coefficient of IPRs variable. After considering the endogenous problem of IPRs index, the results are still unchanged.

From the theoretical predict and empirical test, the positive impact of stronger IPRs protection on economic growth in developed countries is again proved, but the argument in developing countries is still ambiguous. However, since the TRIPs Agreement imposed minimum standards of IPRs protection on WTO members, we find no evidence that stronger IPR protection reduces growth, even in developing countries. For developing countries, the positive effect of stronger IPRs protection primarily comes from encouraging imports and inward FDI from advanced countries, which need other government policies to induce. Since countries of WTO members must meet the accompanying TRIPs obligations, developing countries should be more constructive in policies design to augment imports and inward FDI from advanced countries. Base on this, developing countries can reap the benefits of freer trade without sacrificing economic growth.

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Figure 1 IPRs Protection and Economic Growth

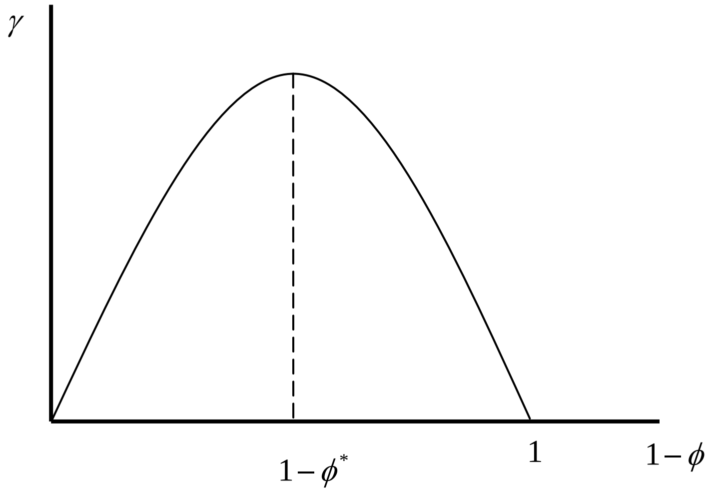

Table 1 Variable Definition, Basic Statistics, and Data Sources

Variable name	Definition	Mean	Standard Error	Data Source
GDP	Annual real gross domestic product of destination country (US$ million)	928238.432	167774.731	World Development online (WDI)
Labor	Labor force (thousand)	49968.541	127037.460	
Capital	Capital stock	1203132.126	2799577.206	
RD	R&D expenditure (US$ million)	16166.041	41811.290	
Human Capital	Secondary-school enrollment rate	98.733	25.770	
IPR	The degree of IPRs protection of destination Country. It ranges from 1-10 and a higher value denotes a stronger protection	6.295	1.710	The World Competitiveness Yearbook, International Institute for Management Development

Note: The means and standard errors are calculated by pooling data for the 1997-2003 period.

Table 2 IPRs and Economic Growth (Base model)

	Tot		*Developed-countries*		*Developing-countries*	
	Fixed Effects	Random Effects	**Fixed Effects**	Random Effects	**Fixed Effects**	Random Effects
lnCapital	0.120***	0.336***	0.203***	0.244***	0.106*	0.203***
	(0.038)	(0.036)	(0.039)	(0.037)	(0.063)	(0.054)
lnLabor	0.423***	0.205***	0.707***	0.562***	0.255*	0.198***
	(0.092)	(0.035)	(0.097)	(0.046)	(0.164)	(0.058)
Ipr	0.011***	0.007	0.012***	0.010**	0.009	0.006
	(0.004)	(0.005)	(0.004)	(0.004)	(0.006)	(0.007)
lnRd	0.238***	0.248***	0.185***	0.211***	0.240***	0.232***
	(0.017)	(0.019)	(0.026)	(0.025)	(0.024)	(0.024)
Human capital	-0.001	-0.001*	-0.0001	-0.0003	-0.001	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
R^2	0.805	0.928	0.986	0.990	0.791	0.830
Hausman test		376.62***		20.16***		66.80***

Note: Figures in parentheses are standard deviations. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3 IPRs and Economic Growth (Panel IV Estimate)

	Tot		*Developed-countries*		*Developing-countries*	
	Fixed Effects	Random Effects	**Fixed Effects**	**Fixed Effects**	Random Effects	**Fixed Effects**
lnCapital	0.080*	0.353***	0.171***	0.279***	0.062	0.185***
	(0.047)	(0.039)	(0.067)	(0.041)	(0.074)	(0.062)
lnLabor	0.415***	0.206***	0.693***	0.557***	0.3016**	0.220***
	(0.104)	(0.041)	(0.155)	(0.067)	(0.168)	(0.063)
Ipr	0.042***	0.017	0.073*	0.029	0.033	0.026
	(0.015)	(0.0150)	(0.040)	(0.021)	(0.020)	(0.021)
lnRd	0.210***	0.238***	0.032	0.176***	0.229***	0.222***
	(0.023)	(0.024)	(0.128)	(0.061)	(0.026)	(0.026)
Human capital	0.0004	-0.001	0.002	0.0001	0.0002	-0.001*
	(0.001)	(0.001)	(0.018)	(0.001)	(0.002)	(0.002)
R^2	0.814	0.933	0.980	0.990	0.767	0.821
Hausman test		37.68***		14.96***		4.68

Note: Figures in parentheses are standard deviations. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.