

2010

An Examination of Non-linear Relationships between Intellectual Property Rights Protection and Growth

Brian R. Lemak
Gettysburg College
Class of 2010

Follow this and additional works at: <http://cupola.gettysburg.edu/ger>

 Part of the [Economic Theory Commons](#), [Finance Commons](#), and the [Macroeconomics Commons](#)

Share feedback about the accessibility of this item.

Lemak, Brian R. (2010) "An Examination of Non-linear Relationships between Intellectual Property Rights Protection and Growth," *Gettysburg Economic Review*: Vol. 4, Article 3.

Available at: <http://cupola.gettysburg.edu/ger/vol4/iss1/3>

This open access article is brought to you by The Cupola: Scholarship at Gettysburg College. It has been accepted for inclusion by an authorized administrator of The Cupola. For more information, please contact cupola@gettysburg.edu.

An Examination of Non-linear Relationships between Intellectual Property Rights Protection and Growth

Abstract

This paper examines the possibility of a non-linear relationship existing between intellectual property rights protection (IPR) and gross domestic product (GDP) growth rates. A theoretical justification is developed for the potential existence of a non-linear relationship in terms of a quadratic relationship. This is then examined using panel data from 191 countries and taken in 5 year intervals, although the data had many missing observations. Results indicate there is statistically significant evidence that a quadratic relationship exists between IPR and GDP growth, however there are reservations about this evidence due to a dearth of observations in countries with very weak intellectual property rights protections.

Keywords

property rights, intellectual property, GDP

An Examination of Non-Linear Relationships between Intellectual Property Rights Protection and Growth

Brian Lemak

Abstract

This paper examines the possibility of a non-linear relationship existing between intellectual property rights protection (IPR) and gross domestic product (GDP) growth rates. A theoretical justification is developed for the potential existence of a non-linear relationship in terms of a quadratic relationship. This is then examined using panel data from 191 countries and taken in 5 year intervals, although the data had many missing observations. Results indicate there is statistically significant evidence that a quadratic relationship exists between IPR and GDP growth, however there are reservations about this evidence due to a dearth of observations in countries with very weak intellectual property rights protections.

I. Introduction

The Solow growth model indicates that growth depends on three factors: capital, labor and technology growth. Capital and labor are rather simple to define and measure. The difficulty in properly generating a Solow growth model lies in modeling technological change. Other results in the literature, namely Lai (1998), have shown that using foreign direct investment (FDI) and intellectual property rights protection (IPR) can serve as good proxy variables for technology growth. However, these results do not consider potential non-linear relationships between IPR and growth.

Taking inspiration from Helpman's (1993) North-South model of trade, I propose a new model for looking at long run growth. Helpman argues that there is an innovating country in the North and an imitating country in the South

and develops a model of trade around this premise. The Northern country could also be a firm that has some form of technology and the Southern country could be a firm which imitates technology, although not necessarily domestic technology. Applying the model this way, changes in IPR policy will be seen in GDP growth, with policies where the benefit to the innovating firm outweighs the cost to the imitating firms will lead to increases in GDP growth. Policies where the costs to the imitating firms outweigh the benefits to the innovating firm will see GDP growth fall, thus giving two different responses in the growth rate for the same policy change. As a result, the direct impact of IPR on growth would have a non-linear impact, quadratic in this case. This will be discussed in more detail later in the paper.

If this non-linearity truly exists then there are major policy implications internationally. Simply increasing IPR will not necessarily lead to more growth. The IPR must be

calibrated to be in balance with the needs of the innovating and imitating firms. This method of calibrating IPR based on domestic market structure will be more efficient than the current IPR regimes only if this non-linear relationship exists. This paper will seek to determine if this non-linear relationship exists.

In the next section the relevant literature will be reviewed and their importance to this study will be discussed. The third section will outline the theoretical model I will use to determine if this non-linear relationship exists. The fourth section will discuss the empirical model that will be used based on conclusions the theoretical model gives. The fifth section will be devoted to the interpretation of results. The sixth section will examine statistical critiques of the model and ensure that the results are statistically justified which will be followed by the final section where I

will discuss my conclusions and indicate any avenues for future research.

II. Literature Review

The article, “International Trade, Economic Growth and Intellectual Property Rights: A Panel Data Study of Developed and Developing Countries,” by Patricia Higinio Schneider (2005) investigates an empirical specification that investigates a relationship closely related to my work. Schneider’s purpose for the study was based on the idea that countries may experience different technological diffusion based on whether or not they are a developed or a developing country. If these different diffusion rates exist and have a large enough impact, it could imply that different types of countries require different policy regimes to encourage growth.

Unlike the other papers in the literature, Schneider uses a much larger set of developing nations in her data.

Including these countries should allow for more meaningful results, as small sample sizes of developing nations could have lead to bias in earlier work. Schneider uses aggregate data at the country level, instead of the usual micro-level models in the literature. While this specification loses some detail, it allows Schneider the ability to make more inferences for countries and country groupings. Her results indicate that separating developed and developing countries yields different results than specifications which include both groups together, however I believe that simply correcting for country-specific omitted variables by using a fixed effects approach will suffice for my model.

The most shocking result was in regard to the impact of IPR protection in the split specification using innovation as the dependent variable. As expected, the coefficient on IPR protection was positive and significant in the developed countries model. The results for the developing countries

model showed a negative relationship, and in some specifications this was a significant result. This result would seem to confirm Schneider's hypothesis that there are different diffusion rates for developed and developing economies, since the impact of IPR protection is so radically different. If the diffusion rates were the same, the coefficient on IPR would be fairly close together. Since Schneider's results have a significant difference between developed and developing countries, it makes it likely the diffusion rates are different.

The GDP specification showed little of the divergence seen in the innovation specification. IPR is only significant in the regression that includes all countries, and only when fixed effects are applied, indicating there may be country-specific omitted variables that need to be corrected. This does confirm the findings of Gould and Gruben (1996);

however it seems to contradict the findings in the innovation specification.

Schnedier's conclusions about the divergent results on the coefficient of IPR are that the innovation that occurs in developing nations may be more directly related to other technologies than what occurs in developed nations. If this is true, then increasing IPR protections would stifle innovation in developing nations, and provide an adversarial relationship between firms in developed versus developing economies. This is similar to the reasoning I have used in my North-South adaptation which will be discussed in greater detail in the next section.

The article "Intellectual Property Rights and Economic Growth," by Rod Falvey, Neil Foster and David Greenaway (2006) investigates the impact of IPR on economic growth in a panel data using 79 countries and threshold regression techniques. Their results indicate that

the relationship between IPR and growth depends on the initial level of GDP in a non-linear fashion. They make special note that in no case did increased IPR protection lead to negative growth, so there are no real changes for policy recommendations. They found that there is no impact for middle income countries but high and low income countries experience positive effects from increasing IPR. The authors theorize this may be due to middle income countries being more likely to engage in imitation. However, this makes little sense to me since it is even more likely that low income countries would engage in imitation, since middle income countries would be engaging in imitation because they can gain net utility from the imitation of outside innovation. It stands to reason that low income countries could get the similar utility from imitation, but the results indicate this is not true.

The authors argue that simply squaring IPR or creating an interaction term between IPR and initial GDP is not sufficient. They base this argument off of results obtained, indicating that the coefficient estimates on these variables were not significant. However, this conclusion was based on results from a smaller dataset than I plan on using. The threshold model works quite well, however I think the authors may have been able to find success with the much simpler specification.

The article “Patent Rights and Innovative Activity: evidence from national and firm-level data,” by Brent B. Allred and Walter G. Park (2007) investigates the impact of IPR on innovation. The authors find that significant non-linear relationships exist, however care must be taken in applying these results to this paper. This paper dealt with the impact of IPR on innovation and while innovation clearly has an impact on GDP, there is no guarantee that IPR will

display the same non-linear relationships when growth is the dependent variable instead of innovation.

There is a theoretical reason to believe the relationship should carry through. According to the authors patent filings are dependent on IPR and IPR squared in addition to other variables. Suppose, instead of foreign direct investment (FDI) and IPR, these proxies for technology growth were replaced with patent filings. Then the model will still have IPR in it and because IPR are in the equation in both linear and non-linear form, the model would also have IPR in linear and non-linear form after substitution. Thus, the model specification with both IPR and IPR squared is theoretically justified from the results of Allred and Park, since they showed the existence of non-linear relationships when innovation is used as the dependent variable.

The article “International Intellectual Property Rights Protection and the Rate of Product Innovation,” by Edwin L.-C. Lai (1998) investigates the impact of FDI and IPR on a country’s innovation rate in a theoretical manner. Lai’s results lead to a number of theorems which are quite relevant to this research mainly that stronger IPR will lead to lower innovation and a lower wage rate of the South relative to the North, provided that imitation is the main source of innovation for the South. If this is not the case and so-called “multinationalization” is the main source of growth, stronger IPR will lead to higher innovation and a higher wage rate of the South relative to the North. This is the theoretical reason this “multinationalization” concept must be accounted for, which will be included in the model via the FDI variable. This gives the ability to control for countries where imitation is the main source of growth and for countries where multinationalization is the source of growth.

III. Theoretical Methodology

Before developing the empirical model for this paper, stronger justification at the theoretical level is needed.

Consider a country with two types of firms, innovating firms which create their own intellectual property and imitating firms which do not create their own intellectual property, but use intellectual property developed by others either domestically or internationally. This is similar to the model of trade developed by Helpman (1993), however in this case the trade is applied to the domestic economy and there is some distribution of innovating and imitating firms at the domestic level. Now, suppose that the government decides to increase IPR, holding everything else constant. Firms are now faced with a decision to innovate or imitate. The increase in IPR makes it easier for innovating firms to recoup innovation investment costs, thus making more innovation activity viable. The innovating firms will choose

to innovate and the imitating firms will choose to imitate the technology that comes from innovating firms. The innovating firms' innovation will lead to new technologies emerging and as imitating firms adopt those technologies productivity increases and as a result GDP growth increases.

However, with stronger IPR in place, it is more likely that the imitating firms can be taken to civil court for an intellectual property violation. As a result, the diffusion of technology to other firms will slow out of concern about lawsuits and/or fighting any IP infringement lawsuits. The legal profession is one where no generally applicable innovation occurs. New legal arguments and new laws can come from the legal area, but legal firms getting more revenue and higher profits will not lead to the same productivity growth as technological diffusion does. If IPR increases continue, the likelihood of an imitating firm being taken to court for IP violations will approach 1. As a result,

the diffusion of new technology will slow even further, preventing any growth in productivity and thus allowing GDP growth to stagnate.

However, if no IPR exist there will be no incentive for innovating firms to innovate since they will have no ability to make up the research costs. As a result, no technology can be created to diffuse to the imitating firms and GDP growth will stagnate. This setup indicates that there must be some point between no IPR and “infinite” IPR where the GDP growth rate is maximized. An actual prediction for this maximization point would require information about firms’ decision strategies, a true measure of lawsuit likelihood and other variables that are not available empirically. However, this model would indicate that the relationship between IPR and GDP growth is not entirely linear. The simplest non-linear model would be a model where GDP growth was impacted by IPR in a

negative quadratic fashion. This would give some maximization point between no IPR and “infinite” IPR and also allow for stagnant growth at very extreme values of IPR. As a result, an empirical model which showed the existence of a negative quadratic relationship between GDP growth and IPR would be evidence supporting the validity of this theoretical model. Additional ways of testing this could be by looking at patent rate or the allocation of resources between production, innovation and bureaucracy. These are somewhat more complex than looking at GDP growth rates, but should also show some sort of non-linear relationship with IPR. The remainder of this paper will focus on an investigation of the GDP growth rate empirical model.

IV. Empirical Methodology

The model for this paper will help determine if a significant non-linearity exists in the relationship between GDP growth and IPR. Evidence that would help to prove

this would be regression results which show a coefficient estimate that is statistically significant in difference from 0. I hypothesize this coefficient will be negative due to the theoretical ramifications of a negative coefficient. Namely, it would imply that there can be deleterious effects from having an IPR regime that is too strict. Contradicting evidence would be a coefficient that is not statistically significant in difference from 0.

A properly specified model is needed to test this hypothesis. Clearly, GDP growth will be the dependent variable and IPR squared will be an independent variable. Neither of these variables have any units associated with them, since IPR is an index and GDP growth will be measured by the natural log of GDP, which lacks any units. Beyond that relevant theory must drive model construction. The first variable to add is IPR. IPR squared is already included, but to ensure the full effect of IPR is included, IPR

should be included. Based on Lai (1998), a term that can account for multinationalization is needed. Foreign direct investment (FDI) will account for this potential relationship; however the natural log of this variable will be used due to FDI being measured in dollars, since the dependent variable is a unit-less variable.

The remainder of the model will stem directly from the traditional Solow growth model. An assumption that labor force participation is constant over the long-run is sensible here, so there is no need to include any variables related to employment. However, human and physical capital stocks are not static. To account for changes in capital I will use the fact that capital divided by GDP will be proportional to the investment rate in the long-run. Thus, the ratio of investment spending to total GDP as our measure of the investment rate will be used. The benefit of this measurement is it has already removed units from

consideration, so there is no need for any further modifications to the variable. This still leaves human capital stock unaccounted for so a measure of educational achievement will be included to control for human capital effects. Specifically some measurement of enrollment rates or a comparable statistic will be used. This again will not have any units, so no further transformation is needed. Finally, the current level of real GDP per capita will be used to control for any differences in growth due to convergence effects. The model is thus:

$$\text{pcgrowth}_{it} = \beta_0 + \beta_1(\text{investratio}_{it}) + \beta_2(\text{enroll}_{it}) + \beta_3(\text{Ln}(\text{FDI}_{it})) + \beta_4(\text{IPR}_{it}) + \beta_5(\text{IPR}^2_{it}) + \beta_6(\text{Ln}(\text{rGDP}_{it}))$$

However, it is possible that the impact of IPR on growth is not immediately felt. As a result, a second specification will be run with values of IPR and IPR^2 lagged one period. I expect the coefficients on all variables but IPR^2 and $\text{Ln}(\text{rGDP})$ to be positive in both specifications. I expect a

negative coefficient on IPR^2 because it would be consistent with the non-linearity that I outlined in the previous section. The negative expected coefficient on $\ln(rGDP)$ comes from the fact that the Solow model predicts that wealthier countries will grow slower than poorer countries, everything else being equal.

V. Data

Ideally data for this study would be a yearly measure of all the above variables from every country starting at around 1960 and progressing to the present day with no missing observations. Unfortunately, this type of data is not available. Thus, data from every 5 years will be used due to the only reliable dataset for IPR (the Park-Ginarte dataset) only having 5 year increments available. Additionally, there is no data for enrollment rates that dates back far enough for the purposes of this study. Primary school completion rates from the World Development Index will be used as a proxy

for enrollment as this data does go back for a few decades. Unfortunately, there are a large number of missing observations due to countries not reporting. Since this is the only viable measure of human capital for this type of study, there are no options other than using this data while being wary of potential issues. Specifically, only around 600 observations for primary school completion exist while the measurement of IPR and other variables have over a thousand observations, although these datasets are also incomplete.

There is still another problem with the data. The 2005 values for IPR were collected by the International Property Rights Index with help from one of the authors of the Park-Ginarte dataset. Unfortunately, this data was an index from 0 to 10 while the previous values were an index from 0 to 5. I corrected this by dividing all the 2005 values by 2, but this difference in measurement could result in some

measurement error. More importantly, the IPR data is an index which has dubious statistical qualities. This could induce some level of measurement error, but similar to the issue with human capital data there is no viable alternative. The values for percent growth rate, investment ratio and initial real GDP all come from the Penn World Tables version 6.3. The values for FDI and primary school completion rate come from the World Bank Human Development Indicators. All the values for IPR, except for the 2005 values which were discussed earlier, come from the Park-Ginarte dataset. The dataset covers a total of 191 countries. Table 1 provides further details on the general statistics of the variables in the model.

Table 1 Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
pcgrowth	1426	7.165795	7.625921	-18.00167	106.717
investratio	1614	.2100859	.130203	.0116	1.0492
ln(fdi)	681	74.80013	28.03788	3.976747	138.1592
completion	1026	18.35626	2.934997	9.21034	26.49556
ipr	1109	2.484707	.8748409	0	5
ipr ²	1109	6.938425	4.282599	0	25
ln(rgdp)	1614	7.794784	1.355245	4.511518	11.19713

These missing observations could play a large role in the ability to determine the validity of the hypothesis. By having so many missing observations, the sample size is drastically decreased. This increases the likelihood of a non-representative sample and will also inflate the standard errors. As a result of this, vigilance is needed when observing standard errors. The issue of potential measurement error in IPR is a more distressing problem, as this will bias our estimates and change our standard errors. Fortunately, the errors related to the 2005 sample can be removed by simply removing the 2005 sample. This is not

the best solution, however if the errors prove to be large enough to bias results it is a remedy available.

VI. Results

Table 2 Regression output

	Standard fixed effects model results (t-statistics)	Lagged fixed effects model results (t-statistics)
Investratio	35.9561*** (5.73)	37.99499*** (6.55)
Completion	-.071811** (-2.17)	-.0578015* (-1.80)
Ln(fdi)	.6962578*** (3.16)	.5503132** (2.49)
IPR	2.145613 (0.97)	
IPR2	-.9584257** (-2.19)	
Ln(rgdp)	-3.162094*** (-3.76)	-3.431289*** (-3.85)
constant	19.39636 (3.47)	21.86361 (3.34)
Lag(IPR)		1.106924 (0.41)
Lag(IPR ²)		-.4786142 (-0.92)
Observations	430	421
R ²	.2966	.2775
Prob>F	0.000	0.001

* statistically significant in difference from 0 at the .1 level

** statistically significant in difference from 0 at the .05 level

*** statistically significant in difference from 0 at the .01 level

For the standard fixed effects model, the coefficient estimate on investment ratio indicates that a change of .1 in the investment ratio will increase the growth rate of GDP by 3.595 percentage points, holding constant the influence of the other included variables. The p-value associated with this estimate (0.000) indicates that one rejects the null hypothesis that the coefficient estimate is 0. This coefficient estimate is statistically significant in difference from 0.

The coefficient estimate on primary school completion rate indicates that a change of 1 will decrease growth by .072 percentage points, holding constant the influence of the other included variables. The p-value associated with this estimate (0.031) indicates that one rejects the null hypothesis that the coefficient estimate is 0. This coefficient estimate is statistically significant in difference from 0.

The coefficient estimate on $\ln(\text{FDI})$ indicates that a change of 1 in the natural log of FDI will increase growth by .696 percentage points, holding constant the impact of the other included variables. The p-value associated with this estimate (0.002) indicates that one rejects the null hypothesis that the coefficient estimate is 0. This coefficient estimate is statistically significant in difference from 0.

The coefficient estimate on IPR indicates that a 1 point change in IPR will increase GDP growth by 2.146 percentage points, holding constant the impact of the other included variables. The p-value associated with this estimate (0.334) indicates that one fails to reject the null hypothesis that the coefficient estimate is 0. This coefficient estimate is not statistically significant in difference from 0.

The coefficient estimate on IPR^2 indicates that a 1 point change in IPR will decrease growth by .958 percentage points, holding constant the impact of the other included

variables. The p-value associated with this estimate (0.029) indicates that one rejects the null hypothesis that the coefficient estimate is 0. This coefficient estimate is statistically significant in difference from 0.

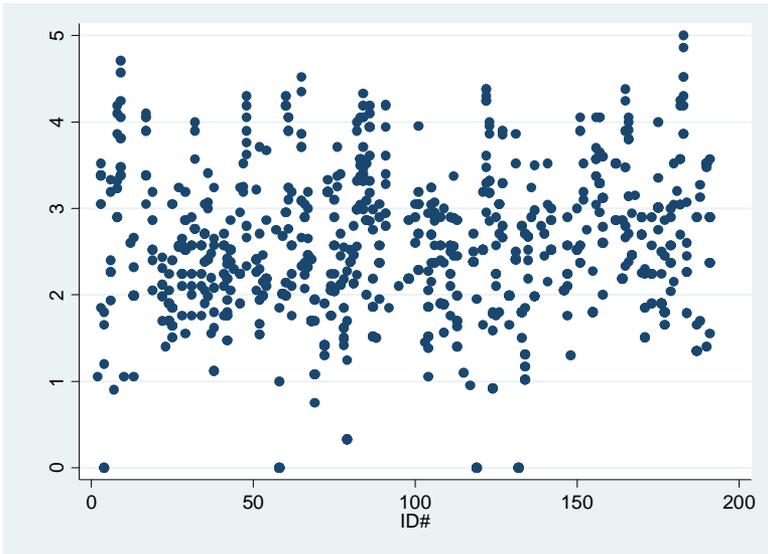
The model's R^2 value indicates that approximately 30% of the variation in the growth rate of GDP can be explained by the variation in the independent variables. The Prob>F value (0.000) indicates that one rejects the null hypothesis that the coefficients on all included variables is 0.

Generally speaking, the results for the standard model were in line with expectations. With the exception of completion rate all coefficient estimates had proper signage. However, the negative coefficient on completion rate does have an economic explanation. The coefficient estimate on $\ln(rGDP)$ was negative and statistically significant in difference from 0. This would indicate that wealthier countries grow slower, everything else in the model being

held constant. However, wealthier countries are more likely to have a high rate of primary school completion. Thus, the negative statistically significant in difference from 0 coefficient estimate is due to the wealthier countries growing slower and having a higher primary school completion rate.

These results do indicate there is a statistically significant in difference from 0 squared relationship between IPR and growth rate. This gives some weight to the argument that there is a non-linear relationship between IPR and growth rate, but caution must be exercised. Figure 1 indicates that very few countries have extremely weak intellectual property rights regimes. As a result, any inference about the impact of IPR on growth rates when IPR is less than 1 must be taken with a grain of salt. It is for this reason that caution is needed when discussing the existence of non-linear relationships between IPR and growth.

Figure 1 IPR vs. ID



Neither of the IPR variables in the lagged model was statistically significant in difference from 0 at the .1, .05 or .01 confidence levels. This would indicate that, despite some theoretical backing, past values of IPR do not have an impact on growth rates today. This is a rather curious result and warrants further investigation.

VII. Empirical Model Critique

Table 3 Correlation Coefficients

	investratio	completion	lnfdi	ipr	ipr2	lnrgdp
investratio	1.0000					
completion	0.5307	1.0000				
lnfdi	0.3147	0.5853	1.0000			
ipr	0.2132	0.3089	0.3512	1.0000		
ipr2	0.2420	0.3214	0.4099	0.9662	1.0000	
lnrgdp	0.5236	0.7729	0.7276	0.4590	0.5044	1.0000

There is little theoretical reason to believe any of these variables, save IPR IPR², and ln(rGDP) should exhibit any multicollinearity. A correlation study, seen in Table 3, indicated there was no significant correlation between any of the independent variables except those noted earlier, confirming this belief. The multicollinearity associated with ln(rGDP) is somewhat worrying, however the standard errors were low enough and the inclusion of ln(rGDP) important enough that correcting for the multicollinearity will hurt the

theoretical strength of the model. As a result, no action was taken to correct for multicollinearity. The standard errors are very close to normally distributed as seen in Figure 1. Additionally, there appears to be no evidence of any serious serial autocorrelation or heteroskedasticity as seen in Figures 2 and 3 respectively. As a result, no correction was made due to the relatively small impact these statistical problems could have on the model.

Figure 2 Histogram of Errors

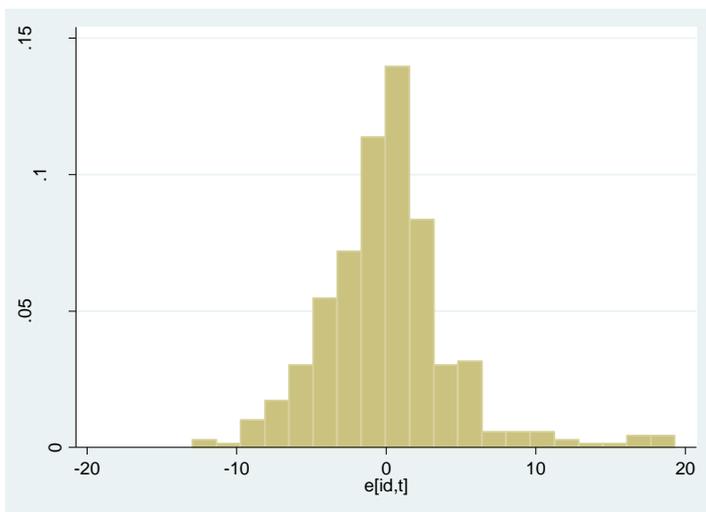


Figure 3 Errors vs. Year

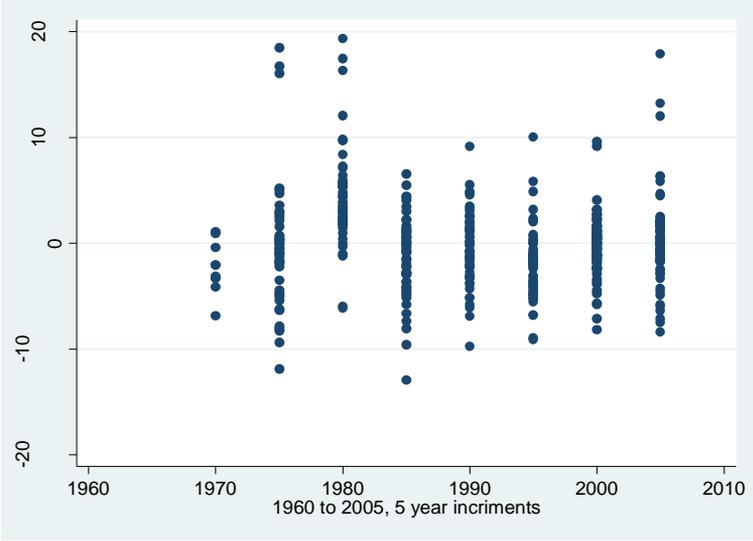
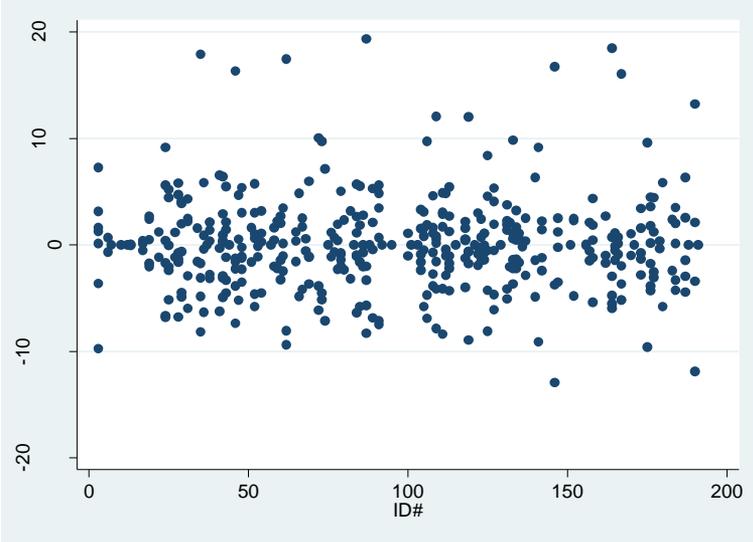


Figure 4 Errors vs. Country ID



The question of the model having possible measurement error is a valid one, considering that countries may have outright lied or “massaged” numbers when surveyed by the publishers of this data. However, if there is any measurement error which truly biases the model it would have to exist over multiple decades (and multiple government regimes) and multiple countries. This is fairly unlikely simply because of the mathematical implications of basic probability theory. If one assumes that one country has a 50% chance to lie during data collection in one period, the combined probability of even ten of the observations being lies is quite low (less than .1%). Additionally, even if a large set of countries did lie, they would also probably have lied in other surveys, making any kind of correction by using a proxy variable rather difficult. As a result, though measurement error could exist, this model will not account

for it because of the low likelihood it exists and the difficulty of correction if it does exist.

Endogeneity was considered as another possible issue but at the theoretical level it does not make much sense. If endogeneity did exist it would say that growth rate dictates IPR policy, but because growth rate is highly variable, with a standard deviation of 7.63 and a mean of 7.17 (see table 1), policy makers would be constantly adjusting IPR. As a result IPR would also be highly varied. It is not possible to say how exactly the relationship worked, but if growth rates have high variability and determine IPR, then IPR should also have a fairly high variability. This does not fit with the basic summary statistics for IPR as IPR has a standard deviation of .87 and a mean of 2.48. If growth rates were truly determining IPR, IPR should be highly varied like growth rates are, with a standard deviation fairly close to the mean. But there is a much larger gap between the mean of

IPR and the standard deviation of IPR then is seen with growth rate, which would confirm this theoretical argument for endogeneity not being an issue.

VIII. Conclusion

To conduct this study I used panel data from a number of sources and a model that included IPR, IPR^2 , $\ln(FDI)$, investment ratio, $\ln(rGDP)$ and primary school completion rate. There was some concern about potential measurement errors in IPR due to IPR being an index from 0 to 5; however there was no real solution as the dataset in this paper is the best dataset available for measuring IPR.

Additional concerns were raised about missing observations in both IPR and primary school completion rate. Primary school completion rate was used because no enrollment rate variables had the necessary time scale that was needed for this study. Similar to the concerns about measurement error

in IPR, there was no real solution to the concerns about missing observations in the variables as no alternative was available.

The results did show statistically significant in difference from 0 evidence of a quadratic relationship between IPR and GDP growth. Care must be taken in interpreting this as evidence of a non-linearity existing because of a dearth of observations where IPR was less than 1. Other results confirming this relationship would allow for more confidence in stating a non-linear relationship between IPR and GDP growth exists. Additionally, there was a statistically significant in difference from 0 negative coefficient on completion rate. This makes theoretical sense, despite contradicting a priori expectations, since wealthier countries are more likely to grow slower and more likely to have a high completion rate.

Future studies should attempt to replicate these results and determine if these results are valid. Results which can confirm this relationship would make arguments for the existence of non-linearities much stronger. Additional studies may also want to look at alternate specifications since the lagged specification did not show any statistically significant from 0 relationship between IPR and growth despite having a fairly strong theoretical basis. Future work may also want to investigate the other empirical ways of proving IPR works on the economy in a non-linear fashion which were mentioned in the theoretical methodology section. Specifically, the impact IPR will have on patent rates or the impact IPR will have on distribution of resources between production, innovation and bureaucracy.

References

Falvey, Rod, Foster, Neil, and David Greenaway. 2006. "Intellectual Property Rights and Economic Growth." *Review of Development Economics* 10, no. 4 (November 2006): 700-719.

Helpman, Elhanan. 1993. "Innovation, Imitation, and Intellectual Property Rights." *Econometrica*, Vol. 61, No. 6 (Nov., 1993), pp. 1247-1280

Schneider, Patricia Higinio. 2005. "International Trade, Economic Growth and Intellectual Property Rights: A Panel Data Study of Developed and Developing Countries." *Journal of Development Economics* 78, no. 2: 529-547.

Stryzowski, Piotr K. 2006. "Intellectual Property Rights, Globalization and Growth." *Global Economy Journal* 6, no. 4: 1-31.

Allred, Brent B., and Walter G. Park. 2007. "Patent Rights and Innovative Activity: Evidence from National and Firm-Level Data." *Journal of International Business Studies* 38, no. 6: 878-900.

Furukawa, Yuichi. 2007. "The Protection of Intellectual Property Rights and Endogenous Growth: Is Stronger Always Better?." *Journal of Economic Dynamics and Control* 31, no. 11: 3644-3670.

Lai, Edwin L.-C. 1998. "International Intellectual Property Rights Protection and the Rate of Product Innovation." *Journal of Development Economics* 55, no. 1: 133-153.

Gould, David M., and William C. Gruben. 1996. "The Role of Intellectual Property Rights in Economic Growth." *Journal of Development Economics* 48, no. 2: 323-350.

Data Sources

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

Dedigama, Anne Chandima, and Hernando de Soto Fellow. 2008. "International Property Rights Index 2009." Property Rights Alliance, <http://www.internationalpropertyrightsindex.org>

Juan Carlos Ginarte and Walter Park. 1997. "Determinants of Patent Rights: A Cross-National Study," *Research Policy*, Vol. 26, No. 3, pp. 283-301

The World Bank. "World Development Indicators 2009." World Bank, <http://go.worldbank.org/SI5SSGAVZ0>.