Chapter 1 Introduction

In the past centuries, researchers have been empirically and theoretically examining the relation of economic growth and intellectual property right (IPR) protection. Helpman (1993) indicated the ambiguity of benefit from the tighter protection of intellectual property rights, and also suggested that the tighter IPRs only stimulate the rate of innovation in the short run but decrease innovation rate in the long run (in the developed countries).

Lucas and Romer (1980) propose the endogenous growth theory - they utilize the accumulation of human capital and the merchandise of others avoiding the decreasing of marginal productivity of capital in Solow's (1956) model. Endogenous growth theory criticizes the defect of neoclassical growth theory. Neoclassical growth theory suggests that the real income per capita is fixed, implying there's no permanent economic growth in the steady-state. Evidence shows the fact of growing in real GDP per person in industrialized countries.

Barro (1990) examines the main determinant of economic growth in the industrialized countries which is the accumulation of knowledge and experience, which has enhanced the output productivity. Therefore, Barro's research emphasizes the contribution of human capital to productivity. Therefore, many researchers focus on the effect of protecting intellectual property rights in endogenous growth models in recent decades.

First of all, we need to investigate whether or not the protection of intellectual property rights that stands for an index of human capital, which explains economic growth. In order to quantify and rank from country to country, we measure the level of IPR protection. Gould and Gruben (1996) employ the proxy for intellectual property rights taken from an index of patent protection developed by Rapp and Rozek (1990), which constructs their own measurement. Moreover, Ginarte and Park (1997) proceed with Gould and Gruben's

conclusion, who employ the level of patent protection developed by Rapp and Rozek (1990) examining the relationship between economic growth and IPRs. By the cross-section of countries for the period 1960-1990, Ginarte and Park's empirical results agree with the fact that IPRs affect economic growth by stimulating the accumulation of human capital inputs such as research and development factors. Patent protection benefits more in the open economy than the closed economy, while the open economy stands for a more competitive environment. The existing literature integrates the concept of intellectual property rights protecting and human capital accumulation that stimulates economic growth together, emphasizing the important determinant role of intellectual property rights in economic growth (Gould and Gruben, 1996; Kwan et al. 2003). The protection of intellectual property rights is suggested to provide motivation for innovation as the energy of economic growth (Ginarte and Park 1997). When IPRs improve economic growth seems to be a truth that we take for granted, part of the researchers thought that IPR would raise imitation cost, tending to diminish technology flows and global innovation (Helpman, 1993; Glass and Saggi, 1999). Moreover, they have noticed that there exist different growth modes between developing countries and developed countries. Developing countries do not gain much from IPR protecting, which provided North-South product-cycle model explaining and tried to find the equilibrium (Helpman, 1993).

Endogenous growth theory support the policy of enhancing education and R&D, later improving the economic growth in the long run. After 21th century, researchers utilize either econometrical or statistical methodology to examine the appropriate regulation of IPR. For example, Takalo and Kanniainen (2000) use real option model analyzing the effect to the investments of innovation firms from protecting IPR. The result shows that protecting IPR does not definitely raise the profit of innovation firm. Ding and Liu (2009) use the DEA frontier to analyze productivity changes by taking software piracy as an input into account. The results of Ding et al. suggest that a policy maker should focus on the enforcement of IPR

protection in the developing economies in order to improve the productivity.

Besides protection of intellectual property rights, Grossman and Helpman (1991) also suggest foreign direct investments (FDI) as another indicator of technological diffusion. Schneider (2005) made a panel data study of 46 developed and developing countries, during the period of 1970-1990, finding that IPR affects the innovation rate and more significant for the developed countries than the developing countries. However, Schneider suggests that the impact of FDI to economic growth rate is less decisive than before. This explains that the capital causes play no more important roles in economic growth. Actually, institutional policy making in one country is getting more important currently. Institution in a country like economic freedom has tremendous effects in economic growth. Economic freedom is a term in debating economic and policy. Mostly the major concepts of economic freedom refer to market liberty and private property rights institution, extensive to social economic welfare. Adkins et al. (2002) investigate three institutional factors affecting macroeconomic growth performance by using the production frontier approach; evidence shows that economic freedom has the most significant effect associated with technical efficiency.

However, it is costly to protect patent for developing countries, especially the patent rights that belongs to foreign countries (Primo Braga, 1990). During the policy making, the optimization of protecting IPRs is still a critical issue to be solved. Chen and Puttitanun (2005) try to develop the optimal IPR decision model to get a balance between strict regulation and relaxation in the developing countries and use panel data analysis to do the empirical estimation. This study shows an alternative perspective on intellectual property rights protection in the developing countries.

In summary, there are opposite perspectives about the impact of IPR protection on the growth of GDP. Gould and Gruben (1997) explain that there exists the “weak” and positive relationship between patent protection and economic growth. Chen and Puttitanun (2005) suggest that increasing GDP per capita will increase IPRs, also confirming the phenomenon of

a U-shape relationship between IPRs and degree of economic growth. Chen et al. doubt whether or not the accumulation of knowledge and experience has been disappearing since IPRs increases in the developed countries. Horii and Iwaisako (2007) extend for a quality ladder model to explain how the total effect of economic growth and social welfare that the stronger IPR made, and mention of the adverse effect of monopoly on productivity and innovative incentives. In contrast to Chen and Puttitanun (2005), Furukawa (2007) provides an inverse U-shaped relationship between IPR protection and economic growth, and concludes that both extremely strong and weak IPR protection lessen the incentives for innovation. According to Furukawa's variety expansion model of endogenous growth, the inverse U-shaped relationship occurs in the developed countries due to the enough effect of accumulated experience on productivity.

Previous literature emphasizes the effect of learning by experience (Arrow, 1962; Dasgupta and Stiglitz, 1988.) On the other hand, researchers confirm the ambiguous effect of IPR protection, which shows a certain direction to either positive side or negative side, on economic growth (Gould and Gruden, 1996; Horii and Iwaisako, 2007; Furukawa et al., 2007). Nevertheless, both results show that the positive and negative directions appear in the IPR protection that indeed affects economic growth, and moreover, the previous studies used the data from 2000 before (Gould and Gruben, 1996; Ginarte and Park, 1997; Schneider et al. 2005). As in our study, we discuss the reasons that cause economic growth by analyzing the panel data from 2000-2007 of 46 countries.

More specifically, this study focuses on the following main issues: (1) the effect direction of IPR protection on economic growth, (2) the relationship between the magnitude of information diffusion by globalization and economic growth, (3) the relationship between the magnitude of information diffusion and protection of IPRs, and (4) the causality between IPR protection and economic growth. Due to the unsteady relationship between IPRs and economic growth, we estimate parameters by OLS for an equation using seemingly unrelated

regression (SUR; Zellner, 1962) model in our empirical research.

In general, OLS regression is performed to estimate the parameters of cross-sectional data separately. The purpose we employ SUR to do the estimation is that we estimate the model for a panel of data simultaneously is in order to eliminate the heteroscedasticity problems. In our research, we cannot ignore the influence of globalization resulting from the prevalence of information diffusion.

Our study investigates the current relation between intellectual property rights protection and economic growth. We also employ several dominant exogenous variables in the econometric model. The empirical result has shown that there exists a negative and endogenous relationship between IPR protection and economic growth.

This study is organized as follows: Section 2 elaborates the hypothesis of endogeneity laying out the econometric regression model, and explaining the relationship between each variable we employ. Section 3 explains the sources of the data we employ and do the variable description. Section 4 is the empirical analysis by using SUR to estimate our model and discuss our empirical results. Section 5 concludes this paper and discusses the research limitations.

Chapter 2 Methodology

2.1 Endogeneity of IPR protection and economic growth

Research and development (R&D) is taken into account as an endogenous factor in the previous researches of economic growth (Romer, 1980; Helpman et al. 1993). Arnold (2002) discusses the stability of the market equilibrium in Romer's model of endogenous change. Eicher and García-Peñalosa (2008) extensively analyzed the effects of endogenous institutional quality on the performance of the economy, which integrated the endogenous strength of IPR protection into an R&D-based growth model. Endogeneity occurs when the independent variable is correlated with the error term in a regression model, which implies that the regression coefficient in an OLS regression is biased.

Endogenous relationship means the independent variable is determined within the dependent variable system, otherwise exogenous if it is determined outside. Theoretically, it is relatively straightforward to determine whether a variable is endogenous or exogenous to an econometric model. However, there is always an empirical question as to whether the model is adequate and thus whether variables that are theoretically exogenous are in fact endogenous to the system being modeled.

2.2 Econometric model

The empirical analysis uses a panel data set from 2000 to 2007, including 46 countries. The technology factor could be important for explaining export behavior of developing country enterprises in medium and low technology industries that previous research suggests the relationship between high-technology exports and patent protection (Liu and Lin, 2005). The GDP growth regression considers high-technology exports to be the level of industrialization in a country. Also, we employ Internet users (per 100 people) and mobile

cellular subscriptions (per 100 people) as the level of information diffusion in country-level.

We do our data analysis by SUR estimation. The reason we estimate a system of four equations using the SUR method is that allows for different error variances in each equation and for correlation of these errors across equations (Makki and Somwaru, 2004). To eliminate any country-specific effects or unobserved heterogeneity we first-differenced the data, we use SUR, which can benefit the estimation procedure of regression coefficients. An OLS regression estimates the parameters of two equations separately. The SUR specification is expressed as a set of linear regressions where the disturbances in the different equations are correlated, all equations are estimated simultaneously in order to eliminate or reduce heteroscedasticity problems when we used SUR with cross-section weights.

To avoid the heteroskedasticity from panel data related to residual contemporaneous correlation, we do the cross-sectional seemingly unrelated regression (SUR) estimation after panel estimation (Zellner, 1962). Seemingly unrelated regression model are multiple regression equation systems. It differs from the multivariate regressions model in that it allows difference explanatory variables between difference equations. This specification provides great flexibility on statistics modeling.

Taking account of the correlation of the error terms across equations led to new estimates that are asymptotically more efficient than usual least squares estimates and appropriate test statistics for testing hypotheses (Zellner, 1962).

A general panel data regression model is

$$Y_{it} = \alpha_{it} + \beta_{it} X_{it} + u_{it}, \quad u_{it} \longrightarrow N(0, \sigma_u^{\,2}) \tag{1}$$

where $i = 1,2,...,G$, $t = 1,2,...,T$ represents the G cross-sectional groups, *t* represents period of time. SUR model assume that α and β vary across the cross-section groups but not over time. The equations in our study can be simplified as

$$Y_{it} = \alpha_i + \beta_i X_{it} + u_{it}, \quad (2)$$

where $i = 1,2,....,G$. Our model considers the mutual causality relation between economic growth rate and protection of intellectual property right, also the multicollinearity. The protection of intellectual property right and economic growth rate appear unrelated except for the correlations among the residuals. The simultaneous equations are as follows:

$$Y_{it} = \alpha_0 + \alpha_1 IPR_{it} + \alpha_2 PopGR_{it} + \alpha_3 Mobile_{it} + \alpha_4 HTX_{it} + u_{it} \quad (3)$$

$$IPR_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 NetUse_{it} + \beta_3 EF_{it} + v_{it} \quad (4)$$

where α_0 and β_0 represent for the intercept coefficient; Y_{it} represents the GDP growth rate of country *i*; IPR_{it} stands for the level of IPR protection in country *i*; $PopGR_i$ represents the growth rate of population; $Mobile_{it}$ represents the mobile cellular subscriptions per 100 people; HTX_i represents the high-technology exports (% of manufactured exports); $NetUse_{it}$ represents number of the Internet users per 100 people; EF_{it} represents the degrees of economic freedom in country *i*; and u_{it} and v_{it} represent the error term of each equation.

If the u_{it} and v_{it} follow the standard assumptions of zero mean, constant but different variances, no autocorrelation, and no contemporaneous (by the condition of given a *t*) correlation between the errors of these two equations, then these equations are essentially unrelated. Multi-equation models use both cross-section and time series data are common in econometric studies.

By applying the OLS procedure to each equation separately, we obtain estimates that are unbiased, consistent, and most efficient. In macroeconomic analysis, these variables often affect the different cross-sectional errors in a similar way so that they are contemporaneously correlated. Then we may have

$$Cov(u_{it}, v_{it}) = \sigma_i, \text{ where } \sigma_t \neq 0, \quad (5)$$

Note that there is not any intertemporal correlation in SUR model, which can be expressed as follows:

$$Cov(u_{it}, u_{js}) = 0, \quad \forall \quad t \neq s \tag{6}$$

$$Cov(v_{it}, v_{js}) = 0, \quad \forall \quad t \neq s \tag{7}$$

$$Cov(u_{it}, v_{js}) = 0, \quad \forall \quad t \neq s, \tag{8}$$

Besides the endogenous effect of IPR protection to economic growth, it is necessary to investigate the impacts of development, technology, competitiveness, and information diffusion in a country. Previous researches separate samples into developing countries and developed countries discussing different effects with different conditions (Chen and Puttitanun 2004, Schneider 2005, Ding and Liu 2009). Nevertheless, based on the classifications in the *World Development Indicators* by World Bank, the rate of population growth and high-technology exports are considered as the development degree of a country. Another reason we employ the percentage of high-technology exports to manufacturer exports into the economic growth regression is the presence of substantial and sustained exports in the high-technology sector is a measure of national competitiveness in high-technology (Seyoum, 2004). Therefore, telecommunication plays an important role affecting economic growth (Lam and Shiu, 2010). We employ Internet users (per 100 people) and mobile cellular subscriptions (per 100 people) as the variables of information diffusion. Evidence shows that strong IPR regulation retards the speed of international information diffusion (McCalman, 2005). This study discusses the relation between country development and information diffusion economic growth, so does the relation between IPR and development.

Chapter 3 Data and Variable Description

3.1 Data

In this paper, we basically investigate the main causes of economic growth from 2000-2007. The data come from various sources. The dependent variable that we take for measuring economic growth is the GDP growth rate from World Bank key indicators during the period of 1998-2007.

Before discussing the impacts of IPRs, the primary problem that we need to solve is the way to quantify and calculate the levels of protection of IPRs in these countries. According to previous literatures, there are various ways to in order to measure the level of IPR protection. Rapp and Rozek (1990) use the index, which is compiled in *Patent Laws* by United States Department of Commerce in 1978 as the measurement of IPR protection. The score are graded among 0 to 5. With respect to this, Ginarte and Park (1997) propose the defect of oversimplification that Rapp-Rozek index calculates levels based on dummy variables. Ferrantino (1993) take dummy variables to measure whether a country exist IPR law characteristic, but the data are not complete enough in our study. Ginarte and Park (1997) establish an index of patent rights for 110 countries during the period 1960-1990 by considering more various aspects into their calculation. Nevertheless, the indexes we referred above cannot support this study in order to discuss the phenomenon during the current decade. We employ the IPR protection level collected from *Global Competitiveness Report Yearbook* published by the World Economic Forum (WEF). The WEF mentions protection of IPRs as an important issue of innovation taken account of competitiveness in a country. The IPR protection indexes are drew from the Executive Opinion Survey (Survey). Most questions in the

survey follow a structure asking participants to evaluate, on a scale of 1 to 7, one particular aspect of their operating environment. At one end of the scale, 1 represents the worst possible situation, and at the other end of the scale while 7 represents the best.

In addition, considering of the measurement of information diffusion, we use mobile cellular subscriptions and Internet users for our variables. According to the report published by World Bank, globalization has been a persistent phenomenon of the post-war period. Previous studies on China manufacturers suggest the key factor of the economic growth rapidly in China is allowing knowledge diffusion (Mu and Lee, 2005). In order to confirm the influence of cross-country information spillover on economic growth, we consider information diffusion into our model. The numbers of mobile cellular subscriptions and Internet users in each country was collected from World Bank. The percentage of high-technology exports is provided by World Bank's *World Development Indicators*. High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery.

This study also considers the effect degree of economic freedom to GDP growth. According to James Gwartney and Robert Lawson et al. defined in *Economic Freedom of the World: 1996 Annual Report*,

> "Individuals have economic freedom when property they acquire without the use of force, fraud, or theft is protected from physical invasions by others and they are free to use, exchange, or give their property as long as their actions do not violate the identical rights of others. An index of economic freedom should measure the extent to which rightly acquired property is protected and individuals are engaged in voluntary transactions."

The economic free data are collected from the web http://www.freetheworld.com. The index published in *Economic Freedom of the World* (EFW) is designed to measure

the consistency of a nation's institutions and policies with economic freedom. The main determinants of economic freedom are (1) personal choice; (2) voluntary exchange coordinated by markets; (3) freedom to enter and compete in markets; (4) protection of persons and their property from aggression by others. The freedom index ranges from 0 to 10, with a higher index indicating a higher level of economic freedom.

Table 1 summarizes definitions and sources of the main variables used in this study. The list of 46 countries of our sample is provided in Table A1 in the Appendix section.

Table 1

Definitions and sources of main variables

Variables	Definitions	Sources
Y	GDP growth rate	World Bank (2008)
IPR	Intellectual property rights protection index	World Economic Forum (2008)
Pop Growth	Population growth rate	World Bank (2008)
HTX	High-technology exports (% of manufacturer exports)	World Bank (2008)
Mobile	Mobile cellular subscriptions (per 100 people)	World Bank (2008)
Net Use	Internet user (per 100 people)	World Bank (2008)
Econ Free	Economic freedom index	Gartzke et al. (2008)

3.2Variable Description

We calculate the averages of IPR protection and GDP growth rate of each country and present the negative relationship between IPR protection and economic growth in Figure 1. In our sample countries, China has the highest average GDP growth rate, 10.11%. The average IPR protection of China is 3.375, which is relatively lower in contrast to most of the developing countries. The average values of IPR protection of United States, Finland, Switzerland, Denmark, and United Kingdom are higher than 6, however the highest average value of GDP growth rate is only 3.36%. According to the two-way significantly negative correlation between IPR protection and economic growth rate, we depict an endogenous relationship in Figure 1.

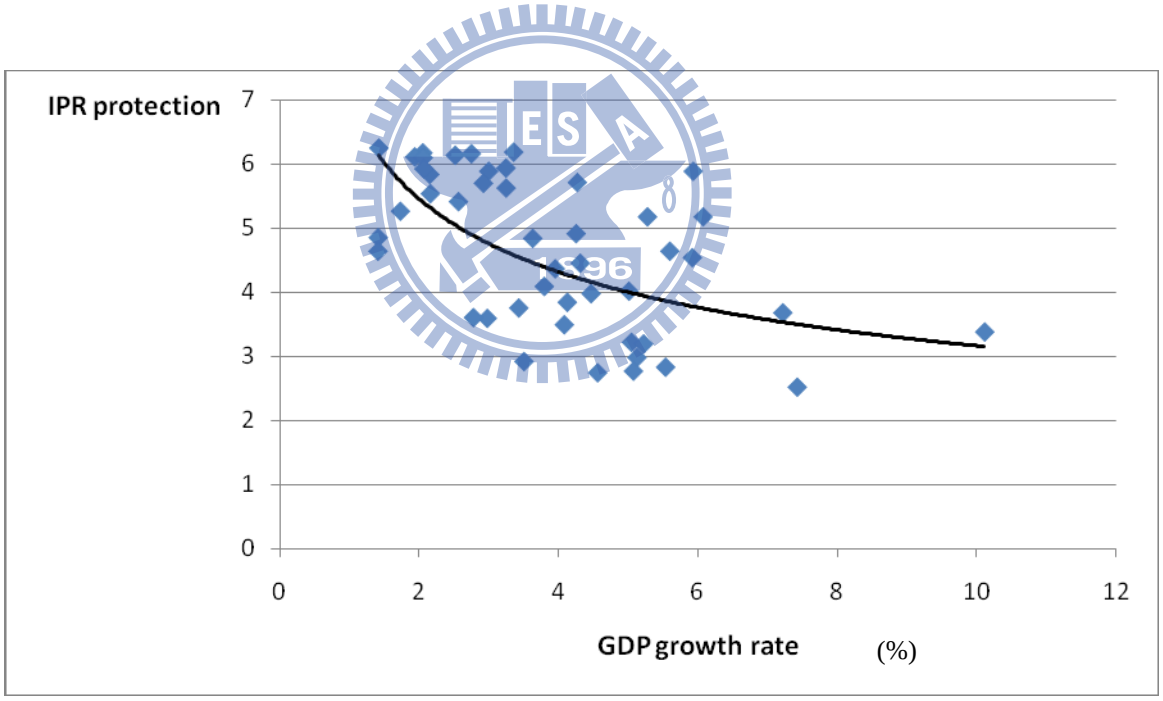

Figure 1

The negative relationship between IPRs and GDP growth rate

Chapter 4 Empirical Results

Table 2 contains the descriptive statistics of panel data. Table 3 reports the empirical result of seemingly unrelated regression estimation. Panel (1) of Table 3 provide the coefficient estimation of Equation (3), and Panel (2) shows the estimation result of Equation (4). Following the principle of SUR estimation, Equation (3) and Equation (4) are estimated simultaneously.

Table 2

Descriptive Statistics for variables (64 countries, 322 observations)

Variables	Mean	Std. Dev	Minimum	Maximum	Unit
Y	3.9453	2.7059	-10.8940	13.0000	%
IPR	4.6761	1.2270	2.1000	6.6000	
PopGR	0.8417	0.7840	-1.8790	4.1650	%
HTX	17.9426	14.9453	0.3730	74.1410	%
Mobile	66.6613	34.8794	0.3520	155.2380	
NetUse	34.3105	24.6470	0.5410	85.9000	
EconFree	7.1103	0.8046	4.7200	8.9700	

Table 3

Empirical Results of Seemingly Unrelated Regression Estimation

(1) Equation 1: GDP growth rate as dependent variable

Variable	Intercept	IPR	Pop Growth	Mobile	HTX
Coefficient	8.2629	-1.2939	0.4461	0.0139	0.0239
	(15.8455)	(-10.1430)	(2.6239)	(3.1691)	(2.6360)
	***	***	***	***	***

(2) Equation 2: IPR protection as dependent variable

Variable	Intercept	GDP Growth	Net Use	Econ Free
Coefficient	-0.0047	-0.1088	0.0209	0.6177
	(-0.0124)	(-8.2916)	(10.8725)	(10.6899)
		***	***	***

Note: t-statistics are in parentheses.

* significant at 0.10 level.

** significant at 0.05 level

*** significant at 0.01 level

The statistical result shows that an increase in the level of intellectual property right protection significantly decreases GDP growth rate. It is interesting to find out while enhancing level of IPR protection would lower GDP growth rate; where there is a trade-off relation between patent protection and economic growth. This result is consistent with previous empirical study on the trade-off between imitating foreign technologies and encouraging domestic innovation of determining the level of IPR protection (Chen and Puttitanan, 2004). This is also consistent with the assumptions that there exists an inverse U-shaped relationship between IPR protection and innovation when the impact of accumulated experience on productivity is large enough in Furukawa

(2007). Koléda (2004) emphasizes on the effect of patent novelty requirement on economic growth may be inversely U-shaped.

In addition, population growth rate, mobile cellular subscriptions (per 100 people), and high-technology exports (% of manufacturer exports) positively affect GDP growth rate at 0.01 significant levels. This shows that countries having high population growth rate, the developing country, have positive effects on GDP growth rate. As we discussed early, numbers of mobile cellular subscriptions represented the degree of information diffusion. The impact of information diffusion on GDP growth rate implied in our result is still consistent with previous research that ICT prevalence may consequently cause the upgrading of GDP (income) in low income countries (Wilpert, 2009). As for the coefficient estimation of IPR protection regression, we have evidenced the correlation between IPR protection and the two dimensions. Empirical result shows that increasing in GDP growth rate decreases level of IPR protection at 0.01 significant levels. The significantly negative correlation between GDP growth rate and IPR protection is consistent with the estimation result of Equation (3). The number of Internet users (per 100 people) and degree of economic freedom are both positively related to IPR protection at 0.01 significant levels.

In this study, our model shows a mutual significant and negative causality between IPR protection and GDP growth rate, while IPR protection is a function GDP growth rate. Table 3 shows that GDP growth significantly decreases a country's level of IPRs protection. The empirical result also shows that both of high-technology exports and Internet user (per 100 people) have positive impact on level of IPR protection. These results illustrate a country which export high-technology manufactures higher has a higher level of IPR protection. While the numbers of Internet user increases, the level of IPR protection also increases. High-technology exports stands for a symbol of developed country. This significant and positive relationship between high-technology

exports and IPR protection describes a fact that developed countries emphasized on tightening IPR protection. The results of covariance matrix are provided in Table A2 in the Appendix section.

Chapter 5 Conclusion

5.1 Concluding remarks

This study investigates the impact of IPR protection on economic growth through a panel data analysis employed from 2000 to 2007. We examine the hypothesis that the increase of IPRs protection causes the decline of economic growth and we also discuss the impact of ICT prevalence on knowledge diffusion. By the impact of globalization, the widespread of knowledge diffusion tremendously increases the accumulation of knowledge.

Our empirical results show that the most significant relationship is the negative effect of IPR protection on economic growth and the positive effect of population growth on economic growth. We also find the negative effect of economic growth on IPR protection. By SUR model estimation, this study suggests that the enhancement of IPR protection significantly decreases economic growth. The prevalence of ICT has positive impact on economic growth. This explains the transition after globalization occurred in the recent decade. Human capitals are facilitated due to the widespread of information diffusion, which has caused the knowledge accumulation as an important determinant of economic growth. The positive correlation between IPR and number of Internet users suggests that the prevalence of Internet strengthen the regulation of the North (developed) countries, protecting the technologies piracy from the South (developing) countries. The positive correlation between economic freedom and IPR protection implies that competitiveness also influences patent right protection from policy-making.

The result in our study shows that increasing the IPR protection does not increase rapid economic growth, but results in sharp economic recession. Also, our empirical result of SUR estimation suggests that policy makers relax the regulation of intellectual property rights protection in an open economy. Stronger protection is not always better to stimulate

economic growth. Economists have been always investigating the main cause of economic growth. Our study supports the research results of endogenous growth theory that the economic growth is caused by the accumulation of human capital. However, our empirical results suggest that purely tightening the protection of IPRs is not the dominant channel of human capital accumulation.

In this study, we extends the conclusion of Koléda (2004) and Furukawa (2007), further confirm the negative endogenous relationship between IPR protection and GDP growth rate by simultaneous regression estimation. The negative endogeneity of IPR and economic growth shows that relaxing IPR protection leads to economic growing sharply. Nevertheless, developed and industrialized countries strictly protect IPRs with policy-making in order to relax the effects of rapid information diffusion due to the increasing incentives of innovations.

5.2 Research limitations

Our research has several limitations. The first limitation is the incompleteness of data. This study employs the IPR protection index established by the World Economic Forum, which is yielded from World Economic Forum's Executive Opinion Survey. As a matter of fact, the level of IPR protection, most prevalently used in academy research, is the index established by Ginarte and Park (1997). However, this has only currently updated to 1995 so that our study is not able to use Ginarte-Park IPR protection index for analysis and estimation. Our study mainly focuses on the changes of relationship between IPR and economic due to the information diffusion and globalization; thus we use the IPR protection level data from World Economic Forum. This series provides a continuous and consistent data from 1999 to 2008. Our empirical results suggest the extension of endogenous relationship between IPR protection and economic growth in the future researches.

Another limitation is the impact of omitted influences on economic growth caused by intermediate and moderate effects. Our empirical results had verified the endogenous

characteristic between IPR protection and economic growth, which is different from most of the exogenous influences in previous literatures. This provides an extensive potential and framework for investigation of the environmental variables in the endogenous relationships. This limitation provides a broad direction for future researches. Our study suggests the potentiality of investigating other endogeneity associated with economic growth.

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Appendix 1

Table A1
List of 46 sample countries

Argentina	Austria	Austrulia	Belgium
Brazil	Bulgaria	Canada	China
Czech	Denmark	Ecuador	El Salvator
Finland	France	Germany	Greece
Hong Kong	Hungary	Iceland	India
Indonesia	Ireland	Isarel	Italy
Japan	Jordan	Malaysia	Mauritius
Mexico	Netherlands	New Zealand	Norway
Peru	Philippines	Poland	Portugal
Singapore	South Africa	Spain	Sweden
Switzerland	Thailand	Turkey	Ukraine
United Kingdom	United States		

Appendix 2

Table A2
Results of Covariance Matrix

	Y	IPR	Econ Free	Pop Growth	NetUse	Mobile	HTX
Y	1						
IPR	-0.3413	1					
Econ Free	-0.2230	0.0754	1				
Pop Growth	0.1537	0.01388	0.1232	1			
NetUse	-0.2890	0.7688	0.6800	-0.1142	1		
Mobile	-0.1522	0.5480	0.5452	-0.1346	0.7022	1	
HTX	0.0655	0.2415	0.2826	0.2845	0.1814	0.0685	1

Number of countries = 64, Number of observations = 322