A STUDY ON THE RELATIONSHIP BETWEEN PATENT POLICY AND ECONOMIC GROWTH

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CHOI, Myounggu

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

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Introduction

Global patent policy has shown a trend of unifying international standards. As intellectual property can easily be duplicated and reproduced, it requires protection under a country's jurisdiction. Global corporations lobby policymakers to standardize patent procedures to minimize the cost of expanding businesses. Therefore, the international discussion about unified regulations for patent policy has produced several results concerning the global structure of intellectual property.

The unifying trend seems inevitable, but there are many national differences among patent regulations. In many low-income countries, patent protection has little effect on short-term economic growth because investment in research and development (R&D) is insufficient; thus, their protection policy tends to be loose. However, the research has also shown that fast-growing economies tend to have higher protection levels for patents regardless of their current GDP status.

The differing levels of patent protection lead to two questions. First, how is the level of protection defined? Patent protection can be measured on several levels. It can be divided into two parts: the registration procedure and the legal protection of registered patents. Each has different effects on the practice of patent law. Countries have various levels of protection, and they differ especially in their administrative and judicial decisions concerning patent law.

Second, how are patent protection levels related to economic growth? Studies on the effect of R&D focus on investment in knowledge to improve the technology level of a country. The patent system is implemented to improve R&D investment, but the effect is ambiguous because it can be observed only after a long period of time. Furthermore, the side effects of the patent system are longer-term and are more latent than its benefits. Thus, the actual effects of patent protection are controversial. Some

argue that it should be strengthened while others claim that it does not help foster economic growth, especially in developing countries. There is also an extreme view that the patent system should be eradicated.

Working through these questions, this paper examines the relation between patent protection and economic growth through empirical data using indexes currently available to analyze the current patent system. This paper focuses on Korea's attempt to use the patent system to foster innovation.

2. Literature review

A. Theoretical Approach

The theoretical literature offers an economic model of the patent system that compares costs to benefits. Most models are growth models with variables for patent protection that try to determine whether the effect of increased protection is beneficial to economic growth and consumer welfare. Those models are constructed on the assumption that the patent market is monopolistic and that R&D is the driving force of economic growth.

In analyzing patent duration, Judd (1985)[1] and Chou and Shy (1991)[2] use a partial equilibrium model to argue that the patent duration that maximizes welfare is infinite. However, Iwaisako and Futagami (2003)[3] argue that a finite patent with an efficient expiration period maximizes social welfare. They divide intermediate goods into patented and nonpatented goods and substitute those with factors of the CES

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[1] Kenneth L. Judd, "On the performance of patents", Econometrica: Journal of the Econometric Society, The Econometric Society, 1985, pp. 567–585.

[2] C.F. Chou, O. Shy, 1991. "The Crowding-Out of Long Duration of Patents" , Tel Aviv–The Sackler Institute of Economic Studies, 1991, pp. 8–91.

[3] Tatsuro Iwaisako and Koichi Futagami, "Patent Policy in an Endogenous Growth Model", Journal of Economics, 78(3), 2003, pp. 239–258.

production function. Through these methods, they show that there is a welfare maximizing equilibrium.

The argument of Iwaisako and Futagami is more plausible because side effects are observed from the patents themselves. As a patent forms a monopolistic market granted by the government, it inevitably reduces the consumer surplus. Supplier insufficiency over an infinite period can distort the market. Considering these side effects, maintaining a patent for an infinite period is unlikely to foster social welfare.

However, these models have limited usefulness in determining national patent policies. Even though such policies have a considerable effect on production technology, they cannot be determined by patent duration only. Some models consider patent breadth, but these are incidental and oversimplify. Economic growth models for patent policy do not consider the dynamics and diversity of patent policies, which are deeply affected by other social factors. These models also consider knowledge development to be one-sided. The development of industrial sectors should facilitate the development of the patent system. Demand for better regulation pushes governments to change the laws to enhance the industrial environment. The correlation between industry and patent policy has been largely neglected in the theoretical approaches.

B. Empirical Analysis

Another research stream analyzes the performance of economies with a patent policy. Several indicators have been developed to analyze the patent policies of countries for the econometric analyses. Most of the indicators use dummy variables to reflect the protection level of a country (the country is given 1 if it has this policy feature and 0

otherwise). Rapp and Rozek (1990)[4] suggested an index for patent policy based on the dummy variable method with an aggregation of the numbers.

However, indicators based on dummy variables share the flaw of economic growth models that oversimplify the dynamics of patent policies. To overcome this flaw, Ginarte and Park (1997)[5] suggested an indicator that considers more of the parts of a patent than had been examined by earlier studies. Researching data from 60 countries covering 1960 to 1990, the study considered coverage, membership in international agreements, protection against patent losses, legal enforcement, and the duration of patent law protection. Using the indicator, the study evaluated the relation between patent policies and GDP per capita and other social factors. The indicator developed by Ginarte and Park was expanded by Park (2008).[6] The index (known as the "IP Index") reflects the degree of patent protection strength. Ginarte and Park used it to conclude that developed countries tended to have higher standards of patent protection.

Based on these indexes, research on IP regulations and other economic indexes (such as GDP growth) has been conducted. Thompson and Rushing (1999)[7] was early research that found a relationship between economic growth and IP protection based on the Rapp–Rozak Index. They regressed on the GDP growth rate, total factor productivity, and patent protection as dependent variables, finding that the greater the degree of open trade and income, the higher the education level, R&D infrastructure, and patent protection, while political instability had no significant relationship with

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[4] R. T. Rapp and R. P. Rozek, "Benefits and Costs of Intellectual Property Protection in Developing Countries", Journal of World Trade, 24(5), p. 75–102.

[5] J. C. Ginarte and W. G. Park, "Determinants of Patent Rights: A Cross-national Study", Research Policy, 26, pp. 283–301.

[6] Walter G. Park, "International Patent Protection : 1960–2005", Res Policy, 2008.

[7] M. A. Thompson and F. W. Rushing, "An Empirical Analysis of the Impact of Patent Protection on Economic Growth: an Extension", Journal of Economic Development, 24(1), 1999, pp. 67–76.

patent protection level. In determining the effects of patent protection on total factor productivity, they found that income level was related to the relationship between TFP and patent protection. When GDP per capita was higher than US$4,000 (1985 dollars), it showed a significant and positive relationship; when it is less than the threshold, an insignificant relationship was observed. Similarly, Sattar and Mahmood (2011)[8] showed that the regression between GDP growth and IP index was correlated only for high-income countries.

To determine how IP protection affects economic growth, researchers have examined the relationship between economic factors and IP regulations. One strand of research has investigated the relationship between IP regulations and foreign direct investment (FDI) inflow. Generally, the protection of intellectual property is assumed to increase FDI because it induces investment in R&D. Braga and Fink (1997)[9] evaluated the relationship between patent protection and FDI inflow, finding that FDI inflow was significantly related with intellectual property rights (IPR); with their higher degree of intellectual property protection, countries can take advantage of knowledge-related FDI inflows. This conclusion was expanded by further research, such as Javorcik (2004)[10] and Nunnenkamp and Spatz (2004).[11] Nunnenkamp and Spatz (2004) used sectorally disaggregated FDI panel data and the Ginarte–Park index to examine the relationship between FDI and IPR protection. They argued that stronger IPR protection helps induce more FDI.

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[8] A. Sattar and T. Mahmood, "Intellectual Property Rights and Economic Growth: Evidences from High, Middle, and Low Income Countries", Pakistan Economic and Social Review, 49(2), 2011, pp. 163–186.

[9] C. A. Braga and C. Fink, "The Economic Justification for the Grant of Intellectual Property Rights: Patterns of Convergence and Conflict", Chicago-Kent Law Review, 72(2), 1997, pp. 439–461.

[10] B. S. Javorcik, "Foreign Direct Investment Increase the Productivity of Domestic Firms? Search of Spillovers Through Backward Linkages", The American Economic Review, June 2004, pp. 605–627.

[11] P. Nunnenkamp and J. Spatz, "Intellectual Property Rights and Foreign Direct Investment: A Disaggregated Analysis", Review of World Economics, Springer, 140(3), 2004, pp. 393–414.

Another view is that stronger IP protection fosters technological development, which induces increased economic productivity. Kanwar and Evenson (2003)[12] researched the relationship between IPR protection and technological change using R&D investment as a proportion of gross national expenditure to capture national increases in knowledge. As an explanatory variable, they used the Ginarte–Park index in a random effects model. They revealed that stronger IPR protection increased technological change.

Empirical research has also examined the relationship between IPR protection and economic sectors based on limited indexes, but this research has several limitations. First, it is difficult to measure actual IPR protection levels. Most studies have used the Ginarte–Park Index, but they may lack sensitivity since their data are quinquennial. Problems of insensitiveness can arise in the research because the technology improves every year, and the economic environment changes increasingly rapidly. Second, the Ginarte–Park index covers only from 1960 to 2005 and thus does not reflect changes in international conditions concerning intellectual property. The knowledge market is sensitive to changes in global market conditions because investment in R&D changes as profitability changes. Changes in the IT sector are not reflected in the data used by most of the research. Third, most empirical studies neglect the correlation between industry and IP regulations. Industrial regulation systems can be a factor in patent policy because they regulate the use of patents in actual industrial processes. Fourth, the indexes do not consider administrative and judicial practices, which differ from country to country. As most indexes consider only those patent laws that regulate patent application and procedures, research based on those indexes can be distorted. For example, if country

[12] S. Kanwar and R. E. Evanson, "Does Intellectual Property Protection Spur Technological Change?", Oxford Economic Papers, Oxford University Press, 55(2), 2003, pp. 235–264.

A has a longer duration of patent protection than country B but patents from A are much more likely to be overturned in patent court because patents from country B are more stable, patent protection in country A cannot be considered better than that in country B; however, IP indexes will consider that A has a better protection system. Much of the research has this problem.

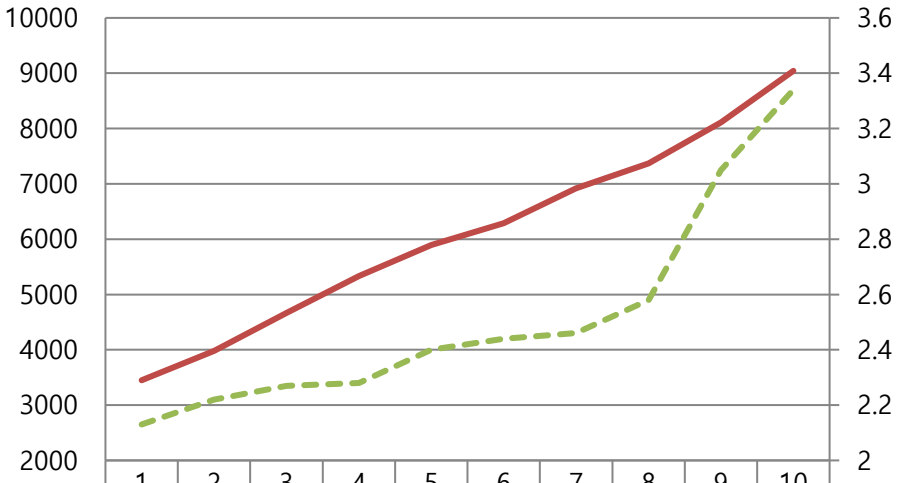
This paper tries to determine the relation between IP protection and economic growth based on a more comprehensive index. As regression-based research tends to oversimplify, this paper will examine the case of Korea, where economic development and the patent system are considered to be highly correlated.

3. Economic model of IPR protection

A. Three-step Framework

An IPR protection system has a cyclic effect on an economy. A government that provides stronger IPR protection and expects stronger economic growth from the policy will try to take advantage of it. Chart 1 shows seemingly positive correlation between Gross World Product and IPR regulation.

<Chart 1> Gross World Product Per Capita and Ginarte-Park Index



	1	2	3	4	5	6	7	8	9	10
YEAR	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
GWP(5Years Average)	3449	3977	4667	5334	5891	6289	6917	7367	8110	9043
GPI(Average)	2.13	2.22	2.27	2.28	2.4	2.44	2.46	2.58	3.05	3.34

** Note: The GWP data (5-year average) are measured in 2010 US dollars with PPP considered. It is the average of each year and the former four years. The GPI (average) is the mean value of the Ginarte–Park Index for 110 researched countries in the sample years.*
** Source: The GWP data (5-year average) were compiled by the Earth Policy Institute. The GPI (average) data are taken from Ginarte and Park (1997) and Park (2008).*

The Ginarte–Park index is the most useful tool for evaluating global IPR protection. It covers five categories of assessment: extent of coverage, membership in international patent agreements, provisions for the loss of protection, enforcement mechanisms, and duration of protection. The measurement scale ranges from 0 to 5, from no protection of intellectual property to perfect protection, respectively.

Chart 1 shows that economic growth and patent protection have been on an ascending trend since the 1960s. Economic growth has been increasing consistently since the 1960s, while overall IPR protection increased rapidly after the 1990s, as TRIPS took effect. The drastic increase in IPR protection may have resulted from the economic globalization that accompanied the formation of the WTO and many FTAs.

Moreover, developing countries have been under pressure to open their markets, which requires constructing patent systems to protect the technology of foreign enterprises. Thus, whether IPR protection and economic growth have a cyclic effect is ambiguous.

Research has shown a direct relationship between IPR protection and economic growth. Gould and Gruben (1996)[13] used the Rapp and Rozak index and concluded that a more open economy with stronger IPR protection had a higher growth rate. Thompson and Rushing (1999) concluded that IPR protection was more strongly related to economic growth in higher-income countries, which was again found by Sattar and Mahmood (2011).

However, it is difficult to estimate the effect of IPR policy on an economy because IPR policy affects economies via many indirect paths. First, IPR protection affects R&D incentives, but it is difficult to measure the policy effect of this process. The Rapp–Rozak and Ginarte–Park indexes rely on a compilation of dummy variables. These indexes have limited power to capture the dynamic effects of IPR protection. Furthermore, assessing patent law using economic measures is not easy. For example, the South Korean government recently established a patent-approval linkage system in the pharmaceutical sector, but this policy is not considered by either index. Moreover, the economic effect of a policy depends on many social factors such as infrastructure, political stability, and culture, which are difficult to capture in the indexes. Moreover, IPR protection is expected to increase the technological level of a country, but its collateral benefit is an increase in intangible assets. The direct economic value of a patent received research attention because non-practicing

[13] D. M. Gould and W. C. Gruben, "The Role of Intellectual Property Rights in Economic Growth", Journal of Development Economics, Elsevier B. V., 48(2), 1996, pp. 323–350.

entities (NPEs) emerged and predated some cash-abundant companies.[14] Intangible assets as a share of GDP are not negligible, representing around 5% to 10% among developed countries,[15] but it is difficult to estimate the value of patent policies on intangible asset because several other factors are involved. The fluctuating value of patents is also a factor, because a critical dimension of their value is their potential.

To deal with these difficulties, this paper examines IPR protection as a staged process. The first step is analyzing the effect of patent policy on R&D expenditure. Increased R&D expenditure is expected to increase knowledge, which forms the second step. The third step is the process whereby knowledge increases economic production through improved efficiency. These steps may not cover all aspects of IPR protection, but they capture the critical flow of the policy's effects.

B. Patent Policy and R&D Expenditure

R&D expenditure is considered an incentive-related index of IPR protection. If IPR strengthens patent protection and provides a better chance to profit from technology, the private sector will exploit this chance by investing in R&D. It can also be inferred that, when a government is trying to boost its nation's technology through the patent system, government investment in the R&D sector will increase.

Arore et al. (2008)[16] analyzed survey data on the US manufacturing sector and argued that there is an overall positive effect of patent protection on R&D across all manufacturing industries. They found that a patent protection premium had an effect

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[14] The so-called "Patent Troll."

[15] www.oecd.org/sti/inno/46349020.pdf; a new OECD project, New sources of growth: Intangible assets.

[16] A. Arora and M. Ceccagnoli and W. M. Cohen, "R&D and the Patent Premium", International Journal of Industrial Organization, Elsevier B. V., 26, 2007, pp. 1153–1179.

in all sectors but varied across industries and firm sizes. Chaudhuri (2007)[17] found that the patent system was not a primary reason for Indian pharmaceutical companies' investment in R&D. These studies showed that R&D expenditure was affected by patent policy but that the sensitivity of R&D expenditure on IPR protection varied significantly.

From these studies, we can infer that there are positive relationships between patent policy and R&D expenditure but that they differ according to the composition of the industry at the country level. Kanwar and Evenson (2003) have shown that this holds for the country level using a regression on the Ginarte–Park Index with gross R&D investment.

C. R&D Expenditure and Intangible Assets

R&D expenditure and intangible assets are considered to be closely related because R&D expenditure is basically an increasing quality and quantity of intangible assets. However, it is almost impossible to estimate the value of intangible assets. Patents do not represent a nation's total amount of intangible assets because they do not include expired patents or knowledge that has been accumulated as know-how for a long period of time; also, some innovations may not have been subject to patent applications due to particular patent strategies.[18] These factors are not negligible. Thus, researchers use proxies for their empirical analysis. Park (2008) and Yang et al. (2014)[19] used US patent applications of national entities as a proxy of knowledge accumulation. Patent applications and grants are easy to examine, and it is better to

[17] S. Chaudhuri, "Is Product Patent Protection Necessary in Developing Countries for Innovation? R&D by Indian Pharmaceutical companies after TRIPS", Indian Institute of Management Calcutta, Working Paper Series no. 614 , 2007.

[18] Most patent systems require the disclosure of technology, with a few exceptions.

[19] C. Yang and Y. Huang, Y. and H. Lin, "Do Stronger Intellectual Property Rights Induce More Innovation? A Cross-Country Analysis", Hitosubashi Journal of Economics, Hitosubashi University, 55(2), 2014, pp. 167–188.

estimate the relationship between knowledge and the economy.

D. Patent and GDP Growth Rate

The patent system can affect GDP growth in two ways: one is by increasing intangible assets, which increases a nation's total assets; the other is through innovation, which increases the efficiency of the gross economy. The former is not negligible but represents a relatively small portion of the effect of IP development. The most important problem is how the patent system affects GDP growth by increasing production capacity via knowledge development.

4. Hypothesis

A. Hypothesis 1

Countries with stronger patent protection are likely to make significant R&D expenditures. Patent protection is assumed to be a private sector incentive because market participants will see the chance to gain monopoly power over a technology as a benefit. If expected profits are higher than the potential costs, they may try to join the patent system. R&D expenditure is a variable used to determine whether the patent system affects social incentives. The premise of this hypothesis is that the benefit is generally greater than is the cost for individuals.

B. Hypothesis 2

Countries with greater R&D expenditures have more patent applications. A patent application is not exactly equal to the value of the patent itself, but the value of a patent is hard to measure because a patent is regarded as only potential wealth. A patent has an imprecise future value; thus, evaluating a patent is difficult. As a proxy,

the number of patent applications can reflect the strength of a country's knowledge production.

Hypothesis 2 is designed to examine the relationship between R&D expenditure and knowledge accumulation in a country. Kanwar and Evenson (2003),[20] referring to Griliches (1990),[21] argued that R&D investment is a better indicator than patent application or physical investment because it is more thorough and closer to inventive activity. However, R&D expenditures are not entirely related to technological advances, and patents are more directly related to technology and factor productivity. Thus, this paper seeks to determine the relationship between R&D expenditure and patent applications.

C. Hypothesis 3

Countries with greater R&D investment and more patent applications will show stronger GDP growth. More patent applications will increase a nation's factor productivity. Technology level is hard to measure, but it can be observed by using the proxy of GDP change. We can assume that more patents will increase the productivity of a country. Moreover, as not all R&D investment is related to patents, we can assume a correlation between R&D expenditure and GDP growth.

5. Empirical Evidence

A. Model

a. Hypothesis 1

[20] S. Kanwar and R. E. Evanson, "Does Intellectual Property Protection Spur Technological Change?", Oxford Economic Papers, Oxford University Press, 55(2), 2003, pp. 235–264.

[21] Z. Griliches, "Patent Statistics as Economic Indicators: A Survey", NBER Working Paper no. 3301, 1990.

Gross expenditure on R&D should be defined by several national factors, including protection of patents. The regression formula is as follows:

$$GERD = f(IPP, EDU, POP, TRADE, e)$$

GERD denotes the proportion of gross expenditure on R&D out of GDP and is defined by the functions of intellectual property protection (IPP), education level (EDU), population (POP), and trade openness (TRADE), along with an error term (e).

b. Hypothesis 2

Patent application is influenced by R&D expenditure, along with protection. Thus, the regression formula is as follows:

$$PAPC = f(GERD, EDU, GDPPC, POP, TRADE, IPP, e)$$

GERD, EDU, TRADE, POP, IPP, and e denote the same thing in Hypothesis 1. PAPC denotes patent application per capita, and GDPPC denotes GDP per capita. PAPC is defined by the factors described above.

c. Hypothesis 3

The GDP growth rate is affected by R&D investment and patent applications. The formula is as follows:

$$GDPGR = f(GERD, PAPC, GDPPC, POP, TRADE, EDU, e)$$

GDPGR denotes the GDP growth rate, and the other factors are as in Hypothesis 2. In this formula, GDP growth rate is defined by R&D expenditure, patent applications, population, trade openness, and education level.

B. Estimation Technique and Data

Data are collected from 51 countries as described in Table 1.

<Table 1>

Group A	Austria, Belgium, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Japan, Mexico, Netherlands, Portugal, Republic of Korea, Singapore, Slovakia, Slovenia, Spain, Sweden, United Kingdom, United States
Group B	Bangladesh, Brazil, Bulgaria, Chile, China, Colombia, Egypt, Georgia, India, Kyrgyzstan, Latvia, Lithuania, Malaysia, Mongolia, Pakistan, Peru, Philippines, Poland, Romania, Russian Federation, South Africa, Thailand, Turkey, Ukraine, Uruguay

Note: Groups A and B are divided according to the criterion of a 7,000 USD GDP per capita in 2001. Most Group A countries are developed, while most Group B countries are developing.

The cross-panel data cover 2001 to 2012 and around 51 countries. The role of the patent system in the economies of both developing and developed countries is examined by studying countries with estimable data. The effects on the least-developed countries (LDCs) and Africa are difficult to capture because few data sources exist. Only Bangladesh, Egypt, and South Africa belong to this group, but those countries may not be representative. These nations face difficulties in data research and patent system implementation because their infrastructure is not sufficiently developed and their educational level is too low for the exploitation of a patent system.

Due to this problem with developing countries, this paper examines the relationship between the patent system and economic growth in "non-least developed countries" and creates a blueprint for the least-developed countries based on the result. The lack of data for LDCs suggests that knowledge development is difficult when basic needs such as for food and shelter are not met. Thus, research based on data from non-least developed countries may be more meaningful.

Measuring the effect of patent policy on innovation requires a proxy for IPR protection. Most empirical studies have used the Ginarte–Park index, but it is limited due to its time gap. Some country-specific effects hold over time; these can be eliminated with a fixed effect (FE) or random effect (RE) estimator, depending on whether the effect is correlated with the explanatory variables. A Hausman test (Hausman 1978[22]) can be used to determine which of the estimators is consistent and efficient. When the Hausman test does not reject the null hypothesis, both models are reported. There is no reason to believe that homoskedasticity holds. The panel data are drawn from countries that have various economic statuses. The factors that are tested in the models may not be consistent based on economic or social factors; thus, robust standard errors are calculated. The content and source of the data are shown in Table 2.

<Table 2>

Variable	Content	Source
GERD	Gross expenditure on research and development	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics
IPP	Survey on protection of intellectual property	World Economic Forum Global Competitiveness Report

[22] Hausman, J. A., Specification Tests in Econometrics, Econometrica, 46(6), 1978, pp. 1251–1271.

PAPC	Patent application per capita	World Intellectual Property Organization (WIPO), WIPO Patent Report: Statistics on Worldwide Patent Activity.
GDPGR, GDPPC	2005 constant GDP per capita and its growth rate	World Bank national accounts data, and OECD National Accounts data files.
EDU	Gross enrolment ratio, secondary, both sexes (%)	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics
POP	Total population	World Bank World Development Indicator
TRADE	Trade, percentage of GDP	World Bank national accounts data, and OECD National Accounts data files.

C. Results

a. Relation between R&D expenditure and IP protection

<Table 3>

	Dependent Variable – GERD			
Independent Variable	Full Sample [FE]	GDP>7000 [FE]	GDP<7000 [RE]	[FE]
IPP	0.013 (0.027) [0.035]	0.009 (0.439) [0.062]	0.752*** (0.218) [0.026]	0.687*** (0.023) [0.023]***
POP	0.117 (0.389) [0.265]	0.719 (0.605) [0.522]	0.078*** (0.018) [0.028]***	0.134* (0.072) [0.199]
EDU	0.006*** (0.001) [0.006]*	0.006*** (0.001) [0.003]*	0.008*** (0.001) [0.004]*	0.008*** (0.002) [0.004]
TRADE	0.008*** (0.0008) [0.008]***	0.012*** (0.001) [0.003]***	0.0005 (0.0006) [0.0012]	0.0004 (0.0007) [0.002]
Constant	0.0004 (0.199) [0.498]	-0.134 (0.434) [0.814]	-0.539*** (0.154) [0.429]	-0.513 (0.0007) [0.529]
R square	0.23	0.34	0.34	0.34
Hausman Test	64.59***	22.18***	0.90	
N	51	26	25	

Note: Population is divided by 10^8 *for simplicity. Figures in parentheses and square brackets are standard error and robust s.e. respectively, while *, **, and *** denote statistical significance at 10%, 5%, and 1% levels respectively.*

Table 3 shows a positive relationship between IP protection and R&D expenditure only for developing countries; no correlation was observed for developed countries. Many studies have shown a correlation between IP protection and GDP growth rate but the assumption of this paper is that IP protection's effect on the economy through R&D holds only for developing countries. Robust standard errors show that the result for developing countries is not biased by heteroskedasticity. Policies in developing countries tend to be uniform over sectors, so that the higher the expenditure, the harder developing countries try to protect intellectual property. Meanwhile, IP protection among developed countries has become almost identical through trade negotiations such as for FTAs and trade unions. For example, most of the countries that have not joined the PCT (Patent Cooperation Treaty) are developing countries[23] (148 countries have signed the treaty). Among sample countries, all Group A nations are PCT members, while four Group B nations are not. This illustrates the diversity in IP policy among developing countries.

There is possibility for developing countries' stronger correlation is induced by the governmental intervention. As illustrated below, Korean government has intervened in development of IP system. Most of its expenditure on R&D came from the source of government in the early stage of economic development. There are tendency of simultaneity of R&D expenditure and stronger IP protection as a policy. Where private sectors are underdeveloped, governmental intervention may lead the expenditure on R&D along with brining stronger protection on IP.

b. Factors affecting patent stock

[23] http://www.wipo.int/pct/en/pct_contracting_states.html.

<Table 4>

	Dependent Variable – PAPC			
Independent Variable	Full Sample [FE]	GDP>7000 [RE]	[FE]	GDP<7000 [FE]
GERD	12762.19*** (2547.51) [7032.60]*	7944.01*** (2366.56) [4316.96]*	6753.76** (2644.58) [4112.29]	39977.81*** (4331.63) [27490.07]**
IPP	3271.41** (1347.38) [2093.70]	2443 (1636.889) [2833.48]	3330.23* (1694.87) [3393.73]	823.31 (1728.401) [1830.07]
EDU	225.61*** (76.06) [224.62]	-62.28 (79.83) [56.12]	-17.05 (81.92) [43.25]	427.80*** (103.44) [369.88]*
TRADE	-105.74** (49.13) [87.67]	-55.33 (46.34) [33.95]	-25.49 (60.85) [31.47]	-33.80 (40.39) [124.09]
GDPPC	1.1609*** (0.3953) [0.6837]*	0.4406 (0.2937) [0.2703]	0.7150* (0.3942) [0.4960]	-2.5157*** (0.7079) [1.8819]
Constant	-59160.09*** (12115.2) [42035.66]	-16719.58 (15576.73) [19481.62]	-34186.33* (17600.25) [35482.04]	-44382.52*** (9873.30) [35505.51]**
R square	0.14	0.14	0.09	0.46
Hausman Test	21.02***	6.80		31.49***
N	51	26		25

*Note: Figures in parentheses and square brackets are standard error and robust s.e. respectively, while *, **, and *** denote statistical significance at 10%, 5%, and 1% levels respectively.*

Table 4 shows that the relationship between R&D expenditure and patent applications is ambiguous for developed countries but clear for developing countries. The IPP figures show that the effect of IP protection on patent applications is not significant when the effect is absorbed by R&D investment. This result has two implications.

First, the number of patent applications is not an appropriate measure of the innovation level of developed countries. Yang et al. (2014) examine US patents and conclude that IP protection has a positive effect only on developed countries, not on developing countries. However, the number of patents granted in the US to non-residents may not be feasible for most developing countries because their innovation

level may not have reached an international standard. Thus, patents granted by most developing countries may lack economic potential and be useful only at the national level. This implies that IP protection and R&D expenditure help foster technological innovation even for developing countries at the early stage.

Second, as explained in Table 3, the IP policies of developing countries may vary more than those of developed countries, thus diversifying the numbers of patent applications. The standard deviation is large in developed countries,[24] but this does not mean that the effect of R&D investment is greater for those countries. Due to their smaller amount of national assets, developing countries find it harder to spend more on R&D. Thus, the focus on innovation of the governments of developing countries might be more extensive and narrow than that of the governments of developed countries, making the effect more pronounced.

c. Factors affecting GDP growth

<Table 5>

	Dependent Variable – GDPGR			
Independent Variable	Full Sample [FE]	GDP>7000 [FE]	GDP<7000 [RE]	[FE]
GERD	-5.18*** (0.96) [0.87]***	-5.73*** (0.94) [0.85]***	-1.47 (1.25) [0.75]*	-1.46 (4.18) [4.78]
PAPC	1.79 (1.90) [1.04]*	1.97 (2.24) [1.90]	2.37 (2.54) [1.76]	1.05 (4.05) [2.34]
POP	1.72 (1.92) [0.94]*	-7.31 (8.35) [4.65]	0.43*** (0.13) [0.10]***	2.56 (2.62) [1.65]
EDU	-0.023 (0.029) [0.359]	0.0008 (0.2867) [0.0333]	-0.008 (0.027) [0.021]	-0.079 (0.075) [0.102]
TRADE	0.067*** (0.017)	0.078*** (0.021)	0.119 (0.008)	0.067** (0.029)

[24] Standard deviations of GERD are 1.019 for developed countries and 0.375 for developing countries.

	[0.023]**	[0.040]*	[0.004]***	[0.029]**
GDPPC	5.18 (14.46) [18.38]	12.20 (14.01) [22.01]	1.21 (14.41) [7.25]	-39.68 (58.65) [70.95]
Constant	4.04 (3.95) [4.01]	4.20 (6.11) [5.66]	4.57* (2.38) [1.66]***	[4.21]*** (6.12) [5.79]
R square	0.09	0.05	0.13	0.13
Hausman Test	33.23***	35.30***	5.62	
N	51	26	25	

Note: Population is divided by 10^8*, and patent application and GDP per capita are divided by* 10^5 *for simplicity. Figures in parentheses and square brackets are standard error and robust s.e. respectively, while *, **, and *** denote statistical significance at 10%, 5%, and 1% levels respectively.*

Table 5 shows how IP policy is disconnected from economic prosperity in developing countries. Expenditure on R&D along with innovation in intellectual assets showed no clear effect on the GDP growth rate at the traditional confidence level. Patent applications showed no clear correlation with ether group, while R&D expenditure showed a clearly negative relationship in developed countries. The result for developed countries shows that high-income countries have reached a point of steady growth; it seems to be the result of various social and economic factors in high-income countries. Surplus production flows into R&D for the highest-income group more than for the middle-income group. The lower the income, the lower the proportion of R&D out of GDP tends to be, and a negative relationship is thus seen in the high-income group.

For the low-income group, its coefficient shows no clear relationship among R&D expenditure, patent applications, and GDP growth. This result is in line with studies that have found that IP protection and economic growth are unrelated in low-income countries (e.g., Thompson and Rushing 1999; Satar and Mahmood, 2011). The lack of relationship may be caused by the problem of infrastructure. Generally, patent implementation is hindered when a country's infrastructure cannot sustain its

knowledge growth. For example, if a country lacks well-founded construction infrastructure, knowledge may not accumulate, explaining the repeated failure to observe a correlation between the patent system and economic growth in developing countries. The failure to observe a relationship between R&D investment and economic growth may be caused by a problem with capital accumulation. The realization of R&D requires long-term change with sufficient quantity, which developing countries may find difficult to manage. There seems to be a threshold level for R&D realization.

D. Implications

The implications of the regression results are complex. For the low-income group, there seemed to be no connection between patent applications and economic growth due to a disconnection between R&D expenditure and GDP growth. This shows that Thompson and Rushing (1999) and Sattar and Mahmood (2011), who found no relationship between patent protection and economic growth in developing countries, were correct about the disconnection between R&D expenditure and GDP growth. There needs to be sufficient R&D expenditure if developing countries' R&D is to benefit the national economy.

The results for developed countries are more complex. They suggest that the connection between R&D expenditure and the GDP growth rate can be negative, indicating that reinforcing patent rights can lead to negative effects on developed countries. This might be a premature conclusion, however, because the regression result does not contain all the social information that affects economic growth; it may lead us to focus on the side effect of the patent system. As mentioned, the patent system can hamper growth in knowledge production due to its monopolistic nature.

In most countries, the limit of knowledge efficacy is around 20 years due to the rapid changes in technology, and, as stronger patent protection can increase R&D investment, it can also lead to an inefficient economic structure. The patent system may thus be protecting patents too strongly in developed countries.

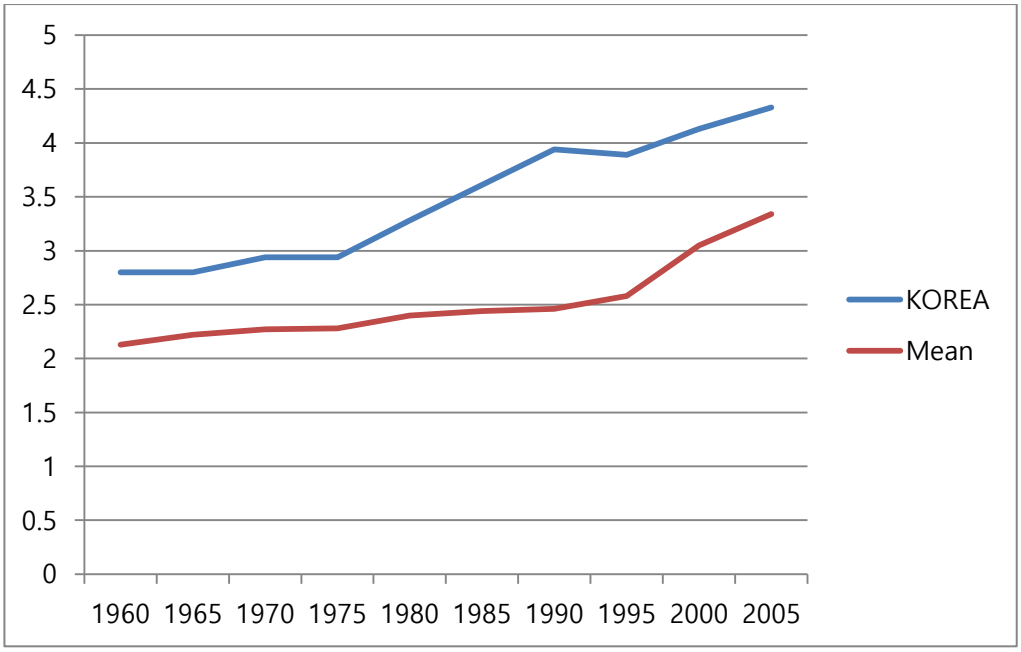
6. Case Study: Korea

A. Introduction

South Korea was one of the poorest countries in the world in the 1950s and 1960s. Its GDP per capita was 91.48 USD in 1961 but had increased to 25,976.95 USD by 2013.[25] South Korea's rapid economic growth was historically unprecedented. Its cause has long been disputed. Its innovative capacity has been suggested as one reason for its development. South Korea's government has facilitated knowledge development since the 1960s. Increases in both the quantity and quality of its intellectual property are also considered reasons for its rapid economic growth.

<Chart 2> GPI index of Korea and Global Mean

[25] World Bank Data.



**Source: Ginarte and Park (1997) and Park (2008). The data of Mean is from 115 countries collected in the sources.*

<Chart 2> shows that the Ginarte-Park index of Korea has been constantly higher than the average of the world. It suggests better protection is provided in Korea than the rest of the world. Even though the development level was extremely low in early 1960s, Korea maintained higher level of IP protection as an economic policy. But Whether South Korea's patent system has contributed to its innovation and economic growth needs more analysis. The Korean government has been trying to strengthen patent protection since introducing its patent law in 1961. This law was one of the policies meant to foster the economy at the early stage of development. Included in the policy package presented by Park Jung-hee, president during the 1960s and 1970s, the patent law went into effect in 1961.

Patent applications have increased rapidly in recent decades. In 1960, patent applications by residents totaled 545, but this number had increased to 13,253 by

1991. It exceeded 100,000 in 2004 (105,250), and reached 159,998 in 2013.[26] Patents increased as the economy boomed. The numbers of applications and grants are even greater than the EPO's.[27, 28] However, their quality and economic impact require further analysis.

B. Patent System

a. Patent admission

To be admitted as a patent, four legal requirements must be fulfilled: (i) invention, (ii) industrial applicability, (iii) novelty, and (iv) inventive step.[29] Of these, (i) invention indicates materiality, or at least potential materiality. The invention cannot be intangible. For example, an idea alone cannot become an invention and cannot be registered as a patent; it can be admitted as a patent only when it takes form through invention. (ii) Industrial applicability refers to a patent's usefulness in improving the productivity of industry. It reflects the patent system's goal of promoting economic development.[30] (iii) Novelty and (iv) inventive step require patents to be novel and have a unique value.

South Korea's legal requirements are stricter than are those in the US on paper. For example, the industrial applicability provision requires that the invention be used only in the relevant industry. This is stricter than the "usefulness" requirement under §101 of the US Patent Act.[31] This provision excludes inventions with solely family

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[26] WIPO Data.

[27] European Patent Office.

[28] In 2013, applications totaled 147,869, and domestic applications totaled 73,420. Korea's applications totaled 204,589 overall.

[29] Korean Intellectual Property Organization, Understanding the Patent Act of the Republic of Korea 3, 2007.

[30] Korea's Patent Policy and Its Impact on Economic Development: A Model for Emerging Countries? Jay Erstling, San Diego International Law Journal, Mitchell Hamline School of Law, 2010.

[31] Id. P. 450

or private uses. In practice, however, this requirement does not pose a severe limitation on patents. The Patent Court of Korea stated the following about industrial applicability: "Based on the trait of the patent, if a person with ordinary knowledge in the field can produce the invented product with the patent application and its detailed description considering the purpose, composition, effect and etc., it has industrial applicability."[32] Thus, the provision functions only as a minimum requirement of patent application. In practice, Korea's patent application process is very lenient, as discussed below.

b. Protection System

South Korean patent protection is not limited to judicial procedures; it also includes administrative actions, assistance for patent holders, and even grant procedures in patent offices. The term "patent protection" denotes (in a limited way) protection provided for patent holders via administrative or judicial procedures. Most patent protection indexes, such as the Ginarte–Park index, follow this limited meaning.

Patent protection in Korea has three bases: (i) infringement (civil procedure); (ii) validity (patent court); and (iii) criminal procedure. As do Germany and Japan, Korea separates infringement cases from validity cases. Infringement cases are dealt with in a local civil court, while patent validity cases are decided in patent court.[33]

In validity cases, the patent court decides whether the patent has fulfilled its requirements. It is generally considered an aggressive measure, but verifications of the scope of a patent right are used as a preemptive strike against an offender before a complaint is made or an infringement suit is filed. When a patent holder wins a

[32] Patent Court of Korea, Decision 2014. 10. 15. 2003HEO6524.

[33] Jurisdiction over infringement and patent cases will be unified in 2019.

validity case, the court's decision is beneficial for the holder, as the defense works as protection. Validity cases require a decision from the Patent Judgment Division of the Patent Office because the court lacks professional knowledge of technology issues.

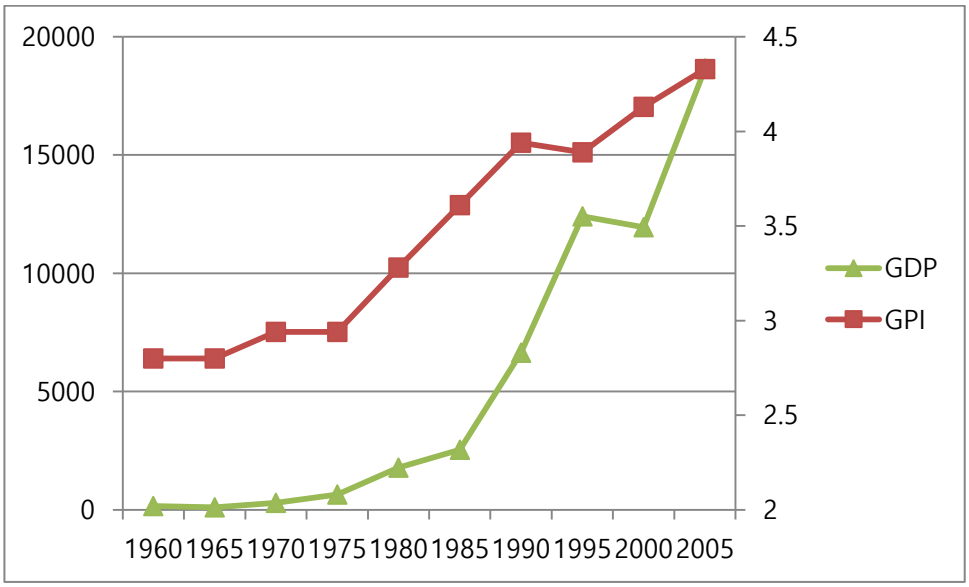
Infringement cases are deemed civil cases, so that the civil law applies. Civil code Clause §750 states that unlawful infringement of another person's right with intention or negligence should be compensated. Generally, the decision of the Patent Judgment Division of the Patent Office is considered powerful evidence, and the civil court makes its decision based on those documents.

One of the interesting features of the Korean patent protection system is its widely used criminal procedure. Patent laws in the US and U.K do not include criminal procedures, and their usage is very limited in countries such as Japan and France. In Korea, however, complaints filed with investigative entities are used to press offenders and protect patent rights. This situation is explained below.

C. Relationship between Patent Protection and Economic Growth

The patent system cannot work properly without industrial development. A country lacking newly developing industries may have an economy with weak potential. The Korean economy has utilized the patent system to flexibly change its industry. Before the 1960s, the country's main income source was agriculture; this changed to small industries and then to heavy industries. Recently, the country transformed its industrial base through IT technology.

<Chart 3> Relationship between GDP and GPI



**Note: GDP data are measured in current US dollars. GPI (average) is the mean value of the Ginarte–Park Index for the 110 sample countries over the sample period.*
**Source: GDP data come from the World Bank. GPI (average) data come from Ginarte and Park (1997) and Park (2008).*

There is a debate about the effect of patent policy on Korea's rapid economic growth. Jay Erstling concluded that the role of patents was decisive in Korea's economic development:

> While it is impossible to quantify the degree to which Korea's policy of building patent capacity has contributed to Korea's rapid growth, there is little doubt that Korea's emphasis on creating a patent system that has emphasized capability building and technological development has played a substantial role. A quick look at Korean patent statistics shows that Korean patenting activity has increased and matured as the Korean economy and technological infrastructure grew.[34]

However, the emphasis on patent policy was limited after the formation of Korea's IP market. In the 1960s and 1970s, Korean industry was developed chiefly by the government, and private entities had little management autonomy. Government intervention in the market was strong, and the free market system had little space to

[34] Jay Erstling and Ryan E. Strom, "Korea's Patent Policy and Its Impact on Economic Development: A Model for Emerging Countries?" San Diego International Law Journal 441, vol. 11, 2010 Spring, p. 474.

operate. Amid these conditions, the effect of the patent policy was limited because R&D investment was not motivated by patent profits. Government was the largest source of R&D in Korea before the 1980s. The ratio of government to private R&D expenditures was 97:3 in 1960 and 71:29 in 1970.[35] Investments by government were not induced by patent protection because the policy aimed at the private investment of resources. As Chart 2 shows, Korea's GPI was under 3.0 during the rapid growth from 1960 to 1990, though it showed some improvement.

The Korean government's economic policy from the 1960s through to the 1980s included a concentrated development plan to foster growth through a small number of large corporations. As the position on global economy was 'fast follower'[36], the innovation of Korea has been focused on importing intellectual properties of developed countries. Most of the R&D expenditure was spent to catch up to the developed countries. Korea had the advantage of low labor costs and tried to import intellectual property that could utilize that strength. Korea's patent policy couldn't affect economic development the way such policies had in other developed countries because Korea lacked the social infrastructure required to use the policy.

Korean patent policy hasn't shown a distinctive effect on economic growth, but it made Korea's industrial transition possible. To induce R&D investment for knowledge, i) there should be resources available for investment, ii) the knowledge should be strongly protected, and iii) it should be profitable. Profitability was enabled by the high level of GDP growth in the 1960s and 1970s, and protection was provided by the patent policy, including the patent law and its implementation. The problem was resources, but, as Korea's market expanded, resources increased through a

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35 Jeong Hyop Lee, "Evolution of Republic of Korea's R&D System in a Global Economy", Science and Technology Institute of Korea, 2011, p. 55.

36 Nayanee Gupta et al., "Innovation Policy of South Korea", Institute for Defense Analysis, 2013, p. 25

process that led to a transition in the source of R&D expenditure. Korea's public–private R&D expenditure ratio changed from 97:3 in 1960 to 19:81 in 1990, and Korea's gross national expenditure on R&D increased from 4 billion dollar to 4,676 billion dollars in the same period.[37] The increased level of R&D, which caused rapid innovation in the private sector, allowed the economy to produce high profits over the long term and made the country flexible as its economic environment changed. The transformation of the Korean economy occurred through several steps, from agriculture to small industry, and then to heavy industry and the IT industry. Without firm and stable protection of patents and increased investments in R&D, this transformation would have been impossible.

D. Problems with Korea's Patent System

- The problem of inequality

The patent system has side effects. Strong patent protection can hamper the development of other inventions, and, if too many patents without economic value are allowed, they can harm the credibility of the intellectual property market and impede R&D investment. Korea features an extreme wealth imbalance among corporations, and this asymmetry involves the patent system. Large conglomerates, which account for only 0.9% of Korean firms, represent 2/3 of corporate sales in Korea.[38] Up until 2015, these large conglomerates made more patent applications than did small businesses.[39, 40]

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[37] Id. P. 55.

[38] Ministry of Statistics of Korea webpage (http://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1325).

[39] The number of patent applications by small firms exceeded that of large firms in 2015 for the first time.

Inequality in business is a factor that can obstruct the development of an economy. As holding patents requires expenditures such as maintenance fees and legal fees for dispute resolution, it is difficult for small entities. Samsung Electronics, the largest corporation in Korea, holds around 103,000 patents and pays more than 100 billion KRW (around 90 million dollars).[41] Small corporations don't have the capacity for such expenditures.

This imbalance in the Korean economy makes it harder to facilitate economic growth through knowledge. The patent system can be important when the open source of knowledge helps small economic entities develop their knowledge or use the knowledge of expired patents to produce better products. It can stimulate winning entities such as large conglomerates in Korea to invest in R&D and develop their knowledge. However, this will not happen if inequality in the economic structure is too severe. In such a case, the patent system is a barrier for large corporations. Evidence of this problem can be observed in patent suit statistics. Gwansik Kim showed that there is an inequality in patent litigation.[42] The research focused on 656 patent infringement indemnity cases from 2009 to 2013. He showed that, when the defendant was a large corporation, the winning percentage was 9.4%, but, for smaller firms, the number increased to 29.3%; moreover, no small firm won a patent case against a large corporation as a plaintiff. [43] Reasons for this phenomenon may vary. Large and small corporations have different capacities for dealing with IP problems and may also have different capacities for producing effective knowledge.

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[40]http://www.kipo.go.kr/kpo/user.tdf?a=user.news.press1.BoardApp&board_id=press&cp=1&pg=1&npp=10&catmenu=m03_05_01&sdate=&edate=&searchKey=2&searchVal=%B4%EB%B1%E2%BE%F7&bunryu=&st=&c=1003&seq=15426) .

[41] http://biz.chosun.com/site/data/html_dir/2013/05/29/2013052903858.html.

[42] Gwansik Kim, *Teukhusosongeui hynhwanggwa gwajae* ("Patent System and its Problems at Present"), Patent Suit Practice Association of Korea, 2015. 9., p. 9.

[43] Id. P. 9.

The economic inefficiency of this inequality can be amplified through the patent system. Korean patent statistics suggest an inequality-driven inefficiency. Even though the GDP growth rate skyrocketed from 1960 to 2000, the expansion of patent numbers was not associated with economic growth. Patent applications increased about tenfold from 1991 to 2013, but GDP growth did not follow and increased only a little more than threefold.[44] The expansion in patent applications is too large relative to the economic growth rate, suggesting that the economy is not producing knowledge effectively and that the patent system associated with the economic structure is obstructing knowledge utilization in lower parts of the economy.

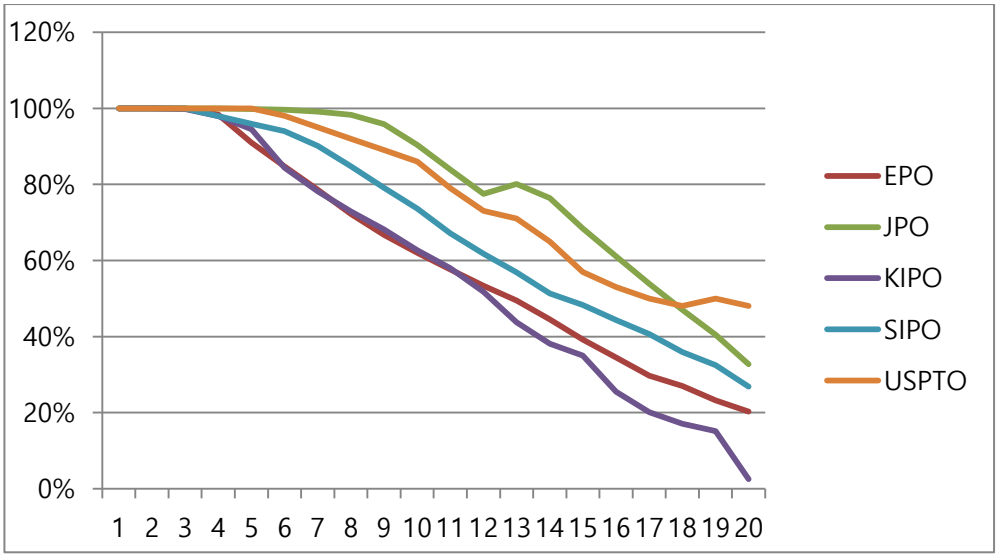
- Problem of Maintenance

Economic impacts and their potential cannot be determined by the government or patent office. The future of an invention cannot be predicted exactly, so that most countries have a minimum level of sufficiency requirements. However, actual protection levels differ among countries. To promote the development of intellectual property and patent registration, KIPO has implemented many policies for educating the general public and companies since its early stage, as discussed. KIPO has become one of the largest patent registration offices in the world. More patents are granted by KIPO than by the European Patent Office (EPO).[45]

<Chart 4> Patent Maintenance Rate of Five Major Patent Offices in 2012

[44] World Bank data.

[45] Five IP Offices, IP5 Statistics Report, 2013 edition, p.7, p. 15.



Source: IP5 Statistics Report 2013, Edition. Raw data is from http://www.fiveipoffices.org/statistics/statisticsreports/2013edition.html.
Note: Each graph refers to the European Patent Office (EPO), Japan Patent Office (JPO), Korea Intellectual Property Office (KIPO), State Intellectual Property Office of the People's Republic of China (SIPO) and United States Patent and Trademark Office (USPTO). The vertical axis denotes maintenance rate through the years on the parallel axis.

Chart 2 shows one of the problems KIPO faces. Naturally, patents can be inefficient to maintain because that may be inefficient to utilize after registration, or new technology might be more efficient. Some patents are registered for future application against competitors but are revealed to not have the expected outcome. In any case, the cost of holding a patent might exceed the benefit, including expected future profits. It is thus common for patent holders to drop their rights.

However, the rate of maintenance is too low in Korea, as Chart 2 shows. The ten-year maintenance rate is only 63%, and the twenty-year maintenance rate is only 3%. Compared to the USPTO rates of 86% and 48%, respectively, these numbers are extremely low, indicating that the Korean patent system is not working effectively, given the large number of patent applications and grants.

- Insufficient Protection

One of the problems the Korean patent system faces is a high overturn rate in dispute resolution procedures. As required by the patent law of Korea, around half of disputed validity cases are judged by the Patent Judgment Division. In 2014, 52.8% of cases were for full revocation by the division; if partial revocation decisions are included, the number rises to 62.1%.[46] This high revocation rate is a problem in many developed countries. Miller (2013) found that, among 980 US patent cases, the court fully or partially invalidated the patent in 37% of the cases from 2000 to 2010.[47] In Germany, the court maintained the patent's validity in only 26% of the cases.[48] The possibility that a patent can be easily revoked poses a great risk for patent holders and makes them act passively in disputes.

Concerning infringement, Korea's patent protection policy is insufficient compared with that of other IP 5 countries,[49] especially the US. The amount of compensation is smaller than in the US. An estimate of Seoul National University shows that the compensation level is only about 1/12.9 of that in the US, even when the difference in the size of their markets is considered.[50] Moreover, unlike the US, Korea imposes no punitive damages, and the compensation must match the loss.

The criminal procedure has been widely used. Unlike for trademarks or copyright, TRIPS[51] does not state that infringements of patents should be included in the criminal procedure. It allows its member countries discretion about whether to punish

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[46] KIPO data (www.kipo.go.kr).

[47] S. P. Miller, "Where's the Innovation? An Analysis of the Quantity and Qualities of Anticipated and Obvious Patents", Virginia Journal of Law and Technology 18, 2013, p. 45.

[48] Joachim Henkel and Hans Zischka, "Why most patents are invalid – Extent, reasons, and Potential Remedies of Patent Invalidity", Technische Universitat Munchen, 2015.

[49] Association of patent offices of Korea, Japan, Europe, the US, and China.

[50] Seoul National University R&DB Foundation, "Jijaegwon sosongaeseo sonhaebaesang sanjungui jukjulsung hwakbobangan (Research on the method to provide appropriate compensation on IP suit)", National Commission of IP Final Report, 2012, p. 190.

[51] TRIPS, part 3, section 1, article 61.

offender, but the patent law of Korea states that those who infringe a patent should be imprisoned with hard labor for less than seven years or fined less than 100 million KRW (around 90 thousand USD). Reported cases of patent infringement as criminal cases totaled 767 in 2013, which is relatively high compared to only six cases from 2004 to 2008 in Japan, which has a similar clause in its patent law. However, the protection provided by the criminal procedure is very weak because most of the cases are dropped and only a few go to court. The indictment rate in 2013 was 3.4%. Investigations are done by the police and prosecutor′s office, which lack professional knowledge of technology. Prosecutors tend to drop cases until the final decision on validity cases are made by the court or the Judgment Division of the Patent Office. Thus, the criminal procedure does not provide sufficient protection for patent holders. In practice, it is used only to press defendants in patent infringement cases for compensation.

The problem with the patent protection system is that small companies and individual inventors are exposed to the risk of patent loss. Generally, legal expenditures on patent cases are higher than are those on ordinary court cases because these cases require technological knowledge and frequently involve appraisals. For small corporations and individual inventors, the price of holding patents might be unbearable. This can make the lower part of the economy vulnerable, as intangible assets become ambiguous.

E. Policy Implications

Korea’s patent system can be a model for countries seeking to promote economic growth with innovation and knowledge development. As the economy develops and education associated with industry functions well, a high level of protection provided

by government can foster industrial development in later stages, when infrastructure is well-founded, and catch up with developed countries. It also allows the economy to transition to other types of industry and respond to external changes. It is doubtful that Korea's patent policy fostered economic growth in the early stage of development, but the country has successfully changed its core industry from low-tech to high-tech industry such as the IT industry with the help of its patent policy. It also allowed the country to smoothly change its source of R&D expenditure from the government to the private market, which made the country grow strongly. Patent applications and grants have increased significantly throughout the 20th century. From the 1960s to recent years, Korea shows that providing better patent protection can enhance economic growth.

However, the system has several problems despite the increased quantity of patent applications. Korea′s technology level is high, but it relies on only a few firms, and its patent policy is limited in protecting small and medium-size companies. The heavy reliance on large conglomerates has been successful in the past, but as the economy grows, the inflexibility of the system makes it doubtful whether the economy will succeed in the future. To enhance performance, the policy should guarantee better protection for lower parts of the economy.

7. Conclusion

A patent system is essential for modern countries, including developing countries. A patent policy is required in a nation′s comprehensive growth plan. However, the effect of strong IP protection has been overstated. As free trade has become a norm of the global economy, IP protection has become more important, leading to multilateral

agreements such as TRIPS and PCT. However, this trend is not based on concentrated research, which should analyze the relationship between the economy and the patent system. This paper suggests that thorough research on individual countries is required. Both the benefits and costs of IP protection should be considered.

Korea has fostered economic growth by providing better patent protection. It has shown exceptional performance in the knowledge market and has effected a significant economic transition. However, the country is heavily dependent on a small number of corporations that fuel the economy, and it is questionable whether the system can support future economic growth. To improve its performance, Korea should provide a more stable system for R&D investors and individual inventors.

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