CONTROL FACTORS OF INTELLECTUAL PROPERTY IN DEVELOPING COUNTRIES - CASE STUDY OF PATENT ANALYSIS IN CHINA

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Abstract

The right on intellectual property is among crucial public policies and a key factor of both technology and Science in World. The intellectual property right plays a crucial role in technology transmission and development inside and outside of countries. China is a country which issued domestically and no locally the most number of patents. Patents distribution in China is unequal in provinces, autonomous regions and municipalities' cities of China. This article investigates the causes of that inequality of patents distributions in China's economy. The main purpose of this research is to demonstrate the determinants of having highest number patents in economy. Gravity model and endogenous growth model are applied in analyzing data. With gravity model, we use the balanced panel data with random effects model estimation in studying the influencing factors of more foreign patent numbers in China's economy. Those two panel data techniques are selected through Hausman test. With time series data set and endogenous growth model, through R-squared test, pooled OLS regression model or linear regression model is the best estimation in investigating the positive impacts of patents in provinces, cities and regions economic development. STATA is used as analysis tool. Among main factors which influence the attraction of the diverse investors or both policy makers and business people to come in China, there are Gross Domestic Products of China through the increase of 75%, similar Patent applicants' Gross Domestic Products influence granted patents number with 28% of enlarge. The third factor controls innovation in China is export flow values to granted patent holders with the increase of 18%.

Keywords:
Granted Patents, Economic Growth, Intellectual Property Right, Export Flows, Import Flows, Innovation, Knowledge

1. INTRODUCTION

Rights of intellectual property become known for the period of the untimely mercantilist time like a way for states or nation to combine and enlarge their wealth and power throughout the manufacturing expansion and foreign enterprise of trading monopolies. The expression of patent has the origin from the Latin word patere means to be open and as its definition is as an open letter of privilege from the administration or government to practice or perform an art [1]. That is origin of Patent word. The developed countries encourage and promote the innovation as engine of economic growth and competition through free trade [2] while the poorest countries are not likely to gain advantage from strong IPR [3] and the developing countries with low income level of economy do not put effort on the intellectual property rights protection. The different level countries' economies in the world have considered the intellectual property rights protection as the engine of their economic growth [4]. Gould and Gruben empirically conclude that IPR protection has positive and significance influence on economic growth [5]. Thompson and Rushing [6] compared the impact of patent right protection on economic growth of developed and developing countries. They

argued that the protection of patent has significant and Positive effects on total factor productivity in more developed countries. WIPO (2017) confirmed that China persists moving ahead in innovation. It was the overall GII ranking of 22nd and it demonstrated strong patent applications, global R&D companies, research talent in business enterprise, and other IP-related variables [7] [8]. This research analyzes the determinant factors of intellectual property right on the economic growth of China with the domestic and foreign patents issued in China's economy during 17 years ago. It also helps the decision and policy makers to know the influencing factors of the intellectual property rights in general and especially which influencing factors help a nation in attracting the international investors to come in country and apply for patents, those patents should help the economic growth improvement. IPR is a legal right granted by a government to promote creative and innovation output by making sure that an inventor obtains the benefits of his/her inventions or works [9]. Greenhalgh and Rogers defined IPRs as the rights to sell and use inventions and knowledge [10], IPR plays a crucial role in technology transmission and development inside and outside of countries [11] and it is a science and technology indicator. It is crucial research to investigate theoretically and empirically the roles of intellectual property [12] and to describe its influencing factors to the low economic income countries. There are different kinds of intellectual property rights such as trade mark, copyright, patent, trade secrets, and geographical indications [13], but this research work considers only patent protection. Among patents protections, we can generally cite domestic and foreign or abroad patents protections but patents are divided into three categories such as utility model, design and invention patents in China. In fact, China issued many and different categories of Patents to resident and non-resident or to foreign countries, Patents distributions are not the same, which is why this article investigates which basic causes of those inequality distributions especially in China's economy and generally in developing countries' economic development. Patent protection is mainly intellectual property in the world and it is used as tools in reducing exports market competition where local firms create more patents [14]. As a new economy, China, as a country of emerging economies, has made remarkable achievements in the intellectual property; it was ranked by GII as twenty second country overall the world. China also has been ranked by WIPO as the first country which filed the most number of IP in all kinds of intellectual property (patents, trademarks and design) in 2015 [15]. Patent protections are the primary among others types of intellectual property rights protection in the world.

We expect to get the answer for the following questions (1) are more foreign patent applicants from far a way of China? (2) What relationship that exists between the foreign patents applicants' economic growth and the number of patents granted to those applicants? This article is organized as follows

introduction, related works, research methodology, results and findings, conclusions and recommendations.

2. RELATED WORKS

In the past centuries, different researchers have been theoretically and empirically examining the relationship between the economy of developing countries and the intellectual property protection. Intellectual property is defined as all creations of the mind such as images, names, inventions, symbols, and artistic works and literary utilized by the firms, enterprises, institutions or individuals in its commerce activities. In general, and according to WIPO [16].

Chen and Puttitnun observed the contribution of capacity of innovation to the IPR regime in developing countries, and they hypothesize so as to the countries with lower economy level have to present well-built protection for IPRs in order to make sure access to foreign technologies; middle-income countries have to grant reasonably weak protection to make easy local imitation of these overseas technologies; and developed countries have to provide strong protection to promote their own innovators [17]

Branstetter and Saggi concluded so as strengthening IPRs in the developing countries enlarge FDI and as a result the share of Southern production that is assumed by multinationals. But due to imitation is reduced, the profit must be earned to attract Firms from developed countries to become a multinational via FDI is lower, reduction of the value of the overseas affiliate sales of a typical multinational firm relative to the sales of a Northern exporter [18].

Ding and Liu advise developing economies' policy makers to emphasize or focus on IPR protection enforcement in order to develop their productivity [19]. All above researchers combined different variables with intellectual property right variable and they made different analysis on developing countries, finally they argued that the intellectual property rights is very useful aspect in economic development of countries especially the countries which are still in least developed countries.

3. RESEARCH METHODOLOGY

This research work empirically analyzes factors of intellectual property in China's economy through the number of foreign and domestic granted patent applicants. To assess or study the influencing factors which influence the domestic and abroad patents applicants, the endogenous and gravity models are applied. Previous works examined the association between economic growth by sample of gross domestic product and the production of Patents through times series dynamic equilibrium rapport analysis method [20], [21]. Ginarte and Park [22] argued that IPR protection influences economic growth through motivating the increasing of human capital inputs such as development and research factors. They confirmed that the benefits gained from patent protection by an open economy are different from the one gained by a closed economy. Usually gravity model is model which is used in different research works but related on international trade. The Gravity model is from physics formula. The gravity model history has been started from traditional gravity model within the international trade through

Newton's law of gravitation. The below is the tradition gravity model. The Eq.(1) and Eq.(2) shows the gravity model.

$$T_{ij} = G \frac{M_i^{B_1} M_j^{B_2}}{D_{ij}^{B_3}} \simeq T_{ij} D_{ij}^{B_3} = M_i^{B_1} M_j^{B_2} \tag{1}$$

$$M_i = G \frac{T_{ij}^{B_1} D_{ij}^{B_3}}{M_j^{B_2}} \tag{2}$$

where T_{ij} is yearly total granted patents from country i to other country, G is the gravitational constant, the constant G is approximately equal to 6.674×10^{-11} Nm^2 kg^{-2}. M_i is Gross Domestic Products of country i, M_j is Gross Domestic Products of country j, D_{ij} is the distance between country i and country j. In order to minimize high difference and high number of some variables such as yearly *GDP*, Exports values, imports values, Foreign direct investment inflows, and government expenditures, we need to use natural logarithm (*Ln*) in the above equation (Eq.(1)) and we add more variables since in previous equation we have GDP of two countries and distance between that countries (country i and country j). We assume that GDP should be influenced by innovation, export flow values, import flow values and degree of economy freedom of country then we apply natural logarithm product and quotient rules, we get Eq.(3). The Eq.(3) shows the effects of foreign patents.

$$LnM_{CN} = B_0 + B_1 LnT_{CNk} + B_2 LnEx_{CNk} + B_3 Ln \operatorname{Im} p_{CNk} \atop + B_4 LnD_{CNk} - B_5 LnM_k + B_6 Openess_{CN} + e_{CNk} \tag{3}$$

where *CN* is meant China and *K* is any country which is granted the number of Patents by China, T_{CNk} is the total yearly granted patents applications from abroad (country *K*) to China. M_{CN} is the proxy of GDP (Gross Domestic Product) of China and M_k is GDP of China's granted patent partner, D_{CNk} represents the distance between China and granted patents partners, Imp_{CNk} is import flow values between China and its granted patents holders, $lnEX_{CNK}$ is export flow values between China and its granted patents holder, $Openess_{CN}$ is freedom degree of China's economy. M_k is Gross Domestic Product of a country which is granted patents by China, and e_{CNk} is error term, B_0 is constant and from B_1 to B_6 are the coefficients. The above Eq.(2) is used in the effects of foreign granted patents on economic growth of China and also learn others variables which influence the China's rapid increase of economic growth but the researcher needs also to empirically learn the factors which influence the presence of high number of patents in China. For this situation, we apply the gravity model with yearly number of granted patents to country k as dependent variable and the equation changes as follows:

$$LnT_{CNk} = B_0 + B_1 LnM_{CN} + B_2 LnEx_{CNk} + B_3 Ln \operatorname{Im} p_{CNk} \atop + B_4 LnD_{CNk} - B_5 LnM_k + B_6 Openess_{CN} + e_{CNk} \tag{4}$$

where *CN* stands for China, T_{CNk} is the total of yearly granted patents applications from abroad (country *K*) to China. M_{CN} is the proxy of GDP (Gross Domestic Product) of China and M_k is GDP of China's granted, D_{cnk} Presents the distance between China and granted patents partners, Imp_{CNK} is import flow values between China and its granted patents holders, Ex_{CNK} is export flow values between China and its granted patents holder, $Openess_{CN}$ is freedom degree of China's economy, M_k is Gross Domestic

Product of a country which is granted patents by China, e_{CNK} is an error term, B_0 is a constant and B_1 to B_6 are the coefficients.

The Eq.(4) shows the foreign patent factors. With this Eq.(3) and its results will help in investigation of the factors which influence outside countries to come in China and apply for Patents but we have to investigate also on the roles of granting different patents to foreign countries in that time, China's GDP will be the dependent variable but with the variables and data.

This research work examines the relationship between China's autonomous regions, municipalities and provinces gross domestic products and the number of granted patents in corresponding region with the following equations:

$$LnM_{regionCN} = B_0 + B_1 LnT_{regionCN} + B_2 LnEx_{regionCN}$$
$$+ B_3 Ln\,\text{Im}\,p_{regionCN} + B_4 Openess_{regionCN} + e_{regionCN} \quad (5)$$

where *region* is China's Provinces, Cities and Autonomous regions, *CN* means China, $T_{regionCN}$ is the total of yearly granted patent applications from China's province, $M_{regionCN}$ is the proxy of GDP (Gross Domestic Product) of China's provinces, Cities and regions and $Imp_{regionCN}$ is import flow values from province, cities and regions of China, $Ex_{regionCN,}$ is exports values exported by province of China, $Openess_{regionCN}$ is freedom degree of China's provinces, cities and regions economy, $e_{regionCN}$ is error term, and B_0 to B_4 are variable coefficients. The Eq.(5) shows the patent effects on local economic growth.

The correlation results in Table.1 is used in analysis of the relationship between the dependent variable and its independent variables. Those correlation tables also show the relationship between the independent variables themselves, otherwise regression models are used. In running regression model, Hausman test is used for choosing the suitable. Estimations between fixed effect estimation and random effects estimation, otherwise the probability value and R-squared help researcher to choose the appropriate regression models.

Table.1. Determinant factors of Patent numbers in China's Economy Econometrics Models

Factors analysis	Cases	Econometric model	Dependent variable	Data Set
Domestic granted Patents	Local patents from Regions, Provinces, and Cities of China	Endogenous Growth model (linear regression model)	Patent numbers from Regions, Provinces, and Cities of China	Time series
	Local patents in whole development of economy	Endogenous Growth model (linear regression model)	Total of all Patents	Time series
Foreign granted patents in economic development	Foreign granted patents with GDP of Applicants	Gravity model(random effects regression model)	Foreign granted patents	Panel data
	Foreign granted patent on economic development of China	Endogenous Growth model (linear regression model)	Total foreign granted patents	Time series

The sample size for domestic granted patent is from 31 China's regions, provinces, and municipalities. China's provinces used here are 22 provinces which are Anhui, Fujian, Gansu, Guangdong, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangsu, Jiangxi, Jilin, Liaoning, Qinghai, Shaanxi, Shading, Shanxi, Sichuan, Yunnan and Zhejiang, and 4 municipalities are Beijing, Chongqing, Shanghai, and Tianjin and 5 autonomous regions which are Guangxi, Inner Mongolia, Ningxia, Tibet and Xinjiang. Within foreign granted patents analysis, this research considers the first 30 countries which have the most total number of granted patents during the period of eighteen years (1998-2015). Those selected countries are Australia, Austria, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, Great Britain or United Kingdom, India, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Republic of Korea, Russian Federation, Singapore, Spain, Sweden, Luxembourg, South Africa, Malaysia Switzerland, United States of America, and Virgin Islands. This research work is using as China's three kinds of patents for the period of eighteen years as the sample size. For obvious reasons, this study only looks at all three kinds of patent protection used in China. The data source for all number of patents for both domestic and foreign granted patents is the Chinese state intellectual property office (SIPO) English website [23] and others data such as Annual GDP, exports values, imports values, Foreign Direct investment flows, annual average exchange rate, human capital and government consumption for provincial levels and national level are extracted from National bureau of statistics of China online database where we find China statistical yearbook for 18 years. The distance between countries' center is from Wolfram Alpha Computational Knowledge Engine [24]. The source of provinces and autonomous regions data is from National Bureau of statistics of China.

4. INTELLECTUAL PROPERTY RIGHT IN CHINA

In General, intellectual property protection has different kinds [25], according to Besen and Raskind there exist old and new forms of intellectual property protection, in the old forms there are as patents, copyrights, trade secrets, design rights and trademarks types while in new types there are as database rights and breeding rights. However, the one kind of intellectual property protection form which is patents is generally considered like the mainly representative as well as key intellectual property rights [26]. A patent refers to as a lawful document that is established to a creator or an inventor by office which has in its charge of patents in order to protect the new technology or knowledge. PRC has experienced rapid increase in the number of both applied and granted patents from the Patent Act promulgation in 1985 [27]. Patent protection is very important intellectual property right kind. In PRC, according to State Intellectual Property Office of the People's Republic of China

industrial property rights are in three kinds such as trademark, patent and copyright, and there are three types of Patents which are invention, utility model and design patents [28]. Each kind is divided into two parts which are one part is from abroad or outside of China is foreign patents and second part is the one which is applied by local Population, enterprise and local industries is Domestic Patents.
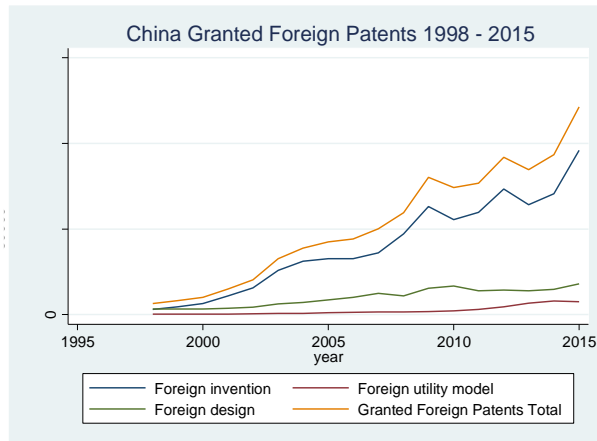

Fig.1. Three kinds of Granted Foreign Patents

The Fig.1 represents the granted foreign patents for three categories of Chinese patents. Granted foreign Invention patents are the most significant foreign granted Patents during the period of eighteen years (1998 to 2015), but the foreign utility model patents are not significant, the curve which presents foreign granted design patents for this period is between the one of invention granted patents and utility mode patents curve but it follows the direction of granted utility patents curve. The invention patents are the one which dominated other foreign patents categories in China within our concerned period.

5. EMPIRICAL RESULTS AND ANALYSIS

Currently China is reported by different reports as the country which grants more number of patents but the developing countries with low income level grant almost nil of patents. This research investigates the factors which caused China to authorize more number of patents. Two parts of patents (for domestic patents and foreign patents) are used in investigating those determinants.

5.1 DETERMINANTS OF LOCAL GRANTED PATENTS

5.1.1 Factors of Local Patent numbers in Provinces, Regions and Cities:

The causes of high number of patents in economic development of China through linear regression model estimation and it regression outcome. This regression model considers the number of granted patents as its dependent variable which helps to analyze or to do investigation on the causes which pressure the autonomous regions, municipalities and Provinces to have more or less number of patents.

$$LnT_{regionCN} = B_0 + B_1 LnM_{regionCN} + B_2 LnEx_{regionCN}$$
$$+ B_3 Ln\,Im\,p_{regionCN} + B_4 Openess_{regionCN} + e_{regionCN} \qquad (6)$$

Within this econometric, $M_{regionCN}$ stands for provinces and autonomous regions' economic growth, CN means China, $T_{regionCN}$ presents number of domestic patents, $Ex_{regionCN}$ is provinces and autonomous regions export flow values, $Imp_{regionCN}$ is import flow values to provinces and autonomous regions, $Openess_{regionCN}$ is China's openness and e is error term. This regression model comprises four independents variables and number of patents granted to innovators in provinces and autonomous regions of China is its dependent variable. The number of observation is $558 = 18*31$ this means that we analyze the data from thirty-one autonomous regions, provinces and municipality cities for period of eighteen years. The below Table.2 demonstrates clearly the determinants of higher number of patents in economy of developing countries.

Table.2. Linear regression model with province and region's Patents number and economic growth

Number of Granted Patents and its Factors in Regions/Province of China						
source	ss	df	MS	Obs.	558	
Model	1600.4677	4	400.1169	$F(4.553)$	= 1105.7	
Res.	200.10129	553	0.36184683	$Prob > F$	= 0.000	
total	1800.5690	557	3.2326194	R^2	= 0.8889	
				adj. R^2	= 0.8881	
				Root MSE	= 0.6015	
LnPat	**Coef**	**Std.Err.**	*t*	**P>|t|**	**95% conf.**	**Interval**
Lngdp	0.900561	0.147506	6.11	0.000*	0.610819	1.19030
Ln ex.	0.234527	0.099065	2.37	0.018*	0.039937	0.429117
Ln im.	0.113126	0.064858	1.74	0.082	-0.014272	0.240526
Ln op.	0.141394	0.14456	0.98	0.328	0.142569	0.425358
-cons	-22.35845	0.5102536	-43.82	0.000*	-23.36072	-21.3561

Significance level (5%): * Probability value which is significant

The data for 31 places given by SIPO shows that the number of patents application is increasing each year depends on the various provinces exist in China. The number of observation is 558 due to the period of 18 years are combined with the places. The application of patents should be accepted or rejected according to the rules and regulations or procedures from SIPO. The yearly granted patents number is also not the same in all autonomous regions, municipalities and Provinces of China. The dependent variable is number of domestic patents (*LnPat*), independent variable such as *Lngdp* - GDP for the places, *Ln ex.* - export flows, *Lnim.* - import flows, *Ln op.* - openness degree, and –*cons*: constant. The factors which influence that inequality of China's autonomous regions, municipalities and Provinces number of granted patents as it is shown by linear regression model (Table.2), the granted patent numbers are statistically and

positively determined by autonomous regions, municipalities and Provinces gross domestic products, this means that the place like Guangdong province, Zhejiang province etc whose share of patents are so high in numbers due to its improvement in GDP or in development of its economy. The other determinant of local patents is export flow values, and constant variable. Export flow values statistically define the patents protection by possibility value of 1.8% and 23.4% of increase while Province and region's GDP defines patent protection with zero% of probability value and 90% increase. In our preceding research we argued that China's exports value has the positive relationship with the Gross Domestic Products of trading partners with 85% of increase [29]. The exports values and volumes are so important in economy development of countries and the IPR in China is crucial in economic development [30].

5.1.2 Factors of Domestic Patents with National Economic Growth:

With the endogenous model, we investigate the influencing factors of more patent numbers in China's economy with the below econometric formula:

$$\ln IPR_{CNt} = B_0 + B_1 \ln GDP_{CNt} + B_2 \ln FDI_{CNt} + B_3 \ln CONTROLS_{CNt} + E_{CNt} \quad (7)$$

With this regression model, CN is means China, t means time, IPR is total of all patents issued from 1998 to 2015, GDP is a proxy of economic growth of China, FDI is annual foreign direct investment, and $CONTROLS$ is a proxy of government expenditures, human capital resources and economic openness. In this regression model equation there are five independent variables and its dependent variable is the annual total of all three kinds of patents. The regression model outputs are summarized within the below table.

Table.3. Determinants of Domestic Patents in China (National Economic Growth)

Factors which influence most Domestic Patents number in China						
Source	ss	df	MS	Obs.	18	
Model	1269.9822	5	253.996439	$F(5,12)$	= 1528.83	
Res.	1.99364793	12	.166137327	$Prob > F$	= 0.000	
total	130.0450 67	17	74.8221085	R^2	= 0.9984	
				adj. R^2	= 0.9978	
				Root MSE	= 0.4076	
LnPat	**Coef**	**Std.Err.**	**t**	**P>|t|**	**95% conf.**	**Interval**
Lngdp	.4997906	3.264755	0.15	0.881	-6.613499	7.61308
Lngov	4.553583	1.813541	2.51	0.027*	.6022165	8.50495
Ln op.	8.459359	61.9829	-2.99	0.894	-126.5898	143.5085
lnhcap	-3.176716	2.535172	.25	-10.234	-8.700382	2.34695
lnfdi	-1.780829	.277553	-1.39	0.189	-4.564378	1.00272
-cons	-19.62108	56.94716	-0.34	0.736	-143.6983	104.4561

7% which is less than five%. The logarithm of government expenditures coefficient estimation is Significance level (5%)	
rho	-.5425276
Durbin-Watson	statistic (original) 2.621619
Durbin-Watson	statistic (transformed) 2.185663

* Probability value which is significant

This Table.3 is drawn in order to present the time series set data for year 1998 to 2015 with Prais Winsten Regression. With the test of R^2 and its results is 99.84% that good results and our regression model probability value is zero, this model is suiTable.in presenting this case. This model used the following variables: aggregate total of granted domestic patents (*lnpat*) which is proxy of intellectual property in this dissertation and this regression model dependent variable, the independent variable is annual foreign direct investment flows (*lnfdi*), human capital (*lnhcap*), trade openness or economy freedom degree (*lnop*), government expenditures (*lngov*) and gross domestic of China (*lngdp*).The results from regression model estimation demonstrate that one variable which government expenditures are statistically significant with the aggregate total of all categories domestic granted patents through the statistical probability value of 0.027 or 2.4.553583 which are the increase effects on the aggregate total domestic patents. In our paper tilted Effects of IP protection on economic growth of developing countries with data from China for fifteen years 2000 to 2014, we argued that IPR is a government policy but the straight effects of IPR protection is to encourage financially innovators, creators who have inventive power, knowledge, and to raise the expenditures of access to that technical innovation or new knowledge with no authorization from the property owner. In common, countries with developing economy are described by weak scientific or technical infrastructures, as the results in the form of the stimulus to domestic improvement in innovation will be muted, even though they will still face the costs arising from the protection of technologies or innovation from abroad. In outcome, the expenses and settlement of the organization as an entire may not be practically discrete. When most developing countries boast non strong technological base which could not gain from IP protection, those countries do not enclose genetic resources and traditional knowledge, which are very importance to their specific economic growth and in general to their economic development. In China's situation, as a developing country and China is among countries which have the upper level of income of economy, it presently is second in leading economy in the world, but with worldwide top of population. On the other hand, China is a developing country, but it has strong technical and scientific infrastructures, the new knowledge and innovation are loud, the expenses for IPR are not so high and China has traditional knowledge and genetic resources which have significance importance to both China's economic growth and world's economic development of in general. As conclusion of our previous research is that IPR is among very crucial public policies, the government or policy makers in developing countries should put emphasis and efforts on the IP which is legal activities and deal with owner's property rights in non-tangible things such as industries reputation or innovations and Goodwill in a diversity

of activities. With strong IPRs protection motivate not only innovations and knowledge but also promote innovations and researches in developing countries. The IPRs enlarge global welfare and their effects are as positive or encouraging effects on countries' economic growth [95]. In this recent regression model we get the new prove that China's government expenses are statistically significant with IPRs.

5.2 DETERMINANTS OF FOREIGN GRANTED PATENTS

As we mentioned it, in section 3, the distribution of patent license is not the same. Some countries have more number of patents than other. This section analyses the determinants of that imbalance of patent licenses to foreign countries through gravity model and endogenous model.

5.2.1 Factors of Foreign Patents and GDP of Patent Partners:

In this section, the researcher is analyzing the association between foreign patents and the rapid of China's economic development growth and which factors influence the foreign countries to come in China to apply for the patents for their innovation. The Table.5 shows us that factors and the association between China's GDP and foreign granted patents numbers through this gravity model formula.

$$LnT_{CNk} = B_0 + B_1 LnM_{CN} + B_2 LnEx_{CNk} + B_3 Ln \operatorname{Im} p_{kCN} \\ + B_4 LnD_{CNk} - B_5 LnM_k + B_6 Openess_{CN} + e_{CNk} \quad (8)$$

In this econometric model, *CN* means China, *M* represents GDP or economic growth of concerned countries, B_0 is a constant coefficient, and from B_1 to B_6 are variable coefficients. T_{CNK} stands for the number of patents granted to country *K* from China, Ex_{CNK} means China's export flow values to country *K* (trading partner), Imp_{KCN} is country *K* export flow values to China in another words is China's import flow values from country *K*, M_k of course stands for the economic growth of country *K* and *openness$_{CN}$* is China's economy openness which is measured through China's summation of export flow values and import flow values over its economic growth variable. This formula is appeared in previous chapter as equation3 and it presents six independent variables excluding constant coefficient and a dependent variable for this econometric model is number patents granted to different countries of the world by China.

Table.4. Random effects model with number of granted patents as independent variables

Random - effects GLS regression			Number of obs =540			
Group variable: Group			Number of Groups =32			
R^2:within = 0.8209			obs per group: min = 3			
Between = 0.3790			Avg = 16.9			
Overall=0.4159			Max=18			
corr(u_i,x) = 0			Wald chi^2(6) =2306.15		Prob>chi2 = 0.0000	
LnG.P.	**coef.**	**Std.Err.**	*z*	*p>|z|*	**95%conf.**	**Interval**
Lngdp$_{cn}$	0.7466122	0.0444031	16.81	0.000*	0.6595837	0.8336407
Lngdp$_k$	0.2801962	0.1129237	2.48	0.013*	0.588697	0.5015226
Lnex.$_{cnk}$	0.1813799	0.0725345	2.50	0.012*	0.0392149	0.323545

Lnimk$_{cn}$	0.0256781	0.0288687	0.89	0.374	-0.0309035	0.0822597
Lnop.$_{cn}$	-1.140577	1.268392	-0.90	0.369	-3.62658	1.345426
Lnd$_{cnk}$	-0.7658308	1.453156	-1.74	0.082	-1.630046	0.0983843
_cons	-21.56789	12.95124	-5.12	0.000*	-29.83185	-13.30394
sigma_u	1.3949745					
sigma_e	0.4237905					
rho	0.91550506 (fraction of variance due to u_i)					

Significance level (5%)

* Probability value which is significant

The Table.4 summarizes this econometric model outcome with fixed effects for 540 = 18*30 as the number of observation. This means that the researcher runs the regression model for eighteen years and the data from thirty countries and those countries are the countries which applied for more total number of patents from China during that time or period of eighteen years.

China granted patents to different countries from all over the world, but there are factors which influence countries to apply for those patents and those patents have some impacts on economic growth and others macroeconomic variables such as export flow values, import flow values of China. This section analyzes the granted patents from 30 countries with gravity model and the researcher designs the strong balanced panel data set for 18 years with total of 540 observations. The first case is about the analysis of factors which influence the foreign countries to apply for patents in China; here the independent variable is the number of granted patents to country *k* (applicants). The strong balanced panel data has three options of estimations which are pooled OLS regression, fixed effects and random effects. The researcher needs to make some tests in order to check which estimation is appropriate to present factors which influence the countries to have patents in China. The R^2 for pooled OLS regression model is only 40% which represents that it is not good model so it is automatically rejected. We need to use Hausman test in selecting the appropriate model between random effect model and fixed effects with null hypothesis of random effect model is appropriate and alternative hypothesis of fixed effect model is appropriate. The probability value for Hausman test appendix Table.7 is 8.4% which is greater than 5%, so the null hypothesis is accepted, random effect model is suitable. Estimation in defining the dependent variable. Random effect model in Table.5.9 shows that the first factor which influences the attraction of the different investors or both policy makers and business people to come in China is the Gross Domestic Products of China (*lngdpcn*), this independent variable is statistically and positively significant with the number of granted panted (*LnG.pcnk*) with the probability value of zero% which is less than 5%, this means that China GDP rapid increases for various years are very important factor in encouraging rapid innovation, knowledge and technology transmission. With the increases of GDP of China increases number of foreign granted patents with 75%. This is theoretically in gravity model, GDP stands for a force mass and this attracts other mass. The second variable which encourages the increases of the number of foreign granted patents from this random model effects is the Gross Domestic Products of the granted patents countries applicants (*LngdpK*). Industries Technology products frequently does not like to authorize or lease their most recent new

technology, products to firms located in countries with no strong IPR since they are afraid of the licensing contract or authorized contract will finally be un enforceable. To have strong intellectual property protection in China attracts most developed countries like Japan, United states of America, Germany, Republic of Korea, France, Netherlands, Switzerland, United Kingdom, Italy and Sweden are the top ten countries which are granted the highest total number of three kinds abroad patents during eighteen years (from 1998 to 2015). Patent applicants' Gross domestic products influence granted patents number with the probability value of 1.3% which is less than 5%. This variable increases the number of patents application with 28%. The third factor which controls the innovation is the exports values from China and granted patent holders (*lnex.cnk*). This variable influences granted patents with the probability value of 1.2% or 0.012 which is less than five%, and it increases number of patents applications with 18% of increases. The strengthen patents regime and rights of a country reduce its international trade impediments and distortions on markets. The number of foreign granted patents is negatively significant with the constant variable (*_cons*) with the probability value of zero% due to high different number between the dependent variable and independent variables. This random effect model rejects the variable of import values (*Lnim.cnk*), variable of openness (*Lnop.cn*) and variable of geographic distance between China and patent applicants (*Lndcnk*) with the statistical possibility values of 37 %, 36 % and 8 % respectively which is not less than 5%. Here we should note that even the distance between China and its foreign patent partners is not significant but the correlation between geographic distance and China's foreign patents is negative as 76.5% as the gravity model theory statement. Usually, Patent transactions are declined by the geographic distance between countries [96]. With the negative impacts of distance between patent partners, the gravity model theory is applied on foreign granted patents of China. To have strong intellectual property rights protection motivate knowledge and innovations and also promotes research and development in developing countries and intellectual property rights increase world welfare and they have positive effects on countries' economic growth [30]. We cannot ignore the effects of geographic distance on economic transactions such as exports and imports values between different countries. With this geographic distance correlation shows that this distance between patent holder and patent provider diminishes the number of patents. With this effect of geographic distance and the above two factors which influence or attract a country to come in China (GDP of China and GDP of Patent holder) follow the gravity model theory. In our previous research which is related to the China's exports flows we investigated the free trade membership effects in encouraging export flows of China and we argued that the transnational cooperation assists government of country to defend its local consumers and domestic industries which raise the member countries' economic growth. The Table.4 of correlation that China uses Chinese language as an official language but it is not a universal language and is no longer among aspects which should manipulate China export flows to other countries for the reason that it is omitted and in data sets there is not any country which has the same official language with China. The distance between China and its trading partners control negatively its export values where distance has significant negative as it is shown by their correlation of 26%. To trade with landlocked countries also

diminishes the volume of export flows between countries, in China exports various services and products in various surrounded by land countries but the association between its export flow values and landlocked is negative through a significant correlation of 0.18 and GDP or economic growth of the importer countries boasts a great positive relationship with China export flow values as 0.85, China trades more to developed countries but the yearly GDP of China also involves positively the volume of exportation volume by 34%. China export flow values are enlarged by the percentage of 14 and 18 when China exports more in the countries that are sharing the same border and it exports more with the countries from ACFTA respectively. Those are the factors which influence the export flows volume of China [98]. The export flow volume controls the intellectual property rights in China.

5.2.2 Foreign Patent factors on Economic development of China:

This section analyzes the determinants of patents in China as follows:

$$\ln IPR_{CNt} = B_0 + B_1 \ln GDP_{CNt} + B_2 \ln FDI_{CNt} + B_3 \ln ex.im_{CNt} + B_4 \ln CONT_{CNt} + E_{CNt} \quad (9)$$

With this regression model, *CN* is means China, *t* means time, *IPR* is total of all patents issued from 1998 to 2015, *GDP* is a proxy of economic growth of China, *FDI* is annual foreign direct investment, *ex.im* stands for total of import and export flow values and *CONTROLS* is a proxy of government expenditures, human capital resources and economic openness. In this regression model equation there are six independent variables and its dependent variable is the annual total of all three kinds of patents. The regression model outputs are summarized within the below table.

Table.5. Determinants of Foreign Patents in China (National Economic Growth)

Factors which influence most Foreign Patents number in China					
Source	ss	df	MS	Obs.	18
Model	129.660103	6	21.6100171	*F*(6,11)	= 617.49
Res.	.384964194	11	.034996745	*Prob>F*	= 0.000
total	130.045067	17	7.64970981	R^2	= 0.9970
				adj. R^2	= 0.9954
				Root MSE	= 0.18707
LnPat	*Coeff*	*Std.Err.*	*t*	*P>|t|*	95% conf.	Interval
Lngdp	38.1084	9.980111	3.82	0.003*	16.14233	60.07448
lnex.m	38.65369	12.37425	3.12	0.010*	65.88923	11.41815
Lngov.	-.1958415	.9695769	-0.201	0.844	-2.329866	1.938183
Ln op.	-913.5493	305.9038	-2.99	0.012*	-1586.839	-240.2596
lnhcap	.9922087	2.098612	0.47	0.646	-3.626806	5.611223
lnfdi	-.7252754	.7835373	-0.93	0.374	-2.449829	.9992785
-cons	934.9701	404.9739	2.31	0.041*	43.62867	1826.312

Significance level (5%)

* Probability value which is significant

This Table.5 drawn with the purpose of demonstrating the linear regression model estimation results in investigation process of the factors which influence the aggregate total of foreign granted patents. With time series dataset for 1998 to 2015 and this model is tested through R^2 is equal to 99.7 that is one feature of suitable. Regression model estimation and regression model statistics probability value is equal to zero. This linear regression estimation used aggregate of total of foreign patents (*lnPat*) as the dependent variable and this variable is a proxy of intellectual property; its independent variables are the annual gross domestic product of China (*lngdp*), total of exports and imports flows (*lnex.m*), annual degree of freedom in economy of China (*lnop*), human capital (*lnhcap*), foreign direct investment flows (*lnfdi*) and constant variable. The factors which help China to be strongest in intellectual property are its gross domestic products since its probability value is statistically significant with the total of aggregated granted foreign patents with 0.3% and also statically significant with total of imports and exports with 0.010, and statistical significant degree of freedom of economy of China with 0.012 and also is statistical significant with the constant variables with the probability value of 0.041 which are under 5%.

6. CONCLUSIONS

With intellectual property rights, people in country are able to demonstrate their competence in creating and inventing new works in the field of technology and culture of their society. When new invention or creation is protected by intellectual property law as a consequence it promotes the commitment of extra assets for more innovation. The intellectual property right promotes also economic growth of countries in supporting new industries creativity as its results is job creation and diminish country an unemployment rate, and improve the value of life in general. To have strong intellectual property system (means the system which is equitable and well-organized) helps developing countries to recognize the roles of intellectual property rights as a mechanism of their economic development and promotion of population culture their community. As a public policy, scientific and technological indicators, intellectual property rights play a vital role in technology communication and economic development. As a new economy, China, as a country of emerging economies, has made remarkable achievements in the cause of intellectual property at the same time. The main purpose of this research work is empirically to examine the roles and main determinants of patent protections in China. We conclude this research work by checking if the researcher gets answers for all research questions and her research hypothesizes are accepted or rejected. With the theories of economic endogenous model, this research work empirically analyses the relationship between the China's autonomous regions, municipalities and Provinces economic development and the number of granted patents provided in those autonomous regions, municipalities and Provinces. The relationship between the gross domestic of China's autonomous regions, municipalities and Provinces and granted patents is the positive relationship; increase in number of granted patents causes the positive changes in economic development. The China's provinces, cities and regions which grants the greatest number of patents to the investors, creators and innovators also it improves its GDP. The intellectual property right plays the crucial role in increasing and improving the China's autonomous regions,

municipalities and Provinces economic development. The intellectual property right has positive impacts on economic growth of China. The relationship between granted patents and exports values from provinces of China is positive but the granted patents are not significant with import values. With the gravity model theory, the most sourcing of Chinese foreign patents applicants is from developed countries. Developed countries get most number of patents from China than other countries of the World. The geographic distance between China and Patent applicant country does not have any impacts on the number of foreign granted patents and also the improvement of China's economy increases the number of patents applicants from abroad. Due to rapid in increase in China's economy, most investors and creators are attracted by that improvement and they apply for licensing patents for their new invention due to improving in infrastructure (roads, hospitals, transportation means) and other facilities which support the new creation, new innovation, new knowledge and new technology. The intellectual property right is one factor which influences positively the rapid increases of China's economic growth. Intellectual property right is very crucial in China economic development. The relationship exists between the foreign patents applicants' economic growth and number of patents granted to those applicants is positive relationship. The researcher compares the roles of domestic granted patents and foreign granted patents as results to check which is very vital in China's economy, it is realized that the number of foreign granted patents is the one which affects positively the economic growth of China. To open economy has positive impacts on domestic economic development. Among the three kinds of domestic patents which are utility model patents, invention patents and design patents, the most important kinds are the domestic invention and utility model patents. In case of three kinds of foreign patents, two kinds are most crucial which are foreign utility model and foreign design patents in economy of China. The intellectual property types have different impacts on economic growth of developing countries.

7. RECOMMENDATIONS

As granted patents are among factors which have positive influence in Chinese autonomous regions, municipalities and Provinces' economy so those regions should consider the patents or intellectual property right protection as their important element in their economy. China is upper developing country or a country with emerging economy, its rapid increase in economic growth attracts the foreign investors, entrepreneurs from developed countries and they apply for patents which are very important factor to an economic growth of a country. Due to this research outputs, and according to economic endogenous growth and gravity theories, show that the improvement in intellectual property, increasing export flow values, diminishing the imports of goods and services, and encouraging competitiveness are factors which influence positively the economic development for emerging countries, their influences are started from the economic growth of provincial levels. The effects of intellectual property on economic development are different due to its kinds and their number of applicants. It is recommended that the developing countries with lower level economy should apply some policies in order to improve their economic growth and also to enforce rules and regulations of intellectual property right as it becomes

its economic growth factor. The intellectual property right has significant positive influences on economic growth of the protection right holder; the researcher recommends the developing countries to apply for patents in different countries. Developing countries with low level economy Public policy analysts and economists have deeply enhance the appreciative of the multifarious link between innovation and intellectual property protection as well as transmission of technological advances and economic growth of their countries. In addition, there is positive association between the intellectual property rights and government expenditures, this means that government of China controls and compensates some costs for intellectual property rights policies. The least countries governments should be more extensive in controlling the whole procedures of production and consumption and strengthen the market system, and encourage creating new innovation, new knowledge and new technology in private sector is very important to the economic development since private sector serves the foreign market and government should establish the foreign trade policy in order to get market expansion in the global market. As government expenditure is among the factors which influence China to be at considerable rank for patents, China's government and policy makers should put effort in improving regions, cities, and provinces that have not sufficiency number of patents in order to encourage innovation

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