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INTELLECTUAL PROPERTY RIGHTS AND INNOVATION IN DEVELOPING COUNTRIES: A PANEL ANALYSIS

Abstract:

Given the importance of innovation for the development and economic growth in developing countries, we therefore consider it necessary to examine the relationship between intellectual property rights (IPR) and innovation. In order to test this relationship, we use of panel data for a sample of 13 developing countries over the period from 1998 to 2011. We make two contributions to the literature. First of all, the majority of empirical studies, using a single indicator of IPR elaborated by Park And Ginarte (1997), usually do not take into account the application of laws on patents filed in the practice. Unlike the previous studies, we incorporate in our work a new indicator developed by Papageorgiadis et al. (2014) which used to measure the intensity of the dimension related to the application of patent systems. We have also used the one developed by Park and Ginarte (1997) that measures the strength of patent regulations. As a second contribution, we add a new factor likely to influence innovation, namely education. The variable of education has not been taken into account in some studies. On the one hand, our empirical results reveal the existence of nonlinear relationships between IPR and innovation and argue, on the other hand, that the economic development, the opening as well as education are essential factors that contribute significantly and positively to innovation in developing countries.

Keywords:

intellectual property rights, innovation, education, developing countries, panel data

JEL Classification: O31, O34, C23

1 Introduction

The implementation of the Agreement On Trade-Related Aspects Of Intellectual Property Rights (TRIPS) and the new growth theories have played a crucial role in the interest granted to the relationship between intellectual property rights (IPR), innovation and economic growth. IPR indirectly improve the quality of human life by stimulating the permanent dissemination of knowledge to the public at large, but also, by encouraging the inventor to innovate more while offering him the recognition of his work as well as a material reward. In general, it is expected, therefore, that IPR promote the activity of a country for innovation. Hence, there would be more innovation if we increase the intensity of the protection of IPR, which means that the relationship between these last two factors is linear. However, this point of view remains very disputed. Some studies have refuted this hypothesis by confirming the existence of nonlinearities between IPR and innovation (Hudson and Minea, 2013 and Papageorgiadis et al., 2016).

In this work, we are interested in the relationship between IPR and innovation by selecting a sample consisting only of developing countries. The choice of developing countries is mainly motivated by the determination of factors likely to improve innovation and subsequently the economic growth of these countries.

We make two contributions to the literature. First of all, the majority of the previous empirical studies, using a single indicator of IPR developed by Park And Ginarte (1997), usually do not take into account the application of laws on patents filed in the practice. In our work, however, we incorporate a new indicator developed by Papageorgiadis et al. (2014) and which is used to measure the intensity of the dimension related to the application of patent systems in addition to the one conceived by Park and Ginarte (1997), which is associated with the strength of patent regulations. As a second contribution, we add a new factor likely to influence the innovation, namely education. This variable has not been taken into account in the study of Papageorgiadis and Sharma (2016). However, according to our results education seems to be important since it influences innovation in developing countries positively and significantly.

Our empirical results confirm the existence of nonlinearities between IPR and innovation. Also, they show that the economic development, the opening as well as education are essential factors that contribute significantly and positively to innovation in developing countries.

The paper is organized as follows. After a brief introduction of the role of IPR on innovation in section 1, we consider the theoretical linkages between IPR and innovation in section 2. In section 3, we reflect on the empirical links. Section 4 concerns the description of the data used as well as the methodological framework. In section 5, we present our empirical results regarding the effect of IPR on innovation in developing countries. And finally section 6 concludes our work and presents a few recommendations.

2 Theoretical Framework

The literature has contributed to clarify the relationship between IPR and innovation. In a North-South international context, a strong protection of IPR in the South would reduce the rate of innovation of the North and the well-being of the South, at the

same time, when imitation is the only channel for the transfer of international production (Helpman, 1993). IPR in the South would increase the rate of innovation, the transfer of the production and the relative wages of the South if the foreign direct investment (FDI) is the only channel for the transfer of the production. However, it will have opposite effects if the production is transferred via the imitation (Lai, 1998). The theory has demonstrated that the relationship between the protection of IPR and innovation is not necessarily linear. On the contrary, it confirms the existence of a curve in U-inverted between the level of IPR and innovation (Horowitz and Lai, 1996 and O'Donoghue and Zweimuller, 2004). Recently, Akiyama and Furukawa (2009) found a relationship in U-inverted between IPR of developing countries and innovation in developed countries. By choosing a model of endogenous growth without scale effects, Furukawa (2010) demonstrated, too, a relationship in U-inverted between IPR and innovation. By following Furukawa (2010), intellectual property (IP) systems, whether very low or on the contrary very strong, lead an effort to minimum innovation, which suggests that a moderate approach is preferable. By choosing a standard economic environment in accordance to Grossman and Helpman (1991), Gangopadhyay and Mondal (2012) found that strengthening of IPR does not always stimulate economic growth or innovation.

To summarize, the theory has demonstrated that, contrary to what is expected, the relationship between IPR and innovation is nonlinear and IPR can discourage innovation.

3 Empirical Framework

A few studies have verified the effects of IPR on innovation through panel data. Aiming at measuring the direct impact of IPR on innovation, Kanwar and Evenson (2003) estimated a model of panel for a sample of countries for a period ranging from 1981 to 1990. By using the indicator of the protection of IPR of Park And Ginarte (1997), the authors found that IPR had a significant and positive impact on the investment in research and development (R&D) proxy of innovation and that a strong protection of IPR could stimulate both innovation and technological progress. However, some empirical studies have demonstrated that IPR have a positive impact only on innovation in developed countries. In fact, Schneider (2005) examined the role of high-tech trade, of IPR and of the FDI on the rate of innovation. With the help of panel data for a sample of 47 developed and developing countries from 1970 to 1990, the author showed that IPR affect the rate of innovation. However, this effect is more important for developed countries. Using panel data for a sample of 22 industrialized countries and 44 developing countries for seven sub-periods of five years from 1970 to 1995, Léger (2006) found a high and significant correlation between the indicator of the protection of IPR of Park And Ginarte and total expenditures on R&D as a proportion of GDP proxy of innovation for industrialized countries. Nonetheless, this correlation is low and insignificant for developing countries. The author explained that innovation, both in industrialized and developing countries, depends heavily on previous investments in R&D, and that the technological factors are more important in industrialized countries. By highlighting the indirect relationship between IPR and economic growth via activities of innovation and by using panel data for a sample of 70 countries (both developed and developing ones), Kim et al. (2012) found that IPR are an important factor of innovation and it contributes to the economic growth, only for developed countries. On the other hand, another empirical studies suggested a negative relationship between IPR and

innovation (Allred and Park, 2007; Lerner, 2009)**.** Recently, by testing the impact of IPR systems on innovation by using the method of OLS for a sample of 94 countries (developed and developing) from 1965 to 2005, Sweet et Maggio (2015) confirmed a relationship in U-inverted between IPR and the level of innovation measured by the sophistication of exports for the sample of developing countries. According to the majority of empirical literature, there are therefore nonlinearities between IPR and innovation (Hudson and Minea, 2013 and Papageorgiadis and Sharma, 2016). By analyzing the relationship between IPR, innovation and the level of development, through using a panel data for a sample of 62 developed and developing countries over the period 1980-2009, Hudson and Minea (2013) noted that there were significant nonlinear effects between IPR and innovation. Similarly, using a panel of 48 countries over the period from 1998 to 2011, their own indicator of measurement of the strength of national patent system and the one developed by Park and Ginarte, Papageorgiadis and Sharma (2016) found nonlinearities between IPR and innovation and noted that nonlinearities and enforcement aspect are important to explain the relationship between innovation and IPR systems.

4 Database

Our dataset includes thirteen developing countries:

Argentina, Brazil, China, Colombia, Jordan, Malaysia, Philippines, Romania, South Africa, Thailand , India, Indonesia and Chile**,** for the period ranging from 1998 to 2011. The database is obtained from World Development Indicators (World Bank). Our dependent variable is the log of patents filed, proxy of innovation. The independent variables include the opening ratio (the ratio of trade to GDP ratio), log of the population (size of the market), the stability of the government (an indicator of the political stability obtained from www.theglobaleconomy.com**)**, log of GDP per capita in constant dollars (measures the economic development), log of exports in high technology in current dollars (represents the technological performance), log of health expenditures per capita in constant dollars (approximation of public goods and infrastructure) and log of the number of enrolments in secondary education, of both sexes (considered as a proxy of education).

Concerning IPR, unlike other studies which have made use of a single indicator of IPR, generally that of Park and Ginarte (1997), we use in our work, two indicators relating to the protection of IPR namely Park and Ginarte (1997), updated by Park (2008) and a new indicator of the application of patent systems developed by Papageorgiadis et al. (2014).

The indicator of the patent protection of Park and Ginarte (1997) focuses on 110 countries (updated 122 countries) for a period ranging from 1960 to 1990 (updated from 1960 to 2005). It is composed of 5 years of intervals and witnessed the ongoing renewal of legal texts relating to the protection of IPR. The value of this indicator varies from 0 to 5. Park and Ginarte relied on five categories of laws on patents in order to build their indicator, the value of which varies from 0 to 1 for each category. The five categories of laws are the following:

(*I*) extent of coverage;
(*Ii*) membership in international patent agreements;

(*Iii*) provisions for loss of protection;
(*Iv*) enforcement mechanisms; and
(*V*) Duration of protection.

The value of the indicator that measures patents protection for a particular country is the weighted sum of these five separate scores.

As far as the indicator of the application of patent systems of Papageorgiadis et al. (2014) is concerned, it is a new indicator which quantifies transaction costs which are confronted, when they undertake elements in relation with components of national patent systems. The construction of this indicator requires the use of three types of transaction costs, namely:

(A) the control of costs related to the efficiency, the effectiveness and commitment of the public authorities.

(B) Property rights protection costs related to the effectiveness, efficiency and impartiality of the judicial application.

(C) Costs of service related to quality of patent administration.

The value of this indicator varies from 0 to 10 and concerns 48 developing and industrialized countries for a period ranging from 1998 to 2011. For the construction of this indicator, Papageorgiadis et al. (2014) used a number of consistent techniques recommended by the Organization for Economic Cooperation and Development in the manual on the construction of composite indicators (OECD, 2008).

Table 1: Variable names

Source: author *l denotes logarithm of a variable*

Variable code	Variable Name
lpatents	Log of patents
gpi	The indicator of Park and Ginarte (0-5)
pi	The indicator of Papageorgiadis et al. (0-10)
lpop	The population
leduc	Log of Education
Open	(Exports + imports)/GDP, in constant dollars
lhigh	Log of exports in high technology, in current dollars
lgdp	Log of the GDP per capita, in constant dollars
stabpoli	The indicator of the stability of the government
lhealth	Log of health expenditures per capita in constant dollars

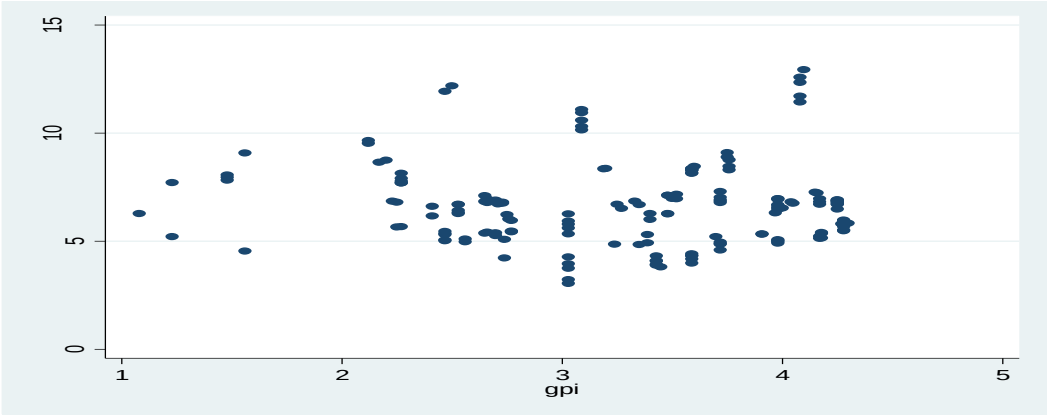
4 Methodology

To start, we used the scatter plot to study the relationship between innovation and IPR. According to figures 1 and 2, this relationship between innovation and IPR is nonlinear for our sample of developing countries. We share the same results with Hudson and Minea (2013) and Papageorgiadis and Sharma (2016).

According to previous results and based on the studies of Chen and Puttitanun (2005), Hudson and Minea (2013), Sweet and Maggio (2015) and, essentially, that of Papageorgiadis and Sharma (2016), our equation is the following:

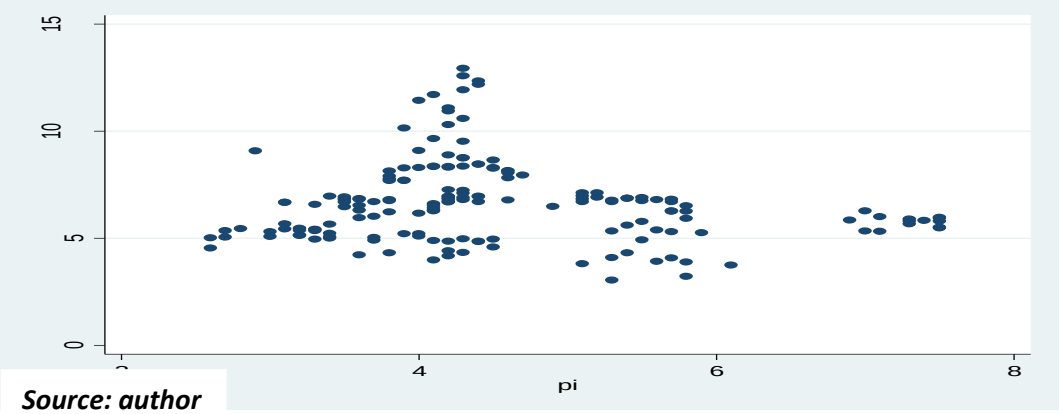
$$lnpatents_{it} = \beta_0 + \beta_1\, gpi_{it} + \beta_2\, pi_{it} + \beta_3\, gpi^2_{it} + \beta_4\, pi^2_{it} + \beta_5\, (lneduc)_{it} + \beta_6\, Open_{it} + \beta_7\, (lnhigh)_{it} + \beta_8\, (lngdp)_{it} + \beta_9\, (stabpoli)_{it} + \beta_{10}\, (lnhealth)_{it} + \beta_{11}\, (lnpop)_{it} + \varepsilon_{it}$$

In order to bend monotonicity assumption and take into consideration the nonlinearities (Furukawa, 2010; Sweet and Maggio, 2015, Hudson and Minea, 2013 and Papageorgiadis and Sharma, 2016), we introduce square terms for the two indicators of IPR of Park and Ginarte (1997) and Papageorgiaidis et al. (2014).



Source: author

Figure 1: A scatter plot of the relationship between patent applications and IPR



Source: author

Figure 2 : A scatter plot of the relationship between patent applications and pi (index of Papageorgiadis, et al., 2014)

5 Empirical Results

Given that we are primarily interested in the relationship between IPR and innovation, it is therefore useful to make a chart that illustrates this relationship before we begin formally our empirical analysis.

Table 2: Main Results

	Fixed Effects (FE) lpatents	**Random Effects (RE)** lpatents
gpi	- 4.800*** [0.000]	- 5.859*** [0.000]
pi	0.595 [0.299]	1.236*** [0.001]
gpi^2	0.725*** [0.000]	0.883*** [0.000]
pi^2	-0.095 [0.145]	-0.146*** [0.000]
Open	0.028** [0.014]	0.059*** [0.000]
lpop	-4.438** [0.043]	-0.595 [0.397]
lgdp	2.765** [0.013]	1.445*** [0.000]
leduc	1.359* [0.079]	1.030* [0.097]
lhealth	- 0.263 [0.452]	-0.288 [0.284]
lhigh	-0.228 [0.101]	0.167*** [0.001]
stabpoli	- 0.014 [0.836]	0.568*** [0.000]
_cons	55.636* [0.060]	-6.323 [0.288]
N	108	108
R^2	0.51	0.35

Source: author *P-values in brackets *p<0.10, **p<0.05, ***p<0.01*

Table 3 : Hausman Test

H0: Difference in coefficients not systematic

Chi2 (10) = 56.18

Prob>Chi2 = 0.0059

Source: author

We use the Hausman test to choose between a fixed-effects or a random effects model. According to table 3, the Hausman test clearly indicates that the fixed-effects model is preferable.

According to table 2, our empirical results show that the log of GDP per capita, proxy of economic development, has a positive and significant impact on the log of the number of patents filed, proxy of innovation. Economic development is therefore considered as an essential factor of innovation in developing countries. The log of the number of enrolments in the secondary education, of both sexes, proxy of education, has a positive and significant effect on the log of the number of filed patents. Education is presented as a crucial factor for innovation in developing countries. In order to grow further, the developing countries are recommended to invest more in education and in human capital. The opening influences positively and significantly the innovation. This opening contributes to the activity of a country for innovation in developing countries. Developing countries should, notably, promote free trade so as to get inspired by innovations coming from developed countries and thus create and innovate even more.

In contrast, concerning the variable log of the population, it has a negative and significant impact on the log of the number of patents filed. The more the size of the market is important the less the effort to innovation is high.

If we exclude gpi^2, then the indicator of IPR of Park and Ginarte (1997) has a negative and significant effect on the log of the number of patents filed. IPR discourage the activity of innovation. As far as IPR are concerned, a low or, on the contrary, a high protection of IPR is not favorable for developing countries. This is due to the fact that it can lead to a minimum innovation effort, which suggests that a moderate protection of IPR is highly more preferable.

However, as regards the other variables to know : the indicator of the stability of the government, the log of exports in high technology, the log of health spending per capita and the indicator of the application of patent systems of Papageorgiadis et al. (2014), it seems that these variables have no impact on the log of the number of patents filed, proxy of innovation.

5 Conclusion

New growth theories have stressed the importance of the R&D and innovation as determinants of economic growth (Romer, 1989 and Grossman and Helpman, 1991), hence the interest granted to innovation in developing countries in this study. In this work, we verify empirically the impact of IPR on innovation, using a specific model well which takes account of the potential nonlinearities in the relationship between IPR and innovation. We make two contributions to the literature. First of all, the majority of empirical studies, using a single indicator of IPR that of Park And Ginarte (1997), usually do not take into account the application of laws on patents filed in the practice. Unlike the previous studies, we incorporate in our work a new indicator developed by Papageorgiadis et al. (2014), which used to measure the intensity of the dimension related to the application of patent systems. We also used the one developed by Park and Ginarte (1997) to measure the strength of patent regulations. As a second contribution, we add a new factor likely to influence the innovation, namely education. The variable of education has not been taken into account in the study of Papageorgiadis and Sharma (2016).

Using panel data for a sample of 13 developing countries for the period that extends from 1998 to 2011, our empirical results reveal the existence of nonlinear relationships between IPR and innovation, that is to say that the increase in the intensity of the protection of IPR is not necessarily followed by more innovation. Our results also argue that the economic development, the opening as well as education are essential factors that contribute significantly and positively to innovation in developing countries.

In order to grow more, developing countries should invest more in education and in human capital. They should, in particular, promote free trade in the purpose of inspire innovations coming from the developed countries and thus create and innovate more. Concerning IPR, a low or, on the contrary, a strong protection of IPR is not favorable for developing countries, because it can cause an effort to minimum innovation, which suggests that a moderate protection of IPR is much more preferable.

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