Implications of International Harmonization of IPR on Growth and Competitiveness Among the Developing Nations

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1 Introduction

What does the word competitiveness mean for and what makes a country competitive? It is Porter (1990) and Krugman (1994) separately brought the idea of competitiveness into the academic literature in the late 1980s and early 1990s, respectively. According to Krugman (1994), competition stands for a location's 'external balance'. Inspired from a firm's focus on sale and market share, Krugman's idea of external balance includes a location's ability to sell products, defend international market share and to make sufficient amount to pay for its import as the competitiveness. Since the idea has emerged from the firm's activity, it has been criticized on many grounds.[1] Competitiveness can be analysed from a location's productivity level as well (Porter 1990). This idea of competitiveness is motived from a location intrinsic property to create value based on the production factors it has its disposal. This productivity definition of competitiveness is supposed to focus on long-term growth and prosperity rates. World economic forum defines competitiveness as 'the set of institutions, policies and factors that determine the level of productivity of a country'. We believe productivity leads to growth, which leads to higher-income levels and that further improves the well-being of the citizen of the country.

In the literature, the term competitiveness is further interpreted in two different ways, viz. technological competitiveness and price competitiveness (Cantwell 2006). Price competitiveness (PC) is a short-term phenomenon in which a lower interest rate declines the value of the domestic currency and that further leads to PC. A nation achieves 'price competitiveness' through two ways: one, by reduced export price in

[1]Features which are exclusively aligned to firms like: firm's rivalry, running out of business and zero sum view of competition are not functional for the 'location'.

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foreign currency terms for domestically produced goods and two, by a rise in import prices in domestic currency terms. This price competitiveness is, however, unlikely to be sustainable. Long-term 'technological competitiveness', on the other hand, is likely to be sustainable as it is deriving from higher export-led currency appreciation as a result of the improved quality of products. While looking at various definitions, we can understand that competitiveness is a complex phenomenon where there is no unique way of defining it.

It may be easy to quantify the competitiveness based on the given attributes, but it may not be the case while assessing the factors that drive to the competitive advantage. There are intermediate factors that transform competitiveness into economic well-being. These intermediate factors include indicators like export, research and development (R&D), investment, foreign direct investment (FDI) inflows and the like. The strong performance of these indicators usually associated with the effective transformation of competitiveness into well-being. This is what makes these indicators as a powerful tool to diagnose the transformation. These indicators, however, can be influenced by various policies and laws. Intellectual Property Rights (IPRs) are one of such laws that can act as a 'two-edged sword' if it is not properly designed.

For developing countries, a robust IPR policy is becoming increasingly more significant as their companies need to compete with firms from developed countries on a global platform. Success stories of emerging economies like Singapore and South Korea expose the effectiveness of Intellectual Property as a tool for wealth creation for nations (Kim 2016). Inspiring from these success stories, most of the developing countries have started experimenting with IP policies to enhance their potential possibility as a growth enhancer and enabler. It is exciting to see that the knowledge component in manufacturing has been increasing considerably during the last few decades and it is that technology, know-how and human creativity can help for growth, competitiveness and development. To achieve this, however, one could make use of IP policy effectively. To ascertain this, we could argue in line with Basant and Sebastian (2000), as it says that for an active competitive environment, we could make use of all such policy instruments related to trade, investment and technology development for attaining the competition. IPR policy is one such plan that is believed to enhance trade, investment and technology.

A stable IPR regime is likely to draw investment, especially from foreign direct investment (FDI), and thereby laying the foundation for competitiveness. A higher IPR likely leads to more innovation and that further brings national competitiveness (higher IPR $\rightarrow$ more innovation $\rightarrow$ competitiveness), and however, the approach is yet to be empirically proved. It remains unproven because of the following reasons. One, there are not many empirical attempts have been made in this area (Muzaka 2013 is an exception). Second is the identification of proper indicators of innovation and competitiveness. Many studies employed to research and development (R&D) expenditure as well as GDP growth, respectively, as the proxies for innovation and competitiveness. Both these measures have their own weaknesses. We know that not all innovating firms do formal R&D and R&D-doing firms do not innovate every year. Most of the firms likely to keep R&D centres only to avail the tax benefits from the government. By considering all these issues, we could generalize that R&D

may not be a suitable indicator of innovation in all cases. The present study, therefore, considers more relevant indicators for innovation as well as competitiveness to identify the possible IPR–innovation–competitiveness relationship.

There have been a considerable number of studies that discuss the relationship between IPR and growth and few studies on the IPR and competitiveness relationship (Muzaka 2013). Hardly few studies talks on the link IPR is having with innovation and competitiveness, especially in developing country context. The study, therefore, considers how the strategic use of IPR helps to achieve the stated goals like the innovative capability of a country as well as their competitiveness and growth.

1.1 Conceptual Framework

The impact of IPR on the competitiveness of a nation is unclear mainly due to its peculiar attributes. Firstly, IPR may not work in the same way for both developed and developing countries. Scholars have a different opinion where one group of researchers believe that the enhancement of IPR improves the economic conditions of the entire nation, while the other group argues that it benefits only to the developed nations. Stronger IPR protection is likely to produce both positive and negative impacts on the economy that further depends on conditions prevailing in each nation (Maskus and Fink 2005). One of such conditions is the level of economic development, and hence, one can argue that strong IPR encourages competitiveness and innovation only in an advanced industrialized economy. The argument is that developing countries not relied on IPR to foster their domestic innovation as they are in favour of swift diffusion of technology. Keeping in view, IPR may not work both for developed and developing nations in the same way; increasing the protection for innovation in these two sets of countries is always open to debate. Secondly, a higher IPR is criticized even in the developed countries also based on the following ground: (i) it is likely to be anti-competitive (Richards 2004). Developing countries still need to build their competition laws, rules and policies and those governing IPR laws and (ii) in the north also its inability to foster innovation and knowledge development is severely criticized (Chang 2002). Finally, while enabling tighter protection in all the countries simultaneously, the scope for further innovation will be very less. Figure 1 shows the trend in average IPR scores of various countries. A comparison of average IPR scores over the years and between the three groups of countries reveals that, for HICs, the average score stood at just below 7 during 2007 and 2015, whereas for middle-income countries (both upper and lower), this has been increased during the same period. This is a clear indication of bridging the gap among the countries with respect to their IPR scores.

In this context, it will be beneficial for policymakers if we could analyse the performance of developing countries after the implementation of TRIPS mandate. A further study, based on recent data set and new econometric technique, would not add much to the literature; instead, it contributes one more research into the debate. The present study, therefore, looks at the relationship from another angle—the contribution of

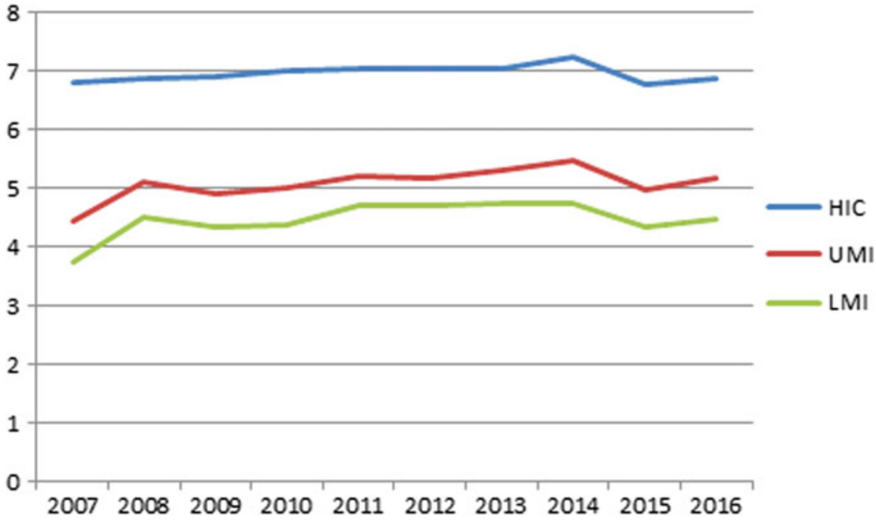

Fig. 1 Average IPR scores of developing and developed countries. *Source* Author calculated

enhanced IPR on growth and technological competitiveness through innovation by giving special emphasis to developing nations. The study further gains its importance from one of the arguments of Helpman (1993), who stated that: '*Who benefits from tight intellectual property rights in less developed countries? My analysis suggests that if anyone benefits it is not the south*' (Helpman 1993). For him, 'North' denote advanced developed nation that produces highly refined technologies and 'South' refers to the developing nation that adopts technology from North. Therefore, there arises a question—if the so-called South is not so benefitted from strengthening their IPR, why those nations should follow the stringent TRIPS obligations.

Developing countries are mainly known for their 'incremental innovations', and their objectives and mechanisms are different from that of developed nations. These countries are often responding to their local needs for a better outcome. One of the examples is Chile's experiment with mineral extraction. Chile, the world's largest copper supplier, has come up with a smart mining technology to improve their productivity and operational efficiency with an objective of satisfying their local needs. Another instance is the so-called inclusive innovation in India with the aim of improving the welfare of middle-income household. The small segment four-wheelers, Nano car, is the best example. In both cases, IPR helps to protect these innovations, but the growth of the economy is not the sole aim. Therefore, in developing countries innovations are likely to focus on competition and economic welfare.

Further, the changing nature of the economy regarding production and manufacturing could also affect the relationship. The successive paradigm shift in the manufacturing sector could also change the determinants of innovation as time elapses. For example, during 1913—the second stage of paradigm—society's need was a 'customized product'. However, when it reaches the fifth stage of the production, what society demanded is a 'clean product'. Moreover, the technology enabled in the production process has been changing from electricity to bio/material technology during the same period.[2] Therefore, what was not crucial to the innovation and competitiveness may be turning out as an unimportant factor and vice versa, according to the present circumstances.

The present study, therefore, argues that stronger IPR induces more significant innovations in developing nations and that further improves the economic and social conditions. Many works of the literature identify various mechanisms by which IPR could affect innovation and vis-à-vis competitiveness of a nation (Grossman and Helpman 1991a). The study hence would like to analyse the effect of IPR on innovation at the first stage and the impact of innovation on the competitiveness and in the second stage, separately for developed and developing nations. Further, the study would like to analyse the effects of strong IPR on the general indicator of economic performance, i.e. growth of a country. The present study attempt to make a comparative report on what—competitiveness or economic growth—is mostly influenced by the IPR improvement.

Global-scale IP reform is likely to bring cost and benefits to various nations. One way to analyse such effects is the North–South model (Krugman 1979). The model argues that innovation typically occurs in the North, the region of developed countries. Technology produced in the North diffuses to the South with a lag either through licensing or FDI. These technological lags give rise to trade, with North exporting new products to the South. Strengthening of IPR in developing countries hence becomes an important factor from the perspective of the developed nation. Effective enforcement of IPR accelerates technology transfer from the developed nation to developing nations and therefore contributes to economic benefits in the form of growth and competitiveness (Lai 1998; Glass and Wu 2007). The case is, however, not possible when the transfer of technology is limited to rent transfer from developing to developed nations. Further, stronger IP enforcement will hamper the ability of local firms in developing countries to experiment with foreign technology at a lower cost. The same will also restrict the diffusion of technology (Glass and Saggi 2002; Branstetter et al. 2007).

The variety-growth model developed by Helpman (1993), on the other hand, explains the production shift effect, in which stronger IPR in the south could lower the long-run rate of innovation in the North. The tightened IPR reduces the scope of imitation and therefore production back to the North. What is noteworthy here is the modified version of the variety-growth model (Lai 1998). The revised version considers FDI as the primary source of foreign technology. However, the model emphasizes a lag between South and North firms in the production process. Stronger IPR is likely to attract more FDI in the South, and therefore, the production occurs in the South through the local subsidiaries of North firms. Thus, both agents will be benefited through welfare improvements.

All the models explained above argue that the invention process begins in the North. The South imitates the same with a lag and comes to the market at a competitive

[2]See Table 6 in Appendix.

price. The quality-ladder model argues that both South and North will be benefited from this act as both sets of countries race to improve each of a continuum of industrial product, earlier for 'the last generation' and later for 'next generation' (Grossman and Helpman 1991b).

2 Review of Literature

2.1 Discussion on Why Developing Countries Need to Enhance Their IPR Strength

Developing countries usually follow the strategy of imitation as a source of their technological development. High cost and risk involved in the appropriation and development of new technology are the main reasons behind this. However, with the advancement of globalization and subsequent international trade, domestic recipients of the modern technology are expected to provide the minimum standard of protection to the product and process manufactured in the developed nations. The discussion, therefore, mainly concentrates on the requirement of maintaining a global IPR standard.

The main argument for protecting IPR comes from the 'public good' attributes of the knowledge. The 'non-excludable' character of knowledge has increased the possibility of imitating the innovator's idea and that further reduces the potential profitability of the innovator. Since imitation is less costly than innovation, the later should be protected from imitation for promoting the value innovation. IPR provides adequate ownership to IP by giving legal power to innovators to recoup from their costlier innovation. Although knowledge is 'non-rival' in nature and has been provided at free of cost to maximize the benefit out of innovation, it argues that the profit will be optimized in the shorter period only. In the long run, however, the principle will severely damage the incentive for further innovation.

Foreign trade and investment are the second and third reasons. International trade allows developing nations to acquire high value-added goods through import. Similarly, FDI inflows enhance the innovative domestic capacity of a nation by augmented investment in R&D and better training. Sufficient protection to IP in developing countries is a prerequisite to ensure cross-border trade and investment into the nation (Hassan et al. 2010). Empirical evidence also showed that stronger IPR as a crucial factor while deciding cross-border investment and trade.

2.1.1 FDI Inflow: A Case of Developing Nations Versus Developed Nations

In this section, we examine the evidence of FDI inflows into developing and developed country separately during 2005–2015. Figure 2 shows the average growth rate

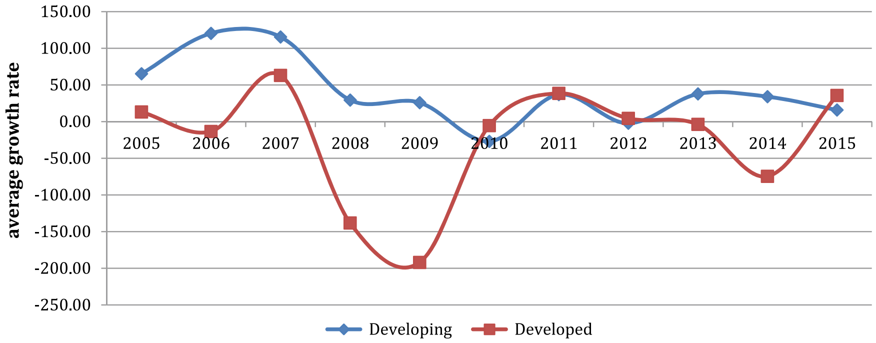

Fig. 2 Growth rate in FDI inflow: developing nations versus developed nations. *Source* Analysed from world development report (various issues)

in FDI inflows into developing as well as developed nations. The analysis shows the apparent differences in the inflow of FDI among these two sets of the country where developing nation's having the edge over the developed one. This difference is likely to be an outcome of enhanced protection of property rights in those nations. During 2007–2010 and 2013–2015, the growth rates in FDI inflow have become negative. However, such a negative trend in developing countries appears only in 2010. This trend indicates investor's preference in developing nations as the safest place to put their investment, though the motive behind this is unclear.

Dunning's (1980) ownership–location–internalization (OLI) theory explains why a firm is investing abroad. Transnational corporation's advantage in 'ownership' is a necessary condition for their overseas investment. This advantage may take in the form of new technologies: technical know-how, organizational skill and so on. In addition to this, 'location' and 'internalization' advantages are sufficient condition to invest abroad. Location advantages are associated with low transportation cost and input prices, whereas internalization advantage allied with avoiding transaction cost with prospective licensees.

The strength of the relationship between IPR and FDI depends on how the level of IPR affects those three (OLI) factors. Regarding ownership, it is unclear whether they would be able to protect the whole part of their intellectual assets. It is, however, believed that the firm who created the intellectual knowledge is likely to invest in the foreign nation rather than extending a licence to any external firms. Reduction in technology transfer cost is the main argument behind this strategy (Saggi 1999). Various levels of IPR protection may also influence the internalization decision and locational advantages of a firm. Given these facts, many researchers argue a positive IPR-FDI relationship. One probable explanation of this positive relationship could be the smaller risk of imitation due to the high protection and that further leads to high demand for protected goods (Mansfield 1994). Some researchers, on the other hand, argue that higher protection leads to licensing their knowledge rather than directly investing in the specific nation (Maskus and Penubarti 1995). Thus, the theoretical support of the influence of IPR on FDI is ambiguous. The statistics we have explained above reveal that transnational corporations are relying more on developing nation to transform their investment into a valuable one. It could be a case of 'locational' advantage because 'ownership' advantage is more significant in the developed nation compared to developing countries as the level of IPR is already high in the developed states.

Fourth, developing nations are likely to be in the back seat in the production of technology, and by principally, they depend on the developed states for the same. Hence, without ensuring sufficient protection for their creation, north countries would not make the technology needed for developing nations (Diwan and Rodrik 1991). North developed firms may react to the weak IPR in south states by enhancing their techniques more challenging to reproduce which will adversely affect developing nations (Yang and Maskus 2001). Domestic innovation consideration is also a matter for strengthening IPRs in developing countries. There are innovative local activities that shall rise under strong IPR (Chen and Puttitanun 2005). It is quite ambiguous to say whether stronger IP protection encourages or discourages in-land innovation in developing nations. Theoretical models predict that stronger patent protection in developing countries may not add much to the productive R&D and further to the innovation and, therefore, reduces the output in the domestic economy (Chin and Grossman 1990; Deardorff 1992; Helpman 1993). Counter-argument is that stronger patent protection provides a favourable local environment for local innovators. Hence, even firms in developing countries can also benefit from innovation. But according to Deardorff (1992), the benefits of such protection gradually diminish as and when more and more states adopt stronger IPR protection for their creativity. Therefore, there should be an optimum level of IPR in developing countries that enables imitation of the foreign technologies as well as provide an incentive for domestic innovation. From these arguments, we could interpret that the impact of harmonization of IPR is vague regarding the competitiveness and growth of developing nations.

2.2 Factors Affecting Innovation and Competitiveness

Since the study argues that IPR stimulates innovation and innovation further accelerates growth and competitiveness, this section concentrates on significant determinants of innovation, competitiveness and growth. Studies say that strengthening of IPR could lead to more significant innovations in developed nations and that indirectly benefits developing nations (Taylor 1994; Kanwar 2003, 2006). These indirect benefits arise through FDI, trade or licensing. By creating an environment conducive to human knowledge accumulation, IPR may spur innovation and growth. IPR could affect developing countries negatively if they are not in a position to undertake R&D activities for further development of IPR-based product and processes (Sakakibara and Branstetter 2001; Falvey et al. 2006; Horii and Iwaisako 2006). R&D expenditure (RDE), considered as an input of the innovation, is the second major factor that affects the same (Chen and Puttitanun 2005).

Qian (2007) finds that IPR, particularly domestic patent protection, alone does not stimulate economic growth and competitiveness. It requires a higher level of technical development along with educational attainment and economic freedom. We measure technological ability through annual per capita GDP growth rate. To measure the education variable (EDU), we use the percentage of total enrolment in the tertiary sector among the school-age population. To measure the openness of a nation (OPEN), we use international trade volume (import and export) as a percentage of GDP.

We consider three variables resident patent application (PAT), OPEN and domestic investment (INV) as explanatory variables in the competitive equation. INV is the residual of the difference between FDI inflow and gross fixed investment. Kumar and Pradhan (2002) employed the same method. Apart from these three variables, we have considered FDI inflows and RDE as independent variables in the growth equation. Based on the above discussion, the research would like to test the following aspects:

1. Re-examine the direct link between IPR and growth both in developed and developing nations based on a recent set of indicators.
2. Estimate the relationship between IPR and domestic innovation.
3. Examine the relationship between IPR and competitiveness through innovation. That is, there could be an association between IPR and innovation in the first hand and between innovation and competitiveness in the second.

3 The Model, Econometric Issues and the Data

The present model consists of a system of two simultaneous equations: one deals with innovation and other for growth and welfare.

$$\text{INN} = f(\text{IPR}, X_{it}) \tag{1}$$

$$\text{GCI/GROWTH} = f(\text{INN}, Z_{it}) \tag{2}$$

where INN is domestic innovation, represented by residents patenting, GCI is global competitiveness index—a measure of competitiveness, and IPR is intellectual property right score attained by each country. GROWTH denotes per capita income growth, and X_{it} and Z_{it} are the explanatory variables that influence the corresponding dependent variable.

To measure competitiveness, we use the Global Competitiveness Report (GCR) published by the World Economic Forum. The GCR, after considering crucial factors that drive to growth, welfare and competitiveness, constructed an index known as the Global Competitiveness Index (GCI). GCI consists of 12 pillars that include,

(i) institutions, (ii) infrastructure, (iii) macro-economy, (iv) health and primary education, (v) higher education and training, (vi) market efficiency, (vii) technological readiness, (viii) business sophistication and (ix) innovation. The impact of these variables on a nation's competitiveness may vary according to the nation's characteristics. The GCI, therefore, has given adequate weight to each variable while constructing the index. The present study, however, does not consider GCI score per se for evaluating the relationship. Since the index includes 'innovation' as one of the pillars, we removed the innovation score from the GCI score after considering the due weight associated with each country.[3] IPR can stimulate a nation's growth as well. Therefore, the second dependent variable in the performance equation is the growth, measured by per capita income growth of a nation. We consider per capita income growth instead of the level of per capita to tackle the business cycle aspect (Chen and Puttitanun 2005).

R&D expenditure and patent counts are the widely used measures of innovation, the earlier as the input and the later as the out of innovation (Ambrammal and Sharma 2014). We use patent application by residents (PAT) as a dependent variable in the innovation equation and as an independent variable in the competitiveness and growth model. R&D expenditure (RDE), as a percentage of GDP, is considered as an explanatory variable in all the models. IPR is the significant determinants of innovation (Hu and Jaffe 2007). We include the International Property Right Index (IPRI), a publication of the Property Rights Alliance, for measuring the IPR strength. The IPRI consists of three components, (i) legal and political environments, (ii) physical property rights and (iii) intellectual property rights. We have also obtained data on several other variables that can affect innovation and competitiveness. Data on the measure of economic freedom (EF) are obtained from www.freethewold.com. The index ranges from 0 to 10 with a higher index indicating a higher level of economic freedom. We have collected data from various sources. Most of the data come from the World Development Indicators (WDI), World Economic Forum and Freetheworld.

A large sample of countries (99 countries) has been assembled for this study, covering the period 2005–2015. The selection of 2005 as a base year had its own important and justified in the sense that developing countries have to enhance their IPR by 2005.[4] The sample of countries is diverse, representing different income groups and institutional environments.[5] Therefore, based on World Bank (2017), all the nations are classified into three: lower-middle-income ($1026–$4035), upper-middle-income ($4036–$12475), Higher-income countries ($12476 and above).

[3]The exclusion factor will be (Current innovation value × Innovation weight in the current year)/100.

[4]Many can argue that a comparison of pre-IPR era with post-IPR era will get better understanding of the issue that we are considering. The paucity of data is, however, hindering us to carry out the work.

[5]See Table 7 in Appendix.

3.1 Econometric Specification

The empirical model is a system of two simultaneous equations. One is for the domestic innovation, and the other is for competitiveness/growth. The two equations are:

$$\mathrm{INN} = f\left(\mathrm{IPR}, \mathrm{IPR}^2, \mathrm{RDE}, \mathrm{EDU}, \mathrm{OPEN}, \mathrm{GROWTH}\right) \tag{3}$$

$$\mathrm{GCI} = f(\mathrm{INN}, \mathrm{INV}, \mathrm{OPEN}) \tag{4}$$

$$\mathrm{GROWTH} = f(\mathrm{INN}, \mathrm{INV}, \mathrm{FDIINF}, \mathrm{OPEN}, \mathrm{RDE}) \tag{5}$$

For Eq. 3, based on theory, both EDU and R&D will have positive effects if they encourage innovation. According to the literature, RDE is likely to be an endogenous regressor of innovation. Therefore, we have adopted the two-stage least square technique to tackle with endogeneity. For Eqs. 4 and 5, we expect a positive relationship between INN and dependent variables, again if innovation encourages competitiveness and welfare.[6]

4 Empirical Results

4.1 Description of the Data

Table 1 provides the summary of data used in this analysis. For all variables with a standard deviation greater than one is in natural logarithm format, while all other variables are considered in their original format.

4.2 Regression Analysis

The present section describes all the results obtained from the regression analysis. Section 4.2.1 explains results from determinants of innovation. In Sect. 4.2.2, we have the results of welfare equations followed by a growth equation in the next section.

[6]Since GCI is a composite index of many variables that are supposed to be there as explanatory variables, we have considered only three as independent variables.

Table 1 Summary statistics of the data

Variable	Observations	Mean	Std. dev.	Min	Max
GCI	1100	3.62	0.49	0.00	4.94
EF	1085	7.02	0.85	2.93	11.00
IPRI	1089	5.57	1.54	0.00	8.70
EDU	795	46.60	26.13	0.47	113.87
POPL	1089	6.11E+07	1.84E+08	403,834	1.37E+09
INN	863	8865.04	31265.29	1.00	301075.00
RD	636	1.20	1.02	0.02	4.41
GDP CONSTANT	1087	8.57E+11	2.19E+12	9.35E+09	1.86E+13
OPEN	1078	94.65	66.52	21.45	455.42
INFLATION	1072	29.16	746.20	−4.86	24411.03
FDIIN FLOW	1086	6.87	24.84	−58.98	451.72
INV	1066	17.20	26.24	−430.74	79.38
GDP GROWTH	1087	3.76	4.11	−17.67	26.28
PER GDP GROWTH	1089	2.34	3.90	−19.06	24.67

4.2.1 Factors Influencing Domestic Innovation

This section analyses the results obtained from innovation equations. We consider innovation as a function of IPR and other related variables. The results of GMM are given in Table 2 in three heads. Column 1 includes combined results of all

Table 2 GMM estimation of innovation equations

INN	FULL		LMI		UMI		HIC	
	Coef.	Std. Err/Z	Coef.	Std. Err/Z	Coef.	Std. Err/Z	Coef.	Std. Err/Z
IPRI	−0.153	0.152 (−1.01)	**−0.731**	**0.396 (−1.85)***	**−2.795**	**1.676 (−1.67)***	0.269	0.244 (1.11)
$IPRI^2$	**0.033**	**0.015 (2.26)****	0.053	0.047 (1.13)	**0.318**	**0.185 (1.72)***	−0.007	0.02 (−0.33)
RDE	−0.380	0.355 (−1.07)	**0.408**	**0.185 (2.21)****	−1.494	1.924 (−0.78)	0.163	0.491 (0.33)
EDU	**0.649**	**0.205 (3.16)*****	**1.115**	**0.331 (3.37)*****	**2.109**	**1.102 (1.91)***	−0.169	0.189 (−0.9)
OPEN	−0.044	0.251 (−0.17)	0.554	0.33 (1.64)	−1.317	0.827 (−1.59)	0.065	0.365 (0.18)
GROWTH	0.013	0.031 (0.41)	0.045	0.075 (0.6)	−0.052	0.14 (−0.37)	−0.009	0.034 (−0.27)
LM stat	25.74 (0)***		4.84 (0.09)***		1.712 (0.42)		20.31 (0)***	
Hansen J	0.079 (0.78)		0.66 (0.42)		0 (0.99)		4.079 (0.04)***	
Observation	354		58		81		215	

Note ***, ** & * are significant at 1%, 5% and 10 % level respectively. *Source* Calculated buy the author countries, whereas columns 2–4 show the results of lower-middle-income, upper-middle-income, and higher-income countries, respectively.

The nonlinear relationship between IPR and domestic innovation is established in the regression as the estimated coefficients are negative for IPRI and positive for $IPRI^2$. For HICs, the coefficient of IPRI is positive, and $IPRI^2$ is negative. However, it is not significant. These results argue that IPRI may not work in the same way for both developed and developing nations. In developing countries, the impact of imitation dominates over innovation in the early stages. At this stage, these countries technological ability is well suited for imitating the foreign technology rather than putting effort into the efficient domestic innovations. However, as the IPR law becomes prominent, innovation getting dominating over imitation and showing some signs of improvement. Therefore, IPRI becomes positively significant in the later stages. This result supports the 'U' shape relationship established in the earlier literature (Maskus 2000; Primo Braga et al. 2000). This result is valid for both the LMI and UMI countries, whereas the relationship does not hold for HICs. The reason could be, for HICs, IPR has been active even before 2005. Since there is no recent improvement in IPR level of HIC, one cannot expect any positive relationship between IPR and innovation in those countries. As we see from the literature, rather than focusing on their own domicile, now HICs are setting up their production units in LMI countries to exploit the opportunities available with them.

Education, a proxy of the quality of the researcher, is positively significant for FULL, LMI and UMI. However, this is not significant for HIC. The result is not making any surprise as the IPR is not significant for the latter group of countries. Across the models, only LMI produce positive and significant coefficients of RDE. These economies having firms and industries at the technology frontiers and they need to innovate for their survival. Further, there is evidence that even in the take-off stage; R&D played a leading role in the development process of developing economies.

4.2.2 Innovation–Competitiveness Analysis

Table 3 analyses the results from the relationship between domestic innovation and the nation's competitiveness. Regression with all countries shows that there is an improvement in the nation's well-being from local innovation. Competitiveness of all the countries increases by 0.003% when there is a 10% increase in domestic innovation (INN). Among the group of countries, UMIs are the most benefited, as the increment is about 0.007 for every 10% increase in domestic innovation. And for LMIs it is estimated as 0.006. The important thing to be noted here is that INN does not influence the welfare of HIC. One of the probable reasons is, LMI and UMI group of countries enjoy immediate benefits from stronger IPR in the form of GCI. HIC, on the other hand, would benefit from stronger IPR (both in North and South) in the form of economic growth. To test this, we have considered the growth of per capita income as a dependent variable, and the result of the same is discussing in the next session.

Table 3 Competitiveness equations

GCI	FULL		LMI		UMI		HIC	
	Coef.	Std. Err/Z	Coef.	Std. Err/Z	Coef.	Std. Err/Z	Coef.	Std. Err/Z
INN	**0.034**	0.002 (14.6)***	**0.055**	0.010 (5.6)***	**0.068**	0.005 (14.3)***	−0.007	0.004 (−1.5)
INV	0.080	0.014 (5.7)***	0.215	0.038 (5.7)***	0.176	0.037 (4.8)***	−0.025	0.015 (−1.6)
OPEN	0.075	0.014 (5.3)***	−0.082	0.048 (−1.7)*	0.272	0.031 (8.9)***	−0.074	0.020 (−3.7)***
CONS	2.936	0.088 (33.4)***	3.013	0.223 (13.5)***	1.724	0.179 (9.6)***	4.179	0.135 (30.9)***
OBSER	**779**		**200**		**189**		**390**	

Note ***, ** & * are significant at 1%, 5% and 10 % level respectively. *Source* Calculated buy the author

The openness, the volume of export and import as a percentage of GDP, produces mixed evidence on the welfare. Both LMI and HIC are negatively affected while opening their country to the world, whereas UMI is positively affected by it. The reason why LMI is adversely affected might be their strong dependence on import of fuel. For HICs, the case is, however, attributed to income growth. What we can judge from UMI's positive response to OPEN is their dependence on import of high technology product. By providing a sufficient environment for upgrading the imported high tech product, UMI is gaining its competitiveness.

4.2.3 Innovation–Growth Analysis

Analysis based on per capita GDP growth as a dependent variable shows that it is not innovation, but domestic investment (INN) plays the crucial role in the growth process of nations from various income groups (Table 4). The investment elasticity (0.63) is high among UMI and low (0.32) for HIC. We can see that the innovation elasticity is 0.6 for LMI which is not so different from the elasticity of UMI. Another variable which is crucial for the growth of all countries is FDI. The variable is positively significant among all the group of countries. For LMI, openness affects negatively, whereas for HIC, the variable produces a positive influence. For HIC, openness helps them to grow positively, whereas for other countries, the variable is not produced any significant effect. It is remarkable to note that, as I stated earlier in this article, the variable OPEN is influencing HIC's growth contrary to the positive influence on welfare.

Table 4 Growth function

LGDP	FULL		LMI		UMI		HIC	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
INN	**0.027**	0.012 (2.27)**	0.019	0.045 (0.42)	0.038	0.043 (0.9)	0.009	0.021 (0.44)
INV	**0.402**	0.056 (7.11)***	**0.569**	0.182 (3.13)***	**0.631**	0.209 (3.02)**	**0.322**	0.065 (4.94)***
FDIIN	**0.325**	0.031 (10.44)***	**0.263**	0.081 (3.25)***	**0.471**	0.097 (4.88)***	**0.292**	0.039 (7.4)***
OPEN	0.021	0.048 (0.44)	**−0.356**	0.165 (−2.16)**	−0.086	0.125 (−0.69)	**0.183**	0.075 (2.42)**
RDE	−0.227	0.026 (−8.71)***	0.044	0.059 (0.74)	0.013	0.128 (0.1)	**−0.214**	0.049 (−4.38)***
CONS	−0.646	0.292 (−2.22)**	1.030	0.670 (1.54)	−0.888	0.646 (−1.37)	−1.046	0.540 (−1.94)*

Note ***, ** & * are significant at 1%, 5% and 10 % level respectively. *Source* Calculated buy the author

5 Discussion, Policy Implications and Conclusion

In this paper, we discuss the impact of enhanced IPR on the competitiveness and growth of a nation. The effect of strong IPR varies across countries according to their level of development. The present study, therefore, considers three categories of nations separately, i.e. LMI, UMI and HIC. Based on the nature of the data, we follow proper econometric strategies that take into account the issues like count data, endogeneity and heterogeneity among the variables.

There was an ambiguity among the previous researchers regarding the impact of IPR on the growth and competitiveness of a nation. Firstly, many researchers and policymakers have argued that there is not any direct impact of IPR on those two variables. The study, therefore, considers domestic innovation as an intermediate variable that connects between IPR and competitiveness. The study showed that IPR encourages domestic innovation and that further stimulates growth and competitiveness. The statement is, however, not applicable in the same way for all group of countries. The results showed that for LMI and UMI group, IPR affects negatively at the initial stages and turns to be decisive in the later stages, inferring a possible 'U' shape relationship. It is argued that, in these two sets of countries, a huge amount of R&D is required to adapt to foreign technology in the early stages of their innovation. Therefore, the return to R&D will be negative in those early stages. Later, once they have fully adjusted with foreign technology, return to R&D will be positive and started to show a significant impact on innovation. For HIC, on the other hand, IPR is at the optimum level and hence does not bring any significant (marginal) impact on the innovation.

In these two sets of countries (LMI and UMI), innovation is the crucial factor for welfare improvement in the competitiveness but not for growth. Since both the IPR-INN and INN-competitiveness functions are significant and positive, we can summarize that IPR is one of the crucial factors for the competitiveness of a nation.

Table 5 Summary of results

	FULL	LMI	UMI	HIC
IPR → INN	– (Not significant)	U shaped (sig)	U shaped (sig)	+ (Not sig)
INN → GCI	+ (Sig)	+ (Sig)	+ (Sig)	– (Not sig)
INN → GROWTH	+ (Sig)	+ (Not sig)	+ (Not sig)	+ (Not sig)

Source Deduced from Tables 2, 3 & 4

Growth, on the other hand, is not determined by the level of IPR. For HIC, neither competitiveness nor growth has improved from IPR and domestic innovation. One probable reason could be the change in focus of business operations from HIC to other developing economies primarily due to their improvement in IPR protection and secondarily to enjoy other benefits like 'tax sops' offered by the countries, cheap labour availability, abundant natural resource and so on (Table 5).

It is observed that strong IPR does not directly influence competitiveness welfare and growth as it needs to be supported by domestic investment and innovation. Since there is substantial evidence on the influence of IPR on innovation and further to competitiveness and growth particularly among the LMI and UMI, the study is in favour of the present levels of IPR among these two sets of countries. A further increase in IPR can harm the economy as there exists a nonlinear relationship between IPR and innovation. In addition to this, we find that a healthy IPR could contribute more to the competitiveness than the growth per se among the lower-income countries.

The study is limited in the sense that we could not measure the welfare gains/losses to the consumer due to stronger protection of intellectual property rights. According to the theory, stronger IP could harm the welfare of consumers, but total welfare gain is offsetting the loss. Hence, we got a positive welfare effect due to strong IPR.

Appendix

See Tables 6 and 7.

Table 6 Successive paradigm shifts in manufacturing

Paradigm	Craft production	Mass production	Flexible production	Mass customization and personalization	Sustainable production
Paradigm started	1850	1913	1980	2000	2020
Society needs	Customized products	Low-cost products	Variety of products	Customized products	Clean products
Market	Very small volume per product	Demand > supply steady demand	Supply > demand smaller volume per product	Globalization fluctuating demand	Environment
Business model	Pull *sell-design-make-assemble*	Push *design-make-assemble-sell*	Push-pull *design-make-sell-assemble*	Pull *design-sell-make-assemble*	Pull *design for environment-sell-make-assemble*
Technology enabler	Electricity	Interchangeable parts	Computers	Information technology	Nano/bio/material technology
Process enabler	Machine tools	Moving assembly line and DML	FMS robots	RMS	Increasing manufacturing

Adapted from Jovane et al. (2003)

Table 7 List of countries according to their classification

HIC		UMI		LMI and LIC	
Australia	Latvia	Albania	Malaysia	Armenia	Pakistan
Austria	Lithuania	Algeria	Mauritius	Bangladesh	Philippines
Bahrain	Luxembourg	Angola	Mexico	Bolivia	Sri Lanka
Belgium	Malta	Botswana	Panama	Cameroon	Tunisia
Canada	Netherland	Brazil	Paraguay	Egypt	Vietnam
Chile	New Zealand	Bulgaria	Peru	El Salvador	Zambia
Croatia	Norway	China	Romania	Guatemala	Argentina
Cyprus	Poland	Colombia	Russia	Honduras	Ethiopia
Czech Republic	Portugal	Costa Rica	South Africa	India	Madagascar
Denmark	Qatar	Dominican Republic	Thailand	Indonesia	Malawi
Estonia	Singapore	Ecuador	Turkey	Kenya	Mali
Finland	Slovakia	Jamaica	Venezuela		Mozambique
France	Slovenia	Jordan		Morocco	Nepal
Germany	South Korea			Nicaragua	Tanzania
Greece	Spain			Nigeria	Zimbabwe
Hong Kong	Sweden				
Hungary	Switzerland				
Ireland	Trinidad and Tobago				
Israel	UAE				
Italy	UK				
Japan	Uruguay				
Kuwait	USA				

Source World development indicators

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