Innovation, Intellectual Property, FDI & Economic Growth: A Scholarly Review of Findings[1]

MANASWINI BHALLA[2]

CHIRANTAN CHATTERJEE[3]

KALYAN CHATTERJEE[4]

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[2]Assistant Professor, Economics and Social Sciences, Indian Institute of Management, Bangalore

[3]Assistant Professor& Young Faculty Research Chair, Corporate Strategy and Policy, Indian Institute of Management, Bangalore and corresponding author. chirantan.chatterjee@iimb.ernet.in

[4] Distinguished Professor of Economics and Management Science, Pennsylvania State University, USA.

Abstract

This article engages in a scholarly review of findings in the economics, public policy and management literature on innovation, its relationship with intellectual property (IP), foreign direct investment (FDI) and economic growth. Schumpeter (1934) discusses how not just innovation, but its diffusion, imitation and ancillary invention, sets forth the gales of creative destruction in the economy. Innovation is crucial to long run economic growth as shown in recent work by Romer (1994), but empirical quantitative evidence on the positive relationship between innovation and GDP is mixed. Associated with this, in principle, IP protection indeed grants a priori incentives to the innovator to engage in innovation; however, definitive empirical evidence on the positive role of IP in providing incentives for innovation is difficult to obtain from the studies available. This has resulted in recent work exploring the 'case against patents' and the adverse welfare effects of 'secondary patents'. The positive causal relationship between IP & FDI is far from established in either the theoretical world or even in empirical findings. In fact, IP might also induce adverse welfare effects, as evidenced in some recent work in economics that examines the question related to WTO-TRIPs & Indian pharmaceutical markets. These points will be elaborated on in this review.

1. Introduction – What is Innovation?

Innovation and the need to innovate have become standard desiderata for members of civil society including politicians, policy makers, regulators, entrepreneurs, managers, scientists, artists and individuals. In its broadest sense, innovation can be defined as the adoption of a novel, powerful idea to induce a change in the current system. But for innovation economists like Joseph Schumpeter the definition was sharper and more specific. He noted that there are five types of innovation that can be associated with an entrepreneurial act, that of the introduction of a new good; the introduction of a new method of production; the opening of a new market through a novel business model; the conquest of a new source of supply of raw materials and finally, the carrying out of new organization of an industry (for example, through mergers and acquisitions) (Schumpeter 1934). In recent decades building on Schumpeter's observations, the innovation discourse has acquired three dimensions: innovation as a factor for change in society, innovation as progress and innovation for personal or professional recognition. Relatedly, since World War II, there has been a rapid increase in investment in research and development (R&D), an emphasis on *science as the endless frontier* (Bush 1945) and the arrival of the *visible hand* (Chandler 1993)[5].

For a deeper understanding of the concept of innovation, it might be useful to go back in history and explore the evolution of the idea. In his *Theory of Economic Development,* Schumpeter places the entrepreneur and firm at the center of his analysis and says that it is imperative for entrepreneurs to constantly innovate in order to stay competitive in the market. Schumpeter reflects that it is the ability and will of such entrepreneurs that results in innovation, coming out of the process of commercialization of inventions. Further, apart from specifically pinpointing the definitions of innovation categories, he also noted that innovation is a "*process of industrial mutation, which incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one*". These "mutations" brought to the market by *entrepreneurs* were considered as the driving force of economic change, causing *gales of creative destruction*. Further, Schumpeter also

[5]See http://www.nsf.gov/od/lpa/nsf50/vbush1945.htm for Vannevar Bush's famous ideas about creating a base in society of science as an 'endless frontier', the way he envisioned it in post-WWII United States. The *visible hand* is a term used by Alfred Chandler in his book to describe the rise of large corporations and managerial revolution in US.

suggested that the big impact of innovation on an economy is not just due to the acts of innovation themselves but also knowledge diffusion and subsequent burgeoning of investment in imitative activities. These enhance the social benefits of the original product or process innovation[6]. Diffusion would, in turn, motivate the entrepreneurs to innovate again to maintain or create competitive advantage and to supply new products and technology to consumers, thereby "disrupting" the existing market dynamics.

We reiterate here that Schumpeter's path-breaking work conceptualized the positive role of dissemination through imitation, in addition to the basic initial invention. Apart from spreading the new technology to a wider user base, such dissemination would provide incentives to the original inventor to keep up the pace of new R&D to maintain its short-lived monopoly power.

Scholars have built on Schumpeter and have argued that innovation process can be divided into four stages – invention, innovation, imitation and diffusion – repeating itself in such a way that sets the engines of economic growth in motion (Klepper 1996, Christensen et.al 1998, Sledzik K, 2013). In sum, innovation through its intensive and extensive marginal impact is crucially important and lays the foundation for all economic systems (Fagerberg et al, 2003, 2007, 2009).

2. The Relationship between Innovation and Economic Growth

The description above of innovation raises the important question of how then it might drive economic growth. The first conceptualization of the positive impact of innovation, specifically technological progress, on economic growth was formulated in neo-classical growth theory by economist Robert Solow in 1956 (Solow 1956). The inclusion of technological progress was to explain any level of economic growth that occurred in the long run. It was assumed to be exogenous (or *manna from heaven* in Solow's words) and a public good available freely to everyone across economies. The central notion of neo-classical growth theory was that the economic growth pattern of a country can be explained

[6]His ideas also indicated that this is how one could also increase social welfare in the long run. For example, Branstetter et.al (2011) show that the diffusion of generic products in the US pharmaceutical markets has resulted in substantial welfare gains in hypertensive medicines. This is crucial since as economic historians have noted, even in the Malthusian economy, artisanal innovation were diffused through the critical role of the guilds (Mokyr 2010).

by the level of capital accumulation achieved in the country. The theory postulated that the growth in output (GDP per capita) results from increases in capital allocated to each worker. An initial period of growth in productivity will be followed by decline in marginal productivity of capital as more capital is added to the system. And consequently, the capital-labor ratio will also decline, ultimately approaching a constant rate. Therefore, in the long run, the theory postulated that capital stock and labor force will grow at a constant rate determined exogenously. But empirical studies on neo-classical growth theory demonstrated that only a small fraction of US economic growth can be explained by changes in capital stock and labor force, leaving a significant fraction to be attributed to total factor productivity (TFP[7]) growth (Abramovitz 1956, Solow 1957, David 1990 among many others). Further, the empirical evidence showed that convergence of economic growth of poor and rich countries did not occur as predicted by the theory (Solow 1957).

The inability of the neo-classical theory to explain a significant fraction of productivity growth and the problem of non-convergence among nations' economic growth patterns paved the way for the `new-growth' theory (Grossman & Helpman 1991, Romer 1994 & Rosenberg 2004). Economists in this tradition argued that the difference in economic growth across countries was due to the difference in endogenous knowledge accumulated within national borders (Fagerberg et al, 2003). In addition, they postulated that given that there are constant returns to innovation, such endogenously determined innovation will result in sustainable economic growth in the long run. Research in subsequent work in new growth theory has thereafter actively investigated the role of R&D investment in increasing innovation. A central focus was on understanding the industry and the individual firm as key producers of innovations brought about through sustained R&D activity (Griliches 1994, 1998).

Griffith et al (2004) using a panel of industries across twelve OECD countries since 1970 found that R&D, along with human capital, has significant effects on innovation and technology, controlling for cross-country differences in hours, skill levels and markups of

[7]In economics, TFP is a variable which accounts for effects in total output not caused by traditionally measured inputs of labor and capital. If all inputs are accounted for, then TFP can be taken as a measure of an economy's long-term technological change or technological dynamism. It cannot be directly measured; instead it is the residual in an econometric model of output as a function of inputs and is often called the *Solow residual* after Robert Solow's work in this area.

price over marginal costs. In addition, they also found that R&D has a second face – which showed that lagging countries in the OECD sample, in terms of the productivity frontier, would catch up particularly fast with the frontier countries if they invest heavily in R&D. In addition their empirical study also showed that international trade has very little robust effect on productivity.

Ulku (2004) uses similar panel data techniques and information from 20 OECD and 10 non-OECD countries to test the hypothesis that (i) R&D investment increases innovation and if there are constant returns to innovation and (ii) innovation leads to permanent increases in GDP per capita. Additionally, the study found that increase in innovation through R&D investments was witnessed only in large market OECD countries. Other OECD countries seem to promote innovation by using the innovations from these large market OECD countries. Further, they added that innovation does not result in perpetual growth in output. In other words, the constant return to innovation postulated in the new growth theory was not found to be true in this empirical study. The study findings suggested that innovation has positive effect on per capita outputs of both OECD and non-OECD countries in the sample. Aghion and Howitt (1998) explain these findings by conjecturing that this might be due to the fact that R&D investments have to be increased over time to enable improvements in technology and to ensure constant returns to innovation. However, in reality, there are diminishing returns as more innovation occurs and new products are introduced in the market with any new innovation having marginally lower spillover effect on the existing aggregate stock of knowledge. Therefore they argued that innovation, like capital stock will only increase the growth rate of output in the short run.

The empirical literature on the long run effect of innovation on economic growth has yielded mixed results. Wang (2013) using patent and trademark statistics as proxies for innovation, examines the long run effect of innovation on economic growth. In this study, Wang restricts the sample to US, UK, Germany, Japan, France and Australia, which have long established intellectual property rights systems. First, the findings indicate measurement issues with variables that can be used as proxies for innovation; its effect on economic growth varies when trademark and patent statistics are used. A major deviation in results can be witnessed particularly for Japan with the role of innovation being significantly and

positively related to economic growth during both pre and post-World War II time period in the case of trademark statistics. However, in case of patent statistics as proxy for innovation, the positive effect on economic growth is witnessed only in pre-World War II period and it loses its significance during the post-World War II period. Moreover, the study finds that growth rates vary significantly even among these developed countries and generally changes in growth rate were witnessed for the post-World War II time period.

To summarize, this research shows that innovation and technical progress play a fundamental role in economic growth, providing a partial counter to diminishing returns on capital. There are issues with measuring innovation though and, as the case of early post-war Japan illustrates, the usual method of counting the number of patents (even if they are weighed by their citations) might understate the true effect on growth.

In the context of developing economies, Benavente (2002) adopts a system of equations framework to explore the link between R&D and innovation, and the impact of R&D induced innovation on the productivity of firms in the case of Chile. He finds that while firm size is related to probability of a firm to engage in research activities, it is not related to amount of resources allocated to R&D when sectoral differences were controlled. Another result was that neither research expenditure nor innovation has a significant impact on sales and productivity respectively. However, these results have to be taken with a caveat that the model adopted by them does not capture the real effects of innovation on productivity. For the model, productivity is measured as value added per worker, which neglects the increase in productivity through innovation in technical processes and technological change embodied through machinery. Further, Arza and Lopez (2010) use a panel data of industries in Argentina for the time period 1998-2004 to study the effect on productivity of R&D in addition to different types of innovative activities within a firm. The author identifies the limitation of earlier literature which solely examined the relationship between R&D and productivity growth. Further, the actual effects of innovative activities were not measured to their true potential. Therefore, they categorized different inputs of innovation in two groups – (i) *in-house activity*: R&D, industrial engineering and design; and (ii) *external source*: technologies embodied in machinery, intangible technologies and information and communication technologies. Their results suggest that all types of such activities are

important and have a significant positive effect on product and process innovation thereby impacting labor productivity. Specifically, in-house activities had more relevance to product innovation. On the other hand process innovation was impacted greatly by external sources, in particular technologies embodied in machinery. Further, they also found that a firm enjoys an extra payoff in labor productivity when it is committed to long-term systematic investment in R&D.

This work again shows that spending on R&D is not necessarily strongly correlated with innovation, though often the output is measured by the input, as a proxy.

In recognizing the potential of big firms to maintain R&D investment in the long run, Schumpeter argued that such investment in innovative activities by big firms will enhance society's welfare on the whole. The problem lies in the fact that such advantageous position of big firms might lead to concentration of wealth and monopoly power over the market directly, thereby negatively impacting sustainable economic growth. Further, it may lead to decline in diffusion of knowledge and imitation, which were considered by Schumpeter himself to be the primary drivers of innovation and a necessary condition required for constant creation of new economic structures, thereby incentivizing the entrepreneurs to push the global knowledge frontier. However, this is true only in the case of markets with less competition and firms with limited technology capability.

3. Intellectual Property Rights, Innovation and FDI

Although the literature is still to understand it conclusively, if innovation is important to economic growth, it is necessary to understand the drivers of innovation. One of the key drivers is Intellectual Property (IP), which provides the inventor of a new idea incentives to innovate ex-ante and the promise of monopoly rents – either through patents or otherwise – in the economy.

But before we explore the relationship between IP & innovation, let us briefly also summarize the literature's findings on the antecedents that drive national adoption of stronger IP. The empirical evidence is limited here; although limited by data on just one sector, that of software piracy, Marron & Steel (2000) find that intellectual property receives greater protection in developed economies, with protection depending on cultural factors,

such as whether countries have an individualist versus collectivist culture. Piracy rates were also found by the authors to be lower in countries that have strong institutions that enforce contracts and protect property from expropriation. It however remains contestable as to how generalizable these results are, especially in the context of other sectors in global economies, an area that might merit future attention from researchers. In related work, Kim et.al (2012) find in a panel of 70 countries that patent protection is an important determinant of innovation and that patentable innovations contribute to economic growth in developed countries, but not in developing ones. Instead, in developing economies, a minor form of intellectual property rights – namely utility models – is conducive to innovation and growth, controlling for other factors. Overall, this is an under-investigated area of research requiring future work. (Utility models provide protection to smaller adaptations of existing inventions that do not satisfy the standards of novelty and non-obviousness required for a patent.)

While that may be the case, stronger IP or weak, continues to be an area of vigorous recent debate both in the economics and policy research space. While acclaimed scholars like Stiglitz have criticized stronger IP for its effects in fostering inequality (Stiglitz 2006), others have remained unconvinced. Does stronger IP really create incentives for innovation? The evidence from the empirical literature is mixed. In one of the earliest studies in this area, Sakakibara & Branstetter (1991) show that whilst the patent reforms of 1988 in Japan had an effect on the scope of patent rights in the economy, there was no evidence of an increase in R&D spending or innovative output in Japanese firms that could be plausibly attributed to these patent reforms. Qian (2007) further expanded the findings in Japan in a multi-country panel of 26 countries between the period of 1978 and 2002. Her baseline findings are provocative, she notes: "National patent protection alone does not stimulate domestic innovation, as estimated by changes in citation-weighted U.S. patent awards, domestic R&D, and pharmaceutical industry exports. However, domestic innovation accelerates in countries with higher levels of economic development, educational attainment, and economic freedom. Additionally, there appears to be an optimal level of intellectual property rights regulation above which further enhancement reduces innovative activities." The debate continued with Lerner (2009) who explored the question in 60 countries across 177 episodes of shifts in patent policy over a period of 150 years, to find that patent-protection enhancing

shifts did not result in a response by domestic inventors in these countries to augment their innovative output.

To summarize, the evidence has been so inconclusive empirically on the theoretically posited relationship between IP and innovation, that recent research has started looking at this question with an argument of a 'case against patents' (Moser 2013 & Boldrin & Levine 2013, Williams 2013, Kapczynski 2013). A related area of concern has been the role of incremental innovation and rent seeking activity of innovator firms using secondary patents. Theoretical work has in the past documented that secondary patents for incremental innovation, which extend patent monopolies may have adverse welfare effects, since the first innovator then usually appropriates a larger share of the profits from the market (Scotchmer 1996). This assertion has been backed up by empirical findings on 'evergreening' of pharmaceutical patents (Hemphill and Sampat 2012, Kyle & Yin 2013)[8]. In summary, there does not appear to be robust evidence of national economic and societal benefits of extension of monopolies by the grant of secondary patents to the first innovator.

Despite these findings in the empirical economics literature on the somewhat ambiguous relationship between IP & innovation, policy analysts have over time attempted to move towards a flatter world order respecting stronger IP. The introduction of the multilateral agreement on trade-related intellectual property rights (TRIPS through the World Trade Organization mandate) provides evidence of commitment by nations to move towards stronger IP[9].Under TRIPS agreements, the current and future World Trade Organization (WTO) members must adopt and enforce strong and non-discriminatory minimum standards of protection for intellectual property. India, which signed the TRIPS agreement in 1994, was given time till 2005 to make its intellectual property laws compliant with TRIPS agreements. Even though the patent and other intellectual property laws have been amended in accordance with TRIPS agreement, there is still considerable controversy in India and other TRIPs-acceding economies over its implementation – for example, in international means of protecting key information such as databases and electronic information transfer,

[8] A related issue here is that of the welfare creating or destroying role of pharmaceutical advertising since it has been shown to mute price-elasticity of demand at the margin as documented in prior work (Rizzo 1999).

[9] In recent times the Trans Pacific Partnership is another such effort, see: http://www.mfat.govt.nz/downloads/trade-agreement/transpacific/main-agreement.pdf

compulsory licensing, and granting of marketing authority to generic pharmaceutical firms etc. This is expected to continue as an area of future policy debate with even least developed countries now being given extension for implementing TRIPs in 2013[10].

Empirical research on Indian R&D and more specifically R&D in the pharmaceutical sector is inconclusive about any effect of stronger IP on domestic innovation in a world transiting towards a post-TRIPs economy. Dutta and Sharma (2008) used data from Indian firms for the time period 1989-2005 to estimate the effect of strengthening of IP on its R&D activity. They found that innovation-intensive Indian firms increased their R&D expenditure after TRIPs. On an average, the annual spending on R&D by innovation-intensive Indian firms was 20 percentage points higher post TRIPs agreement signing. Further, they also found that these firms with greater innovation intensity also applied for US patents in greater numbers number post TRIPs. These findings were also complemented by work on the Indian pharmaceutical sector (Arora et.al 2008) where no evidence was found of increase in product patenting in Indian pharmaceutical firms with introduction of TRIPs; instead a rise in process patenting was found to explain the rise in R&D spending (as documented by Dutta & Sharma (2008)) . This is consistent with past findings of a similar non-response of domestic pharmaceutical innovation in the Italian context (when that sector shifted to a stronger IP regime (Weisburst &Scherer 1995)).

The evidence from the pharmaceutical industry therefore seems to indicate that a stronger IP regime increases R&D spending, but not necessarily to invention of new products. Process innovation seems to increase more directly.

Let us now turn to the relationship between IP & Foreign Direct Investment (FDI). This is a key connection that policy analysts have tried to establish in recent times arguing a positive relationship (that is only potentially correlational and not causal) between the two[11], thereby advocating gains from FDI (Blalock & Gertler 2008). This however is an argument that in itself remains underexplored. But even more, the directionality of the relationship between IP and FDI is still not settled. Theoretical work especially in international economics

[10] See: http://www.wto.org/english/tratop_e/trips_e/ldc_e.htm

[11]See: http://www.sonecon.com/docs/studies/FDI_IP_and_the_Pharmaceutical_Sector_in_India-Shapiro-Mathur-Final-January2014.pdf

provides a nuanced intuition. Glass & Saggi (2002) show that stronger Southern[12] IP protection makes multinationals more secure from imitation in absolute terms but no more secure from imitation relative to successful innovators still producing in the North. Consequently, stronger Southern IP protection does not alter the expected profit stream from becoming a multinational relative to remaining a Northern firm and hence does not encourage FDI. In fact, they add to this result by showing that FDI decreases with a strengthening of Southern IP protection, because it increases the cost of imitation, crowding out FDI through tighter Southern resource scarcity. Less efficient imitation absorbs more Southern resources despite the reduction in the rate of imitation stemming from the reduced profitability of imitation. Finally, they also find that the contraction in FDI tightens Northern resource scarcity and increased Northern production leaves fewer resources for innovation, so the rate of innovation falls. This theoretical finding is consistent with empirical studies cited in the public policy literature (Chu 2009 & Park & Lippoldt 2003).

A key component in these theoretical studies is the issue of 'market size' (Grossman & Lai 2004). In general, the value of strong IPR that protects patents, trademarks and copyrights of the exporting firm would be enhanced if there is a big market size facing exporters from the North. This is defined as a `market-expansion effect', which is likely to be strongest in countries with large markets (either in absolute size or in terms of per-capita GNP) with significant technical capabilities for imitating products and technologies. In addition, such exporting firms enjoy greater market power, giving them the flexibility to charge higher prices. However, concerns about such pricing power resulting in `monopoly effect' are often overstated in the light of significant number of competitors in reality. The `monopoly effect' is more likely to be significant in countries with small markets and limited technological abilities (Maskus and Penubarti, 1995).

Empirical work on the importance of stronger IP protection to attract FDI also shows that the relationship actually varies across different sectors. Bilir (2014) recently substantiates this in a theoretical setting supplemented with empirical findings. She finds that countries with strong patent laws attract multinational activity, but only in sectors with

[12] Largely developed by Columbia University economist Ronald Findlay, in the North-South models of international economics, the North is usually the set of developed nations while the South is the set of developing nations of the world.

relatively long product lifecycles. By contrast, firms with short-lifecycle technologies are insensitive, because offshore imitation is less likely to succeed before obsolescence. This probably makes intuitive economic sense. Investment in lower-technology goods and services such as textiles and apparel, electronic assembly, distribution and hotels depend relatively less on the strength of IP although more significantly on input costs and market opportunities. Multinationals that operate in high-end technology, which is difficult to imitate, pay little attention to local IP in their decision making even though the art and science of imitation has progressed over decades making anything easy to imitate. Therefore, this has led to strong rise of support for stronger IP protection from the developed economies. Further, the real need for stronger IP protection is felt by firms with easily imitable product and technologies, such as pharmaceuticals, chemicals, food additives and software. In addition, these firms are more intensely concerned with the efficiency of the local regulatory system to uphold and enforce IP to deter imitation since stronger IP is only as strong as the mechanism to enforce it (Maskus, 1997, Rocket 2010).

The Bilir (2014) study builds on past empirical work on the relationship between IP & FDI. Lee and Mansfield (1996) used survey results to construct an index of perceived weakness of IP in destination countries by US firms and used it to examine the relationship between strength of IP in destination countries and flow of US direct investments for the period 1990-1992. Their results suggest that US firms decision to engage in direct investment was negatively impacted by the weakness of IP in destination countries. However, they also found that decision of firms with less than 50% US ownership experienced much less negative impact although they also had lower propensity to undertake technology transfer. Therefore, the results showed that quality and quantity of inward FDI was strongly associated with the strength of IP in the destination countries. In another seminal work, Branstetter et al (2006) make use of strengthening of IP in sixteen countries in the 1980s and 1990s to understand the level and composition of industrial development in a North-South product cycle model. In this model, the South reforms IP, which leads to increases in outward FDI in the North, resulting in shift in production from North to South. This allows the north to reallocate its resources to R&D activities, which increase the global rate of innovation. Their results suggest that expansion by US multinational activity in these sixteen

countries which had reformed their IP rights does not crowd out imitating indigenous firms. But, the expansion in production-shifting by northern multinationals more than offsets any decline in production due to imitative activities of indigenous firms. Thus, stronger IP results in attracting FDI and enhancing southern industrial development.

In conclusion, it is theoretically unclear that strengthening of IP protection by developing countries will potentially increase FDI; the verdict is only just emerging on the moderating effect of product life cycle and of domestic industrial development (or even the role of complementary institutions). As McCalman (2004)suggests, whilst traditional thinking about intellectual property rights (IP or IP rights) indicates that as a country strengthens its IP rights standards, firms will move their governance structures away from equity based institutions such as foreign direct investment (FDI) towards more market-based relations such as licensing agreements, the behavior might be more nuanced. In examining the behavior of Hollywood studios in both the feature film and video markets in 40 foreign countries he found that although moderate IP is associated with a high degree of licensing, both high and low standards of IP encourage more integrated governance structures. Clearly much more remains to be examined in this area before informing unambiguous policy recommendations, which tie in static and dynamic benefits, in the relationship between IP, FDI and economic growth.

4. The Welfare Effects of Stronger IP

In addition to its effects on FDI, another associated area of examination for economists has been the idea of whether stronger IP creates welfare effects in a structural setting. While some seminal theoretical studies exist in this context starting with Helpman (1993), empirical work remains inadequate. A key reason for this lies in the fact that to conduct such an analysis that meets modern evidentiary standards, there would be the requirement for (a) a certain type of aggregate or consumer-level information of demand dataset for products (to back out structurally the demand and supply curve in the economy and back out thereafter welfare estimates) and (b) the need for an occurrence of the IP shift as a natural experiment. The availability of both of these together has been rare and only a handful exists in the context of the pharmaceutical industry. For our purposes, it is fortunate that it is in the context of TRIPs as an experiment and Indian pharmaceutical industry as a

laboratory. Chaudhuri et.al (2006) showed that in the Indian pharmaceutical sector, concerns about the potential adverse welfare effects of TRIPs may have some basis, especially since the overwhelming portion of this welfare loss is driven by loss of consumer welfare. Dutta (2011) adds to these findings showing that in 43 drugs in her sample, stronger patent protection might be followed with large losses for consumers and relatively small gains in profits for the global patent holders. This is an important area of ongoing research. In related work on the supply side and regulatory incentives, Budish et.al (2014) show that fixed patent terms might distort incentives for cancer R&D and Branstetter et.al (2014) argue that generic penetration in US pharmaceutical markets could impact negatively the flow of early stage pharmaceutical innovation and also change the nature of R&D to large-molecule drugs from small-molecule drugs. The broad import of these papers is that the welfare effects have static and dynamic considerations, and the trade-off for society lies in balancing access and affordable healthcare today versus incentives for innovation tomorrow (Higgins & Graham 2009).

5. On GIPC International IP Index (GIPC Index)

We finally summarize our assessment of India on the IP barometer after the conversation on innovation, its relationship with welfare, economic growth, IP & FDI in this section. The U.S. Chamber of Commerce Global Intellectual Property Center (GIPC) states that GIPC international IP index is a "*rigorous statistical tool that businesses and policy makers can use to measure a country's momentum toward building innovative and creative economies, fostering economic growth, and attracting investment*" (Measuring Momentum 2012, pp 4).The following are a few concerns with respect to GIPC International IP Index and its subsequent use:

- **Intellectual Property Rights are Means, not an End in itself:**

  The main objective to strengthen the intellectual property rights framework in a country is to enable individuals, entrepreneurs and firms to invent and innovate. It provides the innovators the basic guarantee that their efforts and willingness to undertake huge and uncertain risks are protected and put to use in such a way that benefits of such acts will accrue to them. Therefore, intellectual property rights are just a means to achieve the end of promoting innovative activities in the system. The

GIPC International IP Index solely measures the robustness of IP system in a country in accordance with the baseline set by developed economies ignoring the compliance of a country with TRIPS agreement. This measure to infer level of innovative activities assigns higher weightage to IP might not be appropriate. Especially given that the scholarly literature discussed earlier now provides evidence that innovative activities are function of human capital, absorptive capacity, knowledge spillover, firm size and other social and institutional factors in addition to robust IP regime. Every economy has undergone a period during which imitation of existing technologies or process led to accumulation of knowledge stock resulting in endogenously driven innovation of new technologies or processes[13]. However, product innovation and technology diffusion are enhanced under tighter IP rights if production is transferred through FDI, than through imitation (Lai, 1998) though even there as Section 3 discussed, the evidence could be nuanced and conditional on the product life cycle of the sector. Hence, an IP policy framework should be balanced to promote and protect domestic innovation and attract foreign investment through which transfer of technology is facilitated.

- **Potential Problems with methodology:**

  The GIPC index constructed using the current methodology raises question over its true reflection of the ground realities. There are primarily two limitations with the methodology - (i) no weights strategy adopted and (ii) no strategy to penalize poor performances. With respect to the first limitation, the current methodology assigns equal weights to all the six categories that GIPC is composed of, namely, patents, related rights and limitation; copyrights, related rights and limitations; trademarks, related rights and limitations; trade secrets and market access; enforcement and membership and ratifications of international treaties. This approach to measuring the strength of an IP regime might result in assigning higher importance to a category which might not have significant and real effect on the IP framework of a

[13]for example: German imitation stage post industrial revolution - Fagerberg et al (2003)) and Western firms usurping knowledge in herbal medicines in recent times (Khanna & Choudhury 2014, see http://www.hbs.edu/faculty/Publication%20Files/14-079_9f881e56-002c-4603-a778-5a698184c827.pdf

country. Hence, an informed weighting strategy using statistical techniques such as principal component or factor analysis should be adopted to ensure that the index offers actual insights about the status of IP framework in a country. Further, the current methodology is a simple addition of all the sub-indices which might be an over-simplification, a weighted geometric mean approach could ensure an appropriate penalizing mechanism such that the final index values are appropriately adjusted for extreme sub-index values.

- **Possible arbitrary choice in baselines:**

  It should be also noted that GIPC index is a combination of binary, numerical and mixed indicators. Most of the indicators are measured by comparing the actual value of the indicator vis-à-vis a benchmark. For example, the standard baseline used for the copyright term is that of 95 years provided in the United States. Where no adequate baselines are found in international law or treaties, the baselines and values used are based on what rights holders view as an appropriate environment and level of protection. In this regard the choice of benchmarks might be arbitrary and not be the appropriate standard of comparison for a particular country's current legislative and regulatory regime.

  Another example of this comes from India's performance on GIPC. Of the six categories of indicators that comprise GIPC, India does well in indicators in the sections Trademarks, Related Rights and Limitations. However, its score in Patents, Related Rights and Limitations, most relevant to the pharmaceutical industry, is abysmal. This is attributed to the low score in indicators that measure patent enforcement and resolution mechanism and patent term restoration for pharmaceutical products. According to the 2014 GIPC report, since India does not have any relevant patent enforcement and resolution mechanism it is awarded 0 points. Also, the index measuring patent term restoration for pharma products is based on a baseline of 5 years according to US and EU standards. Might it be worthwhile to evaluate what is the optimal term for patent term restoration rather than adopting terms from US/EU standards in an ad-hoc fashion?

- **Potential Inconsistency with other indices:**

  The credibility of a new index is determined by the degree of equivalence in terms of country ranking to existing indices which are constructed to provide an insight about the status of similar factor. For this purpose, we consider the Ginarte-Index which is similar to the GIPC index but the difference lies in its sole focus to measure the extent of patent protection, coverage, protection duration and membership in international treaties. The GIPC international IP index is an extension of Ginarte-Park index due to inclusion of copyrights, trademark and counterfeiting & piracy dimension for the construction of its index. Further, we also consider the Global Innovation Index which takes into account the regulatory framework such as those related to IP to measure innovative activity in an economy. The assumption here is that GIPC index and GII should move in tandem since a country will experience low level of innovative activity if the regulatory framework is weak and does not protect the innovator's interest. And second, that their relative positioning in GIPC Index and GII should remain the same. For example, Country A which has stronger IP than Country B should also rank higher than Country B in terms of innovative activity. The following table provides the details of index and sub-index which was used to construct the GlPC international IP Index, Global Innovation Index and Ginarte Park Index.

Table 1: Details of Indices used to measure Innovation Activity

Index	Factors used to construct the index	Weights
GIPC International IP Index	Patents, related rights and limitations; Copyrights, related rights and limitations; Trademarks, related rights and limitations; Trade secrets and market access; Enforcement; and Membership and ratifications of international treaties.	No
Global Innovation Index	Innovative Input Sub-Index - Institutions, Human Capital, Infrastructure, Market and Business Sophistication; Innovative Output Sub-Index - Knowledge and technology outputs and Creative outputs	Yes
Ginarte-Park Index	Extent of Coverage; Membership in international patent agreements; Provisions for loss of protection; Enforcement provisions; and Duration of protection	Weights are attached to all categories and sub-categories to enhance index sensitivity

Source: Park (2008), Charting the course - GIPC (2014), and Global Innovation Index website - http://www.globalinnovationindex.org/content.aspx?page=framework (accessed September 11th 2014)

Table 2: Comparison of GIPC international IP index (2014) with GII (2014) and Ginarte Park Index (2005)

Country	World Bank Group Category	GIPC Index (2014)		Global Innovation Index (2014)		Ginarte-Park Index (2005)	
		Score	Rank	Score	Rank	Score	Rank
US	High Income	28.52	1	60.1	6	4.88	1
UK	High Income	27.59	2	62.4	2	4.54	11
France	High Income	27.15	3	52.2	22	4.67	2
Singapore	High Income	25.12	4	59.2	7	4.21	25
Australia	High Income	24.18	5	55	17	4.17	29
Japan	High Income	23.24	6	52.4	21	4.67	2
New Zealand	High Income	21.32	7	54.5	18	4.01	35
Canada	High Income	17.4	8	56.1	12	4.67	2
Malaysia	Upper Middle Income	14.36	9	45.6	33	3.48	53
Mexico	Upper Middle Income	14.27	10	36	66	3.88	39
Colombia	Upper Middle Income	13.66	11	35.5	68	3.72	45
Chile	High Income	13.55	12	40.6	46	4.28	23
Russia	High Income	13.28	13	39.1	49	3.68	46
Turkey	Upper Middle Income	12.38	14	38.2	54	4.01	35
UAE	High Income	11.72	15	43.2	36		
Ukraine	Lower Middle Income	11.68	16	36.3	63	3.68	46
China	Upper Middle Income	11.62	17	46.6	29	4.08	34
South Africa	Upper Middle Income	11.6	18	38.2	53	4.25	24
Brazil	Upper Middle Income	10.83	19	36.3	61	3.59	49
Nigeria	Lower Middle Income	9.8	20	27.8	110	3.18	67
Argentina	Upper Middle Income	9.45	21	35.1	70	3.98	38
Indonesia	Lower Middle Income	8.09	22	31.8	87	2.77	94
Vietnam	Lower Middle Income	7.8	23	34.9	71	3.03	75
Thailand	Upper Middle Income	7.34	24	39.3	48	2.66	96
India	Lower Middle Income	6.95	25	33.7	76	3.76	41
Total countries			25		143		122

Source: Park (2008), Charting the course - GIPC (2014), and Global Innovation Index website - http://www.globalinnovationindex.org/content.aspx?page=framework (accessed September 11th 2014)

The apriori expectation was that a country which is ranked higher relative to another country under GIPC index will also maintain the same order of positioning under Ginarte-Park Index. The comparison of GIPC international Index with GII and Ginarte-Park does not match with our expectations of consistency. Consider the example of Canada, which is ranked eighth under GIPC index and ranked second under Ginarte Park Index. Countries such

as United Kingdom (UK) (rank-11), Singapore (rank-25), Australia (rank-29) and New Zealand (rank-35) under Ginarte-Park Index are ranked higher under GIPC Index.

Another example which offers a clear-cut case would be the case of India. It is ranked last in the GIPC Index after Thailand, Viet Nam, Indonesia, Nigeria, Brazil, Ukraine, Russia and Malaysia. However, India with a rank of 41 under Ginarte-Park Index was positioned way higher relative to the above-mentioned countries. In some cases, the difference in positioning is very startling - Malaysia is ranked ninth and India being the last is ranked twenty-fifth under GIPC Index. On the other hand, under Ginarte-Park Index the inverse is true with India ranked forty-first way higher than Malaysia which is ranked fifty-third. Similarly, there are other cases where relative positioning of countries under GIPC Index is in complete contradiction with the relative positioning under Ginarte-Park Index.

Moving on, the next comparison of GIPC Index with GII will be measured on whether both IP and innovation moves in tandem. The intuition behind this is simple. One can argue that GIPC and GII try to measure the strength of IP regime and innovation. Since these two are inter related, we believe that the ranks of countries in the two indices should not change. In particular, we test our hypotheses that a country ranked higher relative to a country under GIPC Index should also be ranked higher under GII. Again, we consider the case of India - Nigeria and Indonesia are ranked 20th and 22nd respectively whereas India was ranked last under GIPC Index. However, under GII, Nigeria & Indonesia are ranked 110 and 87 respectively which is lower than the rank assigned to India (76). This is in contradictory to our expectation under which we had expected Nigeria and Indonesia to perform better than India under GII ranking as well. Similarly, Australia is ranked lower than France under GIPC Index although its ranking under GII Index is higher than France. Therefore, the startling differences between GIPC Index and Ginarte-Park Index and weak relationship between IP rights framework and innovative activity evident from non-tandem movement of relative positioning of countries seriously raises questions about exclusive reliance on the GIPC Index. Further, it raises concern over the ability of this index to reflect the actual status of the IP regime of an economy. In conclusion, for the reasons explained above, the index value has to be used with great caution.

6. Conclusion

There is no denying the fact that innovation is key to economic growth. However whilst theory suggests that stronger IP rights are essential to provide incentives for innovation, the empirical findings supporting this claim are ambiguous. Furthermore, economists are also divided on the relationship between IP and FDI. Stronger IP in addition might induce adverse welfare effects as has been investigated in post-TRIPs Indian pharmaceutical markets. The situation thus calls for careful and creative policy deliberation involving multi-party dialogues to resolve this crucial policy puzzle for nations around the world. This is especially important in the context of healthcare and pharmaceutical markets where societies grapple with the trade-off between availability and access to healthcare on one hand and incentives for medical innovation on the other.

Some creative ideas on resolving the deadlock might include one suggested by Yale University philosopher Thomas Pogge on the creation of a Health Impact Fund that ties the IP rights of medicines to the issue of comparative effectiveness of drugs[14]. In addition, David Ridley from Duke University has suggested the creation of Priority Review Vouchers[15] for research on neglected diseases, where an innovator firm engaging in such research will be given a priority review in research in other therapeutic markets in exchange. This is an idea along with that of Pogge's that policy makers can consider. Another potentially fruitful area might be to use concepts in the economics of mechanism design to reframe the IP regime in India. Sometimes called reverse game theory, this newly emerging field in economics studies private information games. Here the focus is on finding the optimal institutions given the constraints imposed by economic incentives and physical feasibility. Thus the design becomes essentially the "inverse" of traditional economic theory, which is typically devoted to the analysis of the performance of a given mechanism. In its stead, one can allow the game designer to choose the game structure. Using these principles, increasingly several public policy problems have recently been addressed[16]. In the context of innovation,

[14] See http://healthimpactfund.org/

[15] See https://faculty.fuqua.duke.edu/~dbr1/voucher/

[16] See for example an application to solving matching problems in Boston public schools (http://economics.mit.edu/files/3021) or in kidney exchange in hospitals (http://web.stanford.edu/~alroth/papers/kidneys.JET.2005.pdf)

Bhattacharya et.al (1992) show that in a three-stage model of research and development (R&D), where in the last of the three stages, firms compete in the product market, in the second stage, the firms simultaneously choose unobservable R & D levels, and in the first stage, the firms can share some or all of their knowledge with other firms in the RJV – two simple licensing mechanisms ensure both efficient sharing of knowledge and efficient R&D effort levels. This is one fruitful area where scholars, policy makers and practitioners can join hands and offer a re-design of the IP framework in developing economies like India setting gold standards for other economies to emulate.

Finally, going forward one important area in India's IP policy would potentially be in its complementarity with India's competition policy. Aghion et.al (2001) ask this important question in a seminal study by investigating if more intense product market competition (PMC) and imitation is good or bad for growth. In contrast to earlier Schumpeterian models in which innovations are always made by outsider firms who earn no rents if they fail to innovate and become monopolies if they do innovate, they find that the usual Schumpeterian effect of more intense PMC is almost always outweighed by the increased incentive for firms to innovate in order to escape competition, so that PMC has a positive effect on growth. India's IP policy if strengthened from its current status-quo going forward could potentially induce enhanced FDI by multinational firms, especially in sectors like pharmaceuticals. This might mean independent entry or entry through mergers and acquisitions, some of which could come under the radar of Competition Commission of India. It would be therefore important to synchronize the actions of these two policy-entities given the findings of Aghion et.al (2001) documented above.

Disclaimer: The overall purpose of the study was to understand the relationship between intellectual property protection, innovation, foreign direct investment and economic growth. It originated from a request from Indian Pharmaceutical Alliance for a systematic unbiased scholarly understanding of theoretical and empirical work in economics, public policy and management in these areas. The key questions investigated included the criticality of innovation in economic growth, the role of IP in creating incentives for innovation, the welfare effects of stronger IP and the relationship of IP with moderators like FDI and multinational activity. At the discretion of the authors, additional issues were also reviewed. The authors acknowledge that the literature in this area is vast and they brought their understanding of research in these areas to select work to be cited, without any attempt to be exhaustive and representative in their review. Relatedly, the authors have also refrained from taking a stance in policy matters. The report merely points out the nuances in the results available in the literature given the initial questions posed to the authors by the Indian Pharmaceutical Alliance. As is clear from the literature reviewed, we have not limited ourselves to any particular industry and have also considered broader conceptualizations of issues in addition to specific quantitative results. The authors also note that they will not be responsible for any misattribution based on this report.

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