

IPRs and the knowledge economy

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Abstract:

India now is firmly established as a knowledge economy. Since the economic reforms that began nearly two decades ago, the Indian economy has been undergoing an important transition- from a closed to an open one; to one where knowledge based production of goods and services is commanding the economy. India has also moved away from a static economy that was characterised by a status quoist government control to one where economic liberalism is the driving force, and one where innovation in products, processes, technologies and systems is critical for the profitable sustenance of productive entities. In short there has been a growing acceptance that knowledge assets will increasingly drive the economy, both internationally and within India. This structural transformation of the Indian economy is the result of many factors, and each has involved the interplay of international forces and influences and domestic abilities and efforts. The role of government, domestic industry, international firms, research institutions, non-government organizations, and of course private individuals therefore has changed significantly in the past few years, and what is more, will continue to change in the future. The direction is towards lower government command and control in all sectors and greater role of the market place in creating the right set of incentives for all. And all of this is in the context of an economy that is becoming more and more integrated with the international economy, and where free movement of knowledge and technology goes hand in hand with the flow of financial and human capital. This paper aims to look at the role property rights, particularly intellectual property rights play in promoting innovation in the knowledge economy.

Introduction

There has been a lot of research on innovation and its contribution to the growth of companies, and to the economy as a whole. The National Knowledge Commission, 2007 defines Innovation as: *“Innovation is defined as a process by which varying degrees of measurable value enhancement is planned and achieved, in any commercial activity. This process may be breakthrough or incremental, and it may occur systematical in a company or sporadically....in order to improve market share, competitiveness and quality, while reducing costs”* Innovation essentially is knowledge creation by an individual or a company. This knowledge comprises the intellectual property of that entity.¹

To develop knowledge, or in other words, to innovate, a company or an individual has to invest in research and development. Most innovations are the result of many years of research and large investments in terms of human inputs and raw material. Once the innovation is made public any person can use it. As an illustration, let us consider the case of a firm that invests heavily in research and development in terms of facilities and manpower and develops a technology to make a better product A. The cost of developing this product would be regarded as fixed costs made by the firm which the firm would aim to recover by charging a premium on product A. Competitors of this firm can access this technology once this better product is in the market. It would be fairly simple for the competition to figure out the technology by reverse engineering or imitation. Soon the competitors would be able to produce A at a much lower price than the firm which developed it. Thus the innovator firm would not earn the expected return against its fixed costs. In the absence of instruments to exclude other from using the innovation, the firm has no incentive to innovate. Thus it is necessary to provide incentives to innovators to invest time and resources toward developing intellectual property. Intellectual property rights ensure that the innovator has access to earning returns against his fixed costs while the knowledge is made available to anyone who wants to use the same for further research and innovation.

¹ The two differences between physical property and intellectual property which define the difference in the way the rights of ownership are defined are as follows: i. Intellectual property unlike physical property is non-rival in consumption. This essentially means that the fact that one person is using that good does not deprive others from using it simultaneously. ii. Intellectual property is non-excludable. In the case of physical property, it is easily possible to prevent others from using that good. This is not the case with intellectual property once it is in public domain.

In the open economy today, each entity needs to have a competitive advantage. In other words, each firm needs to carve a niche for itself to survive competition. In business parlance, the four P's that are critical to the success of any firm are Product, Pricing, Promotion and Placement. Innovation influences to a great extent both Product and Pricing, and therefore is critical to the firm. Intellectual Property Rights enable the firm to protect its innovations and also capitalize on them to enhance revenues. India's stance on TRIPS has been one that has seen various twists and turns, from being a diffident and hesitant signatory to the TRIPS agreement to now being a string votary.

India at the WTO

India has been a steadfast votary of multilateralism even when it was at its protectionist best. Even now, while it continues to be a relatively high tariff country with restrictions on a number of sectors, it leads the small pack of countries that prefer a multilateral institution to bilateral and plurilateral agreements. However, every now and then, the Indian position seems to shift. With each debacle at the WTO, a flurry of talks start, with important trading partners, for bilateral free trade agreements. Every two years or so, India start talking aggressively for a stronger and healthier South Asian Free Trade Agreement. The argument that India makes that that one agreement is better than 150 agreements is often defeated when it realizes that agreements with each member country are not required, what it needs is bilateral agreements with a few major partners and a couple of key trading blocks. That is why in the last meeting at the WTO, India's position looked strange and was more of a posturing against the developed world than a substantial argument on trade issues.

At times, it aspires to lead the pack of poor countries protesting at the WTO and then finds out that this leadership is costly especially when it does not consider itself a poor or developing country any more. India was opposed to liberalization and tariff reduction in non agricultural goods a while ago, now argues strongly for bringing industrial tariffs down and has been doing so unilaterally. It now argues for keeping agricultural protection high.² For industrial tariffs, India would have to cut down duties substantially. Which, if one looks at the tariff structure prevailing in the country, should be brought down in any case. And it is a matter of time that these are brought down to ASEAN levels unilaterally. But while the text is

² Take the draft text circulated in January 2008. The feeling is that the measures suggested both under the agriculture text and the Non Agricultural Market Access (NAMA) do not suit India's interests.

being debated, the familiar arguments are out – why should developing countries cut down tariffs drastically while the developed ones only make marginal reductions. On agriculture, India finds the US offer of cutting down subsidies by a fourth not sufficient. It is also unhappy with the manner in which tariff escalation provisions neglect India's key areas of exports in milk and milk products, meat and met products, mangoes and other fruits.

In India, the debate on International trade has been and continues to be a debate on globalisation. Those who oppose trade on the infant industry argument argue that small businesses cannot compete with large foreign firms. They also argue that imports lead to a shift of production away from indigenous source and therefore cause unemployment. Further, it is argued that free trade leads to dumping of poor quality goods from across the border. These goods are harmful to health and the environment. Also, reliance on imports leads to dependence on foreign countries that then exploit their economic advantage for political benefit. Free trade leads to free flow of currency and this makes domestic economies vulnerable to the whims of foreign investors and causes crises like seen in Latin America and East Asia. However, free trade not only benefits the countries involved but results in higher returns for the entire world. Free trade results in the globalisation of production and consumption. It allows countries to leverage their comparative advantages and produce goods and services that they are relatively more efficient in producing. Countries can then specialize and therefore world production on the whole improves. Globalisation has indeed helped developing and poor countries leverage their abundant resources to produce goods and services that allow for foreign exchange earnings that can then be used for essential imports.

Also, free trade has improved the chances of the really poor countries to conduct business internationally, allowing their firms to widen their portfolios and enter large markets. It is in this context that domestic policies on trade assume significance and political mindset prevails over issues such as import restrictions, export regulations, tariffs and duties. It is important for politics in various countries to understand that unrestricted free trade and the free exchange of goods, services and human resources leads to a convergence in prices and stability across the world. Trade becomes a substitute for migration and allows poor countries to earn higher amounts of money for the factor that they are abundant in. Protectionism actually hurts the consumer as local prices rise and hurts domestic manufacturers as they are unable to get raw material from the cheapest sources. It is crucial for world economic growth that free trade be encouraged without restriction.

It is ironic that the debate against trade rages in a country that has been the pioneer of trade across borders and has historically been both a supplier and a market of foreign goods. On the Elephanta islands off Mumbai, Roman pottery findings have highlighted a flourishing trade between the Roman and the Indian civilization between the 4th and the 7th century AD. Trade with Oman had been going on from the 1st century and continued till well into the 13th century. India's trade was also greatly diversified, it traded with Japan, with China and the Red Sea countries. The silk route saw India's silk and ivory reaching various parts of the world. The Spice route brought in Oman money into India, established again by a major finding of more than 60000 Roman coins along the Cauvery river along the Spice Route. The prime urban centres during the Mughal era were Agra, Delhi, Lahore, Multan, Thatta and Srinagar in the north. The important cities in the west included Ahmedabad, Bombay, then known as Khambat, Surat, Ujjain and Patan. In the east Dacca, Hoogli, Patna, Chittagong and Murshidabad were centres of trade. These were large and well populated cities. Textile trade was critical too. Gujarat exported cotton to Arabia to South- East Asia. Silk and natural colour dyes were exported to Malaysia, Indonesia, and the Philippines. From the East, the indigenous varieties of silk like tussar and munga along with cotton and jute were exported. Kasimbazaar in Bengal was an important trade centre. In the South, it was Malabar in Kerala that produced and exported coloured and printed cloth material. Golconda's Kalamkari, painted cotton fabrics with motifs from Hindu mythology were exported through the port city of Masulipatnam.

In the recent past, especially in the last three years of so, there has been a surge of dollars coming into the Indian economy by way of export earnings, foreign direct investments, portfolio investments and Non Resident Indian (NRI) repatriation. This has fuelled an unprecedented supply of dollars leading to the steady fall in the value of the dollar. A large number of foreign institutional investors (FIIs) are now putting their money into India's capital markets.³ India was traditionally a country that foreign investors and multinational corporations avoided. Even after the open door policies, low interest rates and fast paced economic growth, the flow of Foreign Direct Investment (FDI) was slow despite the fact that other developing countries witnessed a rising trend in the last decade. India was among the

³ The boom at the stock exchange had attracted more than 17 billion dollars by October 2007. NRIs had already made India the largest recipient of non resident repatriation by sending more than 26 billion dollars home last year.

lowest recipients of FDI among developing countries until 1970s. In the decade of the 70s, the total cumulative inflow of FDI was about US\$450 million amounting to 0.20% of gross domestic investment. India started opening up its market from July, 1991 by lowering tariff and non-tariff barriers (NTBs), and liberalizing investment policies. Its openness is still not complete and it remains among the more protected of the emerging economies. Infrastructure continues to be of lesser quality compared to any of the East Asian and Latin American economies it competes with. The surge in FDI in the last two years, despite such problems is indeed remarkable.

What seems to have worked is the fact that India entered into a number of investment treaties and double taxation avoidance agreements with a large number of countries. Also, India's rising domestic income makes it a large market and its trained work force makes it an ideal manufacturing centre. With the exception of mining, agriculture and the retail sectors, India has opened up its economy significantly and that is the reason it has become such a favourite of the foreign investors. Also India has become the favourite destination of US foreign investment. Till the 1990s it was Europe that invested in India. In the recent past, the US has started looking at India and a large number of American firms have invested here – These include AT&T, General Electric, General Motor, Ford, IBM Corp, Motorola, Mobil, Pepsi and Exxon. Most investment comes into three different sectors - infrastructure, consumer goods and oil.

As a result of such large amounts of dollars coming in, the value of the dollar was sure to fall. A weaker dollar and consequently a stronger rupee mean that imports become cheaper. That is the reason India's manufacturing sector that imports its machinery and raw material, is happy. Also rising oil prices have not meant higher cost of petrol and diesel to the consumer in India, because of the cheaper dollar. With a trade deficit that is already high, India could not have asked for more. Imports are going up, but the impact is softened as the dollar become cheaper by the day. On the other hand, the fear that exports would fall has been belied. Despite the rupee becoming strong and therefore pushing up export prices, the volume of exports is only going up. There are some exports that do depend on a weak rupee and these exports are indeed going to suffer, in some low value items like textiles and call centres. We don't have evidence that these sectors are suffering, but it stands to reason that they would. The services sector is critical and in this, IPR legislation and its implementation would hold the key to further progress in this area. With the Knowledge industry in some trouble because

of firms cutting back on Research and Development, India now is interestingly poised as it seeks to take over some of the knowledge business that it has a comparative advantage in.

History of IPRs

The World Intellectual Property Organization (WIPO) was established in 1967 in a convention in Stockholm and became functional in 1970. It has been a specialized agency of the UN since 1974 and is headquartered in Geneva. The concept of intellectual property, however, has existed since the 18th century. There are references to protection of intellectual property in literature dated to that period. However, the issue of IPRs has become more topical only in recent years. In the period immediately following World War II, three organizations were set up to monitor international trade and payments. The first two organizations were the International Monetary Fund (IMF) and the International Bank for Reconstruction and Development (IBRD), popularly known as the World Bank. The third organization that was supposed to be set was something known as the International Trade Organization (ITO). ITO was never actually set up. In its place the General Agreement on Tariffs and Trade (GATT) came into effect.⁴ The Uruguay Round (1986-94) negotiations led to the inclusion of trade-related investment measures (TRIMS), trade-related intellectual property rights (TRIPS) and services.

Intellectual Property Rights as per the TRIPs agreement covers seven forms of intellectual property can be categorized into the following categories:

- Patents – Thomas Jefferson wrote the original statute in early 19th century defining what may be patented. “Any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof” may be patented. A patent protects the technology used to build the machine or process but not the final product built using the innovation. A patent essentially gives an inventor the right to exclude others from using the innovation for the period of the patent which is usually

⁴ GATT was only a legal agreement and not a proper organization. GATT was supposed to liberalize world trade by eliminating both tariffs and non tariff barriers. In fact, GATT has been quite successful in reducing tariffs all around the globe. But because non tariff barriers are much more difficult to pin down, GATT’s success in eliminating non tariff barriers has been much more limited. However, once tariffs began to come down, the focus shifted to eliminating non tariff barriers.

20 years, but may vary across countries. In return the inventor has to disclose information regarding his invention to enable further research and development.

- Copyrights and related rights – A copyright is a legal tool giving a creator exclusive rights to his creation for a limited period of time. A copyright would usually be associated with creative works such as books, music, movies, magazines, paintings, sculptures, etc. This excludes others from copying or reproducing the creation without prior permission. This would apply to works of art, software, literature and the like.
- Trademarks – A trademark is a symbol or design used by an entity to distinguish his or her product or services from the others.
- Geographic Indications – A geographical indication is a name or sign used to indicate the origin of the product in terms of design or quality. This may be done to attribute certain qualities with that product.
- Trade Secrets - A trade secret is information that has commercial value. The person in control of the trade secret takes steps to protect these trade secrets. An example of this would be employment agreements which forbid employees from disclosing this information. However, unlike the other IPRs, there is no specified time frame for trade secrets.
- Layout-Designs (Topographies) of Integrated Circuits (Semiconductor Mask Works) – Under this category importing, selling or using for commercial purposes a protected layout-design, or any other product wherein the layout-design is incorporated required payment of royalty to the owner of the rights.
- Industrial Designs – Any new or original industrial designs are protected under this category for a specified length of time.

The TRIPS agreement stipulates standardization of IPRs across countries to ensure minimum standards are maintained. Also this provided a forum for settlement of disputes among countries. The TRIPs agreement also had provisions on transitional arrangements. All

disputes would go through the WTO's standard dispute resolution mechanism. The two essential principles behind both GATT and WTO are essentially simple. The first of these is known as national treatment, wherein foreign nationals must be treated in exactly the same way that domestic nationals are treated. No discrimination is permissible. The other is known as the most-favored nation (MFN) principle, which means that all WTO members must be treated in exactly the same way. No discrimination between members is permitted. The TRIPS agreement follows these two principles.

As in the case of any change, the change in the IPR regime in various countries was to be affected in a phased manner. While developing countries were to conform to the stipulations of the TRIPS agreement by 2005, least developed countries had till 2016 for the same. Traditionally, research on intellectual property divides the world into two groups of countries, North and South. The North essentially signifies the developed economies and the South signifies the lesser developed countries. The standard assumptions are that the North is the source of all technology and innovation and the South can only acquire technology from the North either via technology transfer or through imitation. There has been an increasing demand for better intellectual property rights by the North. The reason behind this would be to increase future royalty incomes and protect their exports from competition.⁵

Is there an alternative to IPRs? It has been established that a good IPR regime is needed to enhance the welfare of the innovator. There are many alternatives to patent regimes that have been suggested in the literature over the years. One method is an award system wherein the firm which applies for a patent is given an award and the innovation falls into public domain. The award may comprise a sum of money or a token of appreciation. The award system ensures that the innovation is made public and therefore does not allow the formation of a monopoly. This system is difficult to implement as the decision to give the award would have to be made by the government. This would involve a large cost in terms of time and resources for the government. Another problem with the award system is that the award would be fixed by the government. Thus the expected returns for the inventor may not be enough to justify the initial investment toward the innovation. Over the years, various countries have followed different regimes to suit the prevailing economic political conditions. There have been

⁵ Also better IPR regimes would be required to reduce the incidence of grey imports, reverse engineering and piracy. This is required to ensure returns to their investment in research and development to develop the technology or innovation.

instances where the award system has been sought to be implemented as against an IPR regime. The following section discusses in brief the IPR regimes across various parts of the world.

IPR regimes across countries

In the Indian context, a large portion of the initial IPR regime in independent India was due to British legacy. The concept of patents has existed since 1856. The Indian Patent Act of 1856 was based on the *British Patent Law* of 1852. Herein certain privileges were granted to inventors for a period of 14 years. The Indian patent law has undergone many amendments since then. Recently, amendments were made in 1999, 2002 and 2005. The *Patents (Amendment) Act* 2005 has been effective since January 2005 and is compatible with the Trade-Related Aspects of Intellectual Property (TRIPS) Agreement under WTO. The *Copyright Act, 1957*, which was essentially based on the *Copyright Act* of the United Kingdom 1956, has been effective since January 1958. This act has undergone various amendments since then in keeping with the times. The copyright regime in India today is compliant with most relevant conventions and treaties. India is a member of the Berne Convention of 1886 (as modified at Paris in 1971), the Universal Copyright Convention of 1951 and the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement of 1995. Though India is not a member of the Rome Convention of 1961, the Copyright Act, 1957 is fully compliant with the Rome Convention provisions.⁶ The other relevant statutes on intellectual property are *Trade and Merchandise Marks Act* of 1958, the *Designs Act* of 1911, the *Geographical Indications of Goods (Registration and Protection) Act(1999)*, *Design Act* and *Trade and Merchandise Marks Act*. The last two mentioned here were passed to incorporate protection for geographical indications and layout design of integrated circuits as stipulated by TRIPS.

The Chinese IPR regime has gone through many ups and downs over the years. The Chinese adopted similar instruments and institutions to the USSR in the initial years. The government in the 1950s initiated the Provisional Regulations on the Protection of Inventions Rights and Patent Rights and the Provisional Regulations on Trademark Registration to protect

⁶ India, however, has not yet become a member of the 'WIPO Copyrights Treaty (WCT)' and the 'WIPO Performances and Phonograms Treaty (WPPT)', commonly known as the internet treaties. These treaties come under WIPO and work toward protection of copyrights against infringement via Internet and digital methods.

inventions and trademarks respectively. Under these regulations, in case inventions were made during the course of employment, the patent to the invention was owned by the government and the inventor was awarded a certificate. However, in case the invention was made outside of employment, then the inventor owned the patent. Under copyrights, authors were entitled to some payments and any user alteration of their work would require prior permission. In the 1960s, with the advent of the Cultural Revolution, all inventions and technology were taken over by the state. Trademarks too were used only for the purpose of quality control. Individuals had no rights over intellectual property whatsoever and all forms of payments or credit for innovation were done away with. The 1980s saw the end of the Cultural Revolution and thus reinstatement of the patent and trademark laws. In 1984 China got its first Patent Law. However, many sectors like the chemical and pharmaceutical sectors were not covered by this law. Recent changes have brought these sectors also under the same patent law. Also, individuals are now allowed to hold patents whether the invention was done when under employment or outside. The Trademark Law and the Copyright law also came into effect by 1990.⁷

The United States of America has a history of promoting and protecting innovation. The concept of intellectual property rights exists in their constitution ever since its inception. Every state in the USA had put into effect copyright and patent laws by the end of the 18th century. In the initial years, the USA regime was tailored to give a boost to research and inventions in USA as against foreign patents. This was done by maintaining a huge difference between the fee for intellectual property registrations for US citizens and residents and foreigners. The registration process for various IPRs was made equitable for US citizens and residents and others as late as 1989. With the advent of digital recording and transmission, copying of software, music, films, etc is rampant over the internet and the entertainment and software industry suffers heavy losses every year due to this. In 1998, the USA adopted the *Digital Millennium Copyright Act (DMCA)* to address the increasing problem of piracy. The legislation implements both the WIPO Copyright Treaty and the WIPO Performances and Phonograms Treaty. The DMCA also addresses a number of other significant copyright-related issues.

⁷ The enforcement of these laws in China, however, has been an issue that has come to the fore in various conventions over the years. Many instances of reverse engineering and imitation have been brought to the fore over the years. In 2001, the copyright law and trademark law were revised to conform to the rules set down by the WTO. China now has an IPR regime compliant to the TRIPS norms.

In Europe, the IPR regimes differed across countries. While the United Kingdom had legislation for intellectual property rights way back in the 18th century, countries like Holland opposed the concept of patents till the early 20th century. In Switzerland in the 1880s, there was opposition to a patent law in spite of the fact that the Swiss were enthusiastic patentees in other countries themselves. The underlying argument was that due to the prevalence of low tariffs international competitors would take out patents in Switzerland and then drive out Swiss competition under their protection. With the advent of the Paris Convention and the Berne Convention, most countries adopted patent and copyright laws. There was however, a lot of flexibility that the countries had in terms of the nature of their IPR regimes.⁸ In 2001, another EU directive sought to implement the WIPO copyright treaty and implement legal protection for Digital Rights Management techniques. The implementation of this directive is still underway in some countries. With TRIPS, one can say that there is some sort of uniformity in the IPR regimes across the world, at least in principle.

Innovation across Countries

To understand the effect of IPR regimes on innovation, it is important to establish the trends in innovation with respect to other economic indicators. This would help us understand what factors influence the innovation climate in a country. To this end, data regarding the total number of patent applications was collected across countries. An initial analysis of the data shows that USA has been the country with the highest number of patent applications over the last 100 years. The other countries which have been leaders over the last 100 years in innovation are France, Germany, and United Kingdom. Japan and the erstwhile Soviet Union were also among the leaders in innovation for a large part of the 20th century. It may be noted here that through history the leaders in innovation have been the developed economies of the time. Coincidentally, all these countries are in the northern hemisphere. This is the reason behind the north-south model in the literature as mentioned in section 2 of the paper.

The data compiled had the total number of patent applications across 133 countries over a period of 123 years. However, due to a large number of missing observations, and for the purpose of this study, we have considered the data for the 133 countries for the period 1980

⁸ In 1993, the European Union Copyright directive standardized the duration of copyright protection to 70 years across Europe. This was a major step toward standardization of the IPR regimes across the countries.

till 2006. The top 20 countries in terms of the patents filed in the year 2006 are given in the table below

Table 1: The top 20 countries in innovation according to patents filed in 2006

Country	Share in 1980	1990	2000	2006
United States of America	19.90	33.49	35.60	38.74
Japan	14.84	22.01	28.45	31.53
Russian Federation	0.00	0.00	3.98	5.19
Germany	6.50	7.07	3.32	4.69
Canada	7.37	5.26	2.74	3.34
Mexico	0.82	0.60	1.25	2.15
Australia	2.71	4.64	3.06	2.10
United Kingdom	7.66	3.48	1.87	1.76
Singapore	0.18	0.00	1.15	1.65
Hong Kong	0.00	0.41	0.62	1.15
Ukraine	0.00	0.00	1.30	0.83
New Zealand	0.41	1.29	1.04	0.76
Poland	2.48	1.35	0.56	0.60
Israel	0.55	0.61	0.46	0.58
Brazil	1.24	1.24	0.00	0.55
Netherlands	1.07	0.56	0.64	0.53
Spain	2.97	1.30	0.50	0.48
Austria	1.92	0.81	0.28	0.35
Sweden	1.61	1.01	0.48	0.33
Czech Republic	0.00	0.00	0.36	0.30

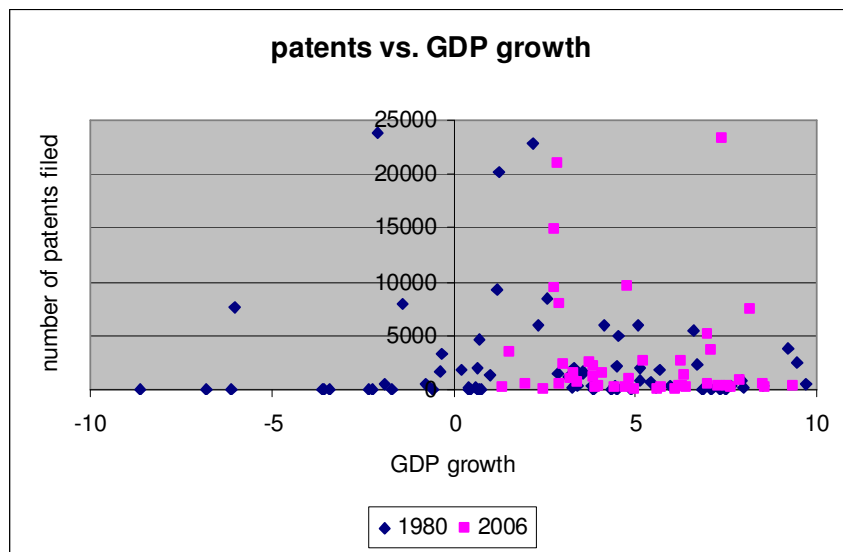
It may be noted that these countries together account for nearly 97% of the patents filed all over the world in the year 2006. The same set of countries accounted for 73% of the patents filed in the year 1980. The most striking feature in this table is the apparent concentration of innovation in the USA and Japan. The other noticeable feature in this table is the contribution of the emerging economies such as Mexico, Brazil and Spain. While innovation in Mexico seems to be on the rise, in the case of Brazil and Mexico their share in the world total seems to be diminishing. One of the factors that would influence the number of patents in a country would be the IPR regime in that country. Other factors would be the GDP of the country, the level of openness of the economy, and the expenditure by the country on research and development.

It has been established in the literature on IPRs that the IPR regime across various countries has been tailored to suit the current needs of their economy as per the stage of development. In this section, we attempt to very intuitively see if the data collected corroborates the dependence on the factors stated in theory. To see whether there is a functional relationship between two variables; one may plot a scatter plot for the two variables. In a scatter plot, the

value of the explanatory variable is plotted on the x-axis and the value of the dependent variable is plotted on the y-axis. In case there is a linear relationship between the two variables, the scatter plot would form a cluster around a straight line and the slope of the line would give us the coefficient of the explanatory variable in the linear form. In the following part of this section, we draw scatter plots of the data collected to understand whether these relationships are present.

a). Patents vs. GDP growth: Intuitively speaking, if an economy is growing one would see that there is innovation in the economy. The underlying idea is that in case the economy is growing, they would innovate to sustain the growth and be competitive in the global economy. By plotting the number of patents filed in the 133 countries against their respective growth rates for the years 1980 and 2006 we get the following graph.

Number of patents filed vs. growth rate of GDP for 1980 and 2006

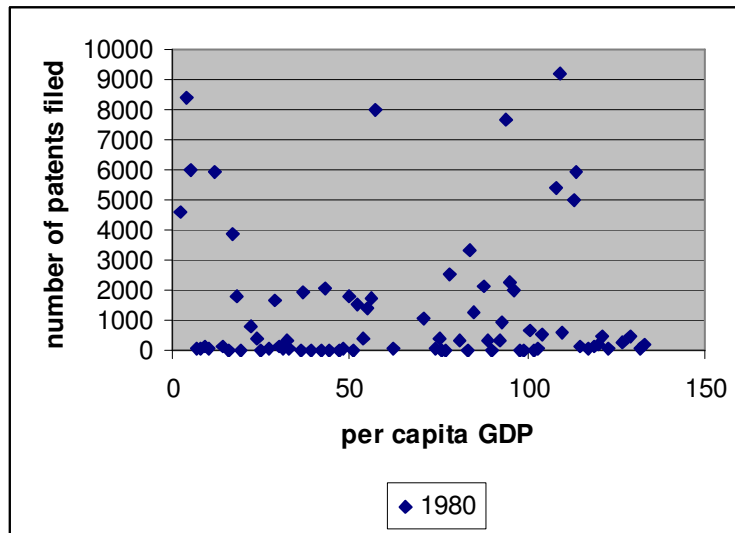


From the above graph, there appears to be no clear linear relationship between the number of patents filed in a country and the growth rate of the GDP of that country. Thus, apparently from the data, the growth rate of the economy does not lead to higher innovation.

b). Patents vs. per capita GDP: The per capita GDP of a country indicates the average income of the people of that country. Thus, if a country has higher per capita GDP it indicates that the people in that country are better off. Intuitively, if the individuals in a country are better off, they would take greater interest in research and development and thus in innovation. The

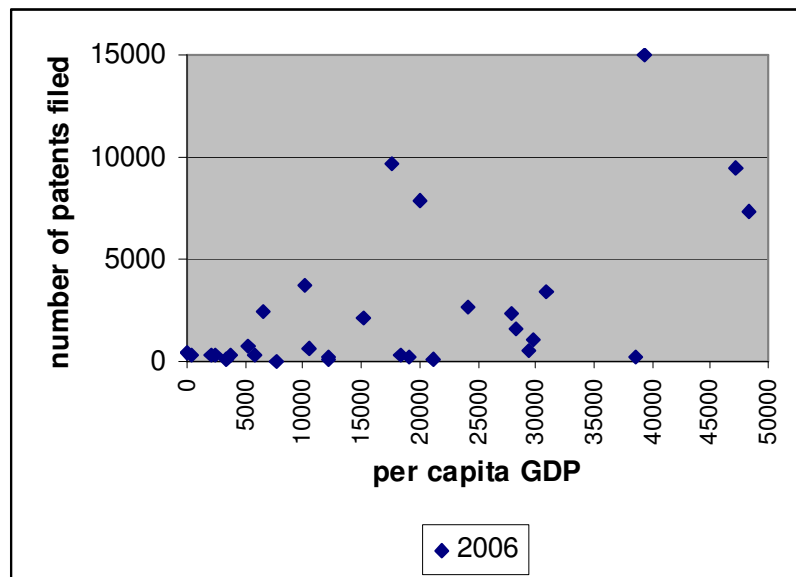
following graphs give the scatter plot of the number of patents filed and the per capita GDP across countries for the years 1980 and 2006 respectively.

Total number of patent applications vs. per capita GDP in the year 1980



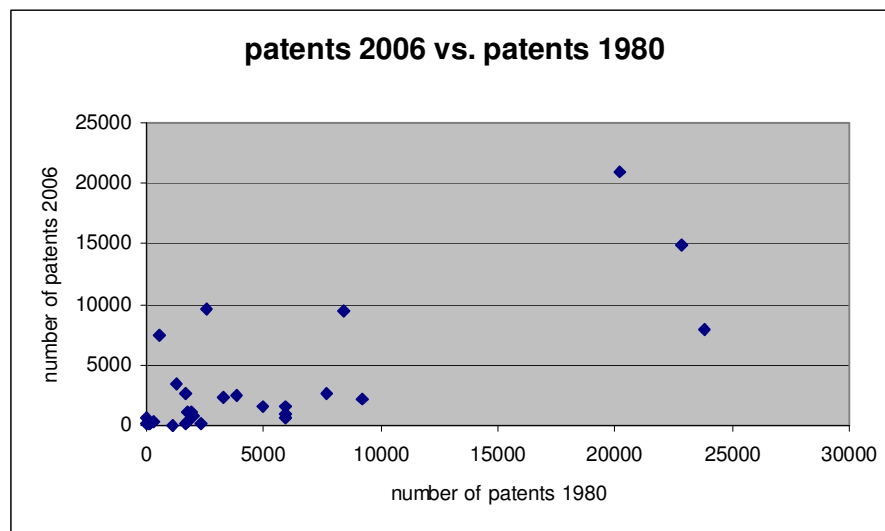
From the above graph for the year 1980 there appears no significant relationship between the per capita GDP and the number of patents filed in a country. However from the corresponding graph for the year 2006, it appears that there is a linear relationship between the two variables.

Total number of patent applications vs. per capita GDP in the year 2006



c). Legacy: The underlying argument here is that in case the country has a history of innovating, whatever the underlying factors may be, it would innovate more than another country that has low innovations in its past. This could be due to the existence of educational and research infrastructure to enable greater innovation. Another factor that would be captured here would be the contribution of the education system toward encouraging innovative thinking. The effect of the IPR regime prevalent in the country would also be captured in this relationship. Thus, if a country has an IPR regime conducive to innovation, then one would find higher levels of innovation in that country over time. To see whether this relationship holds, we plot the number of patent applications in the year 2006 against the number of patent applications in the year 1980.

Total number of patent applications in 1980 vs. total number of patent applications in 2006



The graph here indicates that there is a relationship between the variables plotted against the x and y axis. Fitting a trend line to the above data gives a good fit further showing that our hypothesis holds true. It should be mentioned here that this analysis is a descriptive analysis of the data. To be able to establish these relationships a detailed econometric analysis of the data would be required.

Innovation and IT usage

The use of IT in manufacturing in the United States of America is a story that clearly suggests the positive contribution that Information Technology has made. Overall growth and productivity are

positively impacted through the use of IT. Is this relevant for India? India's fast paced growth in the services sector has been predicated on a software sector that has registered remarkable growth. The penetration of IT in India is abysmally low and most of its IT and ITES prowess is meant for the foreign market. There is little presence in the domestic market. IT use in manufacturing has been increasing over time but is yet to penetrate uniformly throughout the country. Large units are more computerized compared to the smaller units. IT use is often quite different across different industries and different regions. Also the average use of IT is large in certain industries like pharma compared to all others. What is remarkable is that it is units in the Northern and Western parts of India that are more IT intensive than those in the East and the South.

IT is not a way of doing business, as yet, in India. The irony is that management, clerical and marketing employees have greater access to computers and internet than skilled workers. However, IT often acts as a substitute for lack of resources and direct connectivity to markets. Not surprisingly, smaller cities like Lucknow have taken to IT. Studying IT use in Indian industry throws up some fascinating aspects that are a window to understanding the manufacturing sector in India and the implications that industrial and infrastructure policy have on Indian Industry. IT use affects positively the performance indicators of the factories that do invest in IT. Greater IT use is associated with better performance and factories that use IT earn higher profits, employ more people and offer greater remuneration for lower hours of work. Therefore if some firms do not invest in IT intensively, it must be because of constraints that prevent them from adopting the best available technology. The major barriers to IT use are opposition from labour unions, irregular power supply and lack of skilled personnel, in that order.

IT use impacts organisation structure and how firms that use IT could use technology to streamline activity and increase productivity. While IT helps individual firms in an overall sense, it is possible to bring about organizational changes that completely recast the way operations are handled within the company. Not only does it improve productivity, it also changes the organization of labour and skills. Penetration across units results in networking advantages. The benefits of using IT show up only after there is a critical mass of firms and units that get computerised. Therefore some firms wait for this critical mass before they spend on IT infrastructure. It is here that the government can play a very positive role in overcoming this sluggishness in the adoption of IT. If most government dealings are through the use of IT, businesses get an immediate benefit of using IT themselves and are encouraged to invest regardless of whether others are doing it or not.

While India has a broad based legislation, in the case of Intellectual Property Protection, it is not sufficient to make laws; they have to be enforced. At the moment, prices are high because actual purchase volumes are low and piracy rates are high because costs are high. With strict enforcement of

piracy laws, software sales will increase leading to a reduction in their price. On regulatory aspects, Government policies need to be technologically neutral. Economic development happens where there is competition and choice. The IT sector is no exception and therefore state intervention should not distort this choice or impose conditions on the part of consumers. In the context of use of open source software and government policy initiatives in this regard, it is imperative that in areas of high technology, state intervention would certainly curtail innovations. IT is an effective tool in all development policy to eradicate poverty and unemployment and take India forward.

In a study on IT use in the Indian manufacturing sector,⁹ the India Development Foundation discusses these issues and comes up with some fascinating results. Maharashtra and Delhi do well, but Andhra Pradesh and Tamil Nadu fare rather poorly in IT penetration in industry. Cities in the North do better compared to towns in the South and the west. This study first establishes that in Indian manufacturing units, firms that used IT in their factories register higher profitability and greater worker productivity. The counter intuitive finding is that for India, firms that are IT using companies employ more people. It is also established that the total number of workers, both skilled and unskilled, is higher for IT using firms. However what must also be underlined is that the ratio of skilled to unskilled labour is higher with IT use. Most companies reported that their labour unions were sceptical about the use of IT since it is thought to be labour substituting. However, the study demonstrates that IT use actually increases employment. Labour unions need to be apprised of these findings and the political parties affiliated with the unions must play a positive role in getting this idea across.

What is also critical to note is the fact that the knowledge and the software sectors would indeed generate incremental growth in employment that understandably has not been seen in the past. An earlier IDF study on trade in services estimates that the output multiplier for IT and ITES is 4.2. With a compounded annual growth rate of 28 per cent during the last 5 years, the IT-ITES industry's contribution to India's GDP is expected to rise to 7 per cent by 2007-08 against that of 4.8 per cent in 2005-06. It would be important for the IT sector and Indian industry at large to ensure that these benefits are seen as tangible by the larger constituency. The need for better infrastructure is particularly important to enable wider IT use.

Many studies confirm that education and economic growth are mutually inter-dependent. A prosperous economy provides countries with much needed resources to strengthen and expand existing school facilities, and a solid education system helps to generate the capacities and talents to stimulate and sustain economic growth. Development organizations as well as national policymakers are increasingly concerned with how job skills—literacy, numeracy, basic knowledge, and ICT skills

⁹ See <http://www.idfresearch.org/publication.asp>

—translate into employment and serve as an enabling tool for improvement in other sectors. Simply increasing the level of schooling of the general population does not necessarily lead to a booming economy. Thus, future workforce development programs need to focus on *what* is being taught in schools and other institutions and *how* these skills connect to other sectors such as the economy, health, and the environment. Above all, creativity, innovation, and ingenuity must be fostered and rewarded.

By far the most urgent need of industry in general and IT use in industry in particular is the need for skilled manpower that develops a clear understanding and mindset that values Intellectual property. The absence of such an environment would be the greatest constraint one would imagine holding back IT penetration in Indian industry. Skilling requires greater access to education in rural areas where we find IT usage also poor. Through IT education and IT reach, in addition to capacity building on Intellectual property rights and their protection, industry would certainly manage to make industrial growth inclusive. Therefore, in addition to a re look at labour laws, providing better infrastructure and more reliable power, what would be required is a large scale skilling exercise that enables a large labour force enter new markets.

Innovation and IPRs

Innovation is based on making the user experience better or more pleasurable. These innovations may be to enhance the appeal of the product or service according to emotional, cultural or social sensibilities or convenience of use. There are many examples of innovations in India which have catered to Indian market conditions and sensibilities. Below is a list of some successful innovation strategies in India in recent times.

- In the 1980's, CavinKare revolutionized the sale of shampoo by launching 8 ml sachets of shampoo. While conventionally economy packs were larger packages of the same product, CavinKare launched single use packages of these products. By doing this they targeted the customer who does not have enough disposable income to spend on large packs of shampoo. This customer would earlier have opted for other cheaper substitutes, but with the sachet option would become a customer.
- Another similar innovation is pre-paid mobile services. While mobile telephony was becoming more and more affordable, the post-paid services involved monthly fee apart from usage charges. The innovation of pre-paid services involved a small

upfront amount as connection charges and then the user had the freedom to pay for the usage as and when it occurs and also had the flexibility to decide how much they would pay. Thus brought in a large number of mobile users who operate on limited budgets and thus earlier could not afford the monthly usage charges.

- A very visible innovation has been in the field of retail. While the concept of discount stores has existed in various countries, in India the concept of organized retail was limited to luxury products and services with a focus on ambience. Pantaloons Retail (India) Ltd. launched the Big Bazaar stores changing this conventional view of organized retail. The target segment for the store was the middle class and the focus was to provide a value proposition along with the convenience of ‘everything under one roof’ to the customer instead of focusing too much on ambience and experience.
- Possibly the most talked about innovation in recent times is the new small car by the Tatas, the Nano. Aimed at tapping the middle class which currently buys two wheelers. The Nano was designed from scratch keeping in mind Indian conditions and sensibilities along with the most important factor in this segment, the price-value proposition. The Tatas have filed for 34 patents associated with the design of the Nano. Perhaps the most innovative aspect of the Nano is its modular design. The Nano is constructed of components that can be built and shipped separately to be assembled in a variety of locations. In effect, the Nano will be sold in kits that are distributed, assembled, and serviced by local entrepreneurs.

As may be seen from the various examples cited above, Indian firms have been innovating on a large scale in the interest of their own businesses. Most of these innovations essentially been directed toward making products and services cheaper and more accessible to a greater portion of our population. Undoubtedly, any innovation which involves design of products requires large investments in terms of time and resources. Therefore, these innovations are more likely to take place in large business house or in academic institutions due to the ease of availability of resources in such places.

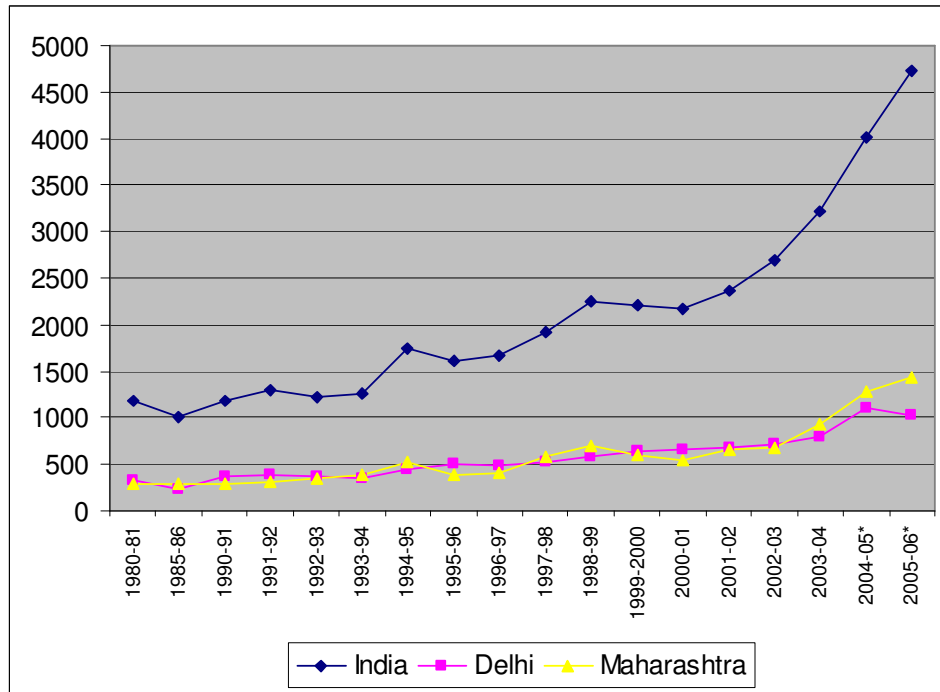
This brings us to the question: what are the factors that enable innovation? In case we can understand these factors, it may be possible to understand how to encourage innovation. The National Knowledge Commission survey on Innovation published in 2007 is a detailed

survey on innovation in India. The key results of the survey showed that the revenue earned from innovations is increasing for large and small and medium enterprises (SMEs) alike. However, as may be expected, a greater portion of the path breaking innovations has come from the large firms. The survey also found that innovation has a significant impact on competitiveness, profitability, and helped reduce costs and increase market share. The survey also strongly suggests that innovation has become critical to growth and competitiveness since economic liberalization.

Broadly speaking, the NKC commission survey shows that innovation is essential to survive competition. This makes innovation even more important in an open economy than in a closed one due to the increased levels of competition. The finding that large firms have a greater portion of the pathbreaking innovations suggests that ability to invest greater amounts in research and development translates into higher levels of investment. One may try to extend this argument to geographic locations of innovations too. As mentioned earlier, the literature on innovation and IPRs is based on the traditional setup with the world being divided into two groups, north and south.¹⁰ In the case of India, innovation has grown significantly in the recent years as shown in the graph below. The following graph gives the number of patent applications for the last 25 years. The number of patents filed in a year has been growing year on year. However, there is a sharp increase in the rate of growth of number of patents since 2000-01. Also this rate of growth of the patent applications (the slope of the curve) has been increasing every year. A similar trend is seen in the number of patents filed in Maharashtra. The trend in Delhi differs slightly with a decrease in the number of patents in the year 2005-06. It is important to note here that the patents filed in Delhi and Maharashtra together account for more than 50% of the patents filed in India.

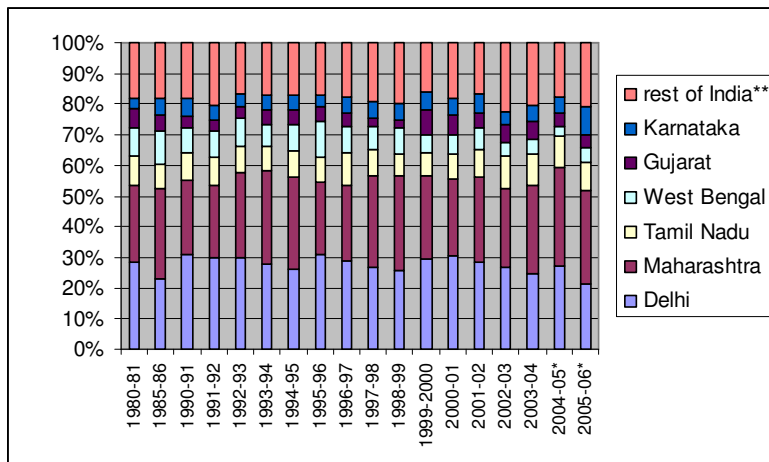
¹⁰ This comes from the fact that historically the innovator countries were the industrial economies in the north and the south comprised developing or under-developed countries. There is a clear relationship between the GDP of a country and its innovation. That is simple to explain as a result of higher capacity to invest in research.

Number of Applications for Patents Filed (1980-81 to 2005-06)

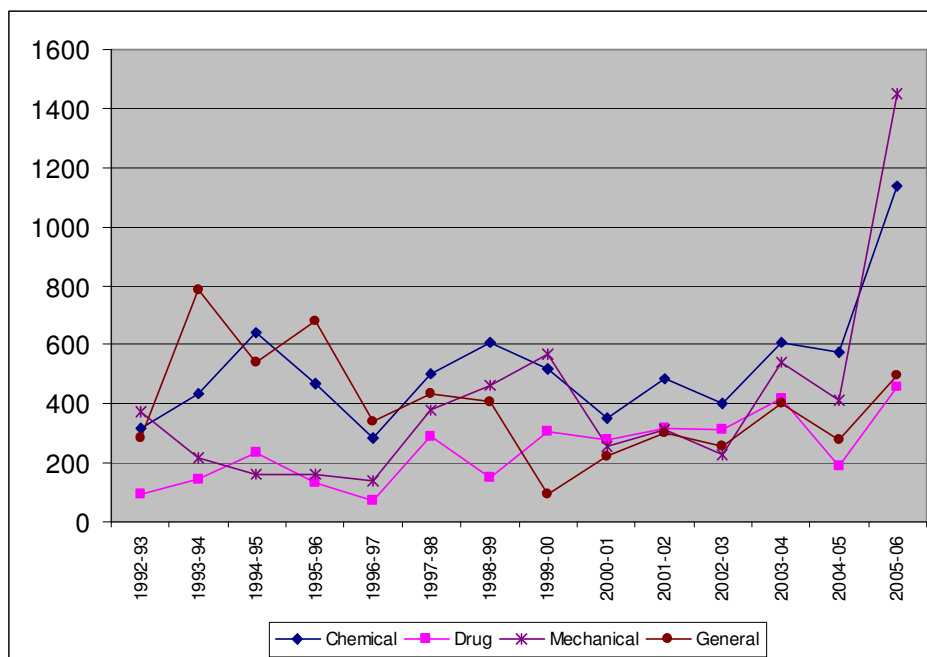


It is interesting to note that there appears to be no significant change in the trends in innovation across the country. The emergence of cities like Gurgaon, Bangalore and Hyderabad in the field of information technology has not led to an increase in the number of patents filed in these cities relative to other cities. The following graph gives the proportion of the trends in the proportion of patents filed in the major states.

Graph 2: Applications for patents filed in major states as a proportion of total number of patents filed in India



Graph 3: Number of Applications for Patents Filed under various categories (1992-93 to 2005-06)



Clearly from Graph 2, the contribution of the major states in the total number of patents filed in India remains largely unchanged. One possible reason for this is that while the research and development may be happening in different parts of the country, the patent application is filed by the administration of the firm, which is invariably based in either Delhi or Mumbai. An analysis of the number of patent applications by field of applications shows that Chemicals and Drugs categories account for more than a third of the total patents filed in India since liberalization. Of the eight categories under which patents are reported by the Controller General of Patents of India, the number of patents filed under the largest four categories over the past 14 years has been shown in the graph. Though there appears no clear trends in any one category, there is clearly a steep rise in the number of patent applications in the Mechanical and Chemical categories in the year 2005-06.

Conclusion - IPRs and Diffusion of Technology

It has been established that IPRs are crucial to ensure that the innovator benefits from his innovation. IPRs give a comparative advantage to the inventor and gives rise to the possibility of a monopoly of the innovator in the sector. The effect of IPRs on the diffusion of technology remains to be studied. It has been shown in research that few innovations have been adopted instantaneously. One possible reason for this is the uncertainty of market demand for the innovation which may not be enough to merit the cost of adopting that

technology. Also, firms may expect the cost of adoption of the technology to decrease with time.

In theory, the process of adoption of a new technology is dependent on the cost of the innovation process and the expected profit from adoption of the new technology. It is assumed that the cost of adoption is a sunk cost would decrease over time at a decreasing rate. It is also assumed that the cost of adopting the technology at the time that the innovation is made is very high and thus the new technology cannot be acquired in a non-proprietary manner at the time of the innovation. We can thus construct an economy, for an example, which has two firms, both profit maximizing to see their possible responses to the new technology. In the case that imitation is very difficult, the firm that adopts the technology first benefits. The cost of early adoption is offset by the higher returns from the new technology. Thus, the second firm has no incentive to adopt. And it is observed that in this setup, there is a very large lag between the adoption of the technology by the two firms. In the case that it is easy to imitate, there is little incentive for either firm to adopt. Thus adoption of the technology is delayed and in the extreme theoretical example, the technology is never adopted. Thus, the IPR regime plays an important role in the decision of the other firms whether to adopt the new technology. This in turn decides whether the innovator has incentive to undertake the cost of innovation.

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