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Intellectual Property Rights, Technology and Economic Development: Experiences of Asian Countries

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Executive Summary

There has been a lot of controversy on the role of intellectual property protection (IPP) regime especially the patent system in fostering innovation, technology and industrial development of a country. IPP is expected to encourage innovation by rewarding the inventor. Strong IPP regime may also inhibit diffusion of knowledge and even technology development in the countries that are technology followers. Countries have fine-tuned their IPP regimes as per their developmental requirements. Against this backdrop, the on-going attempt to harmonize and strengthen the IPP regimes worldwide, as a part of the TRIPs Agreement, is widely seen to be adversely affecting the technological activity in developing countries by choking the knowledge spillovers besides implications for the access and affordability to lifesaving drugs by the poor. This paper critically reviews the literature on the role of IPP regime with a particular reference to the Asian countries to draw policy options for consideration by the Commission.

Patterns and Trends in Global Innovative Activity

The global technology generation or innovative activity is highly concentrated in a handful of technologically advanced developed countries with just top ten countries accounting for as much as 84 per cent of global R&D activity, 94 per cent of US, and 91 per cent of global cross-border technological payments. Prominent among the emerging countries that are beginning to obtain US patents in increasing numbers are Taiwan and South Korea. Therefore these countries together with Japan make important cases for analyzing the role played by IPRs in their technology development.

IPR Regime and Economic Development: The Evidence

IPR regime is likely to affect growth indirectly by encouraging the innovative activity that in turn is the source of total factor productivity improvements. The IPR regime could also affect the inflows of FDI, technology transfers and trade that might impinge on growth. The relationship between IPR and development could be subject to the causality problem as

developed countries are likely to have stronger IPRs regime than the poorer ones. Studies have found the relationship between IPR protection and level of development to be non-linear suggesting that patent protection tends to decline in strength as economies move beyond the poorest stage into a middle-income stage in which they have greater abilities to imitate new technologies. Quantitative studies have also shown that universally imposed minimum standards for patent protection are not likely to contribute to increased growth in countries below a certain threshold in terms of level of development.

<u>IPRs as Determinants of Innovative Activity</u>

The existing empirical literature suggests that the effectiveness of patent protection varies from industry to industry and inventive activity is sensitive to protection only in a few industries such as chemical and pharmaceutical industries. A study of the impact of strengthening of pharmaceutical patent protection in Italy since 1978 showed little or no impact on R&D expenditures or on new inventions. Furthermore, R&D activity is found to be significantly determined by absorption of spillovers of others' R&D activity particularly in the case of chemicals and electrical and electronics. The importance of foreign R&D spillovers as a determinant of R&D activity could be even more critical in developing countries where much of the R&D activity is of an adaptive nature. A number of studies have empirically demonstrated the ability of rather weaker IPRs in stimulating domestic innovative activity in developing countries. Theerefore, the evidence on the role of IPRs as a determinant of innovative activity is quite weak. In fact stronger IPRs may actually affect the innovative activity adversely by chocking the absorption of knowledge spillovers that are important determinants of innovative activity.

<u>IPRs, FDI Inflows, Technology Licensing and Trade</u>

Stronger protection increases the revenue productivity of a firm's intellectual property and should help exporters by making counterfeiting more difficult as has been corroborated empirically by studies. However, the effect of IPR strength on FDI and licensing is not that straight forward. By reducing the transaction cost of transfer of knowledge by MNEs to foreign countries, stronger protection may encourage arm's length licensing of the knowledge and reduce the need for undertaking FDI. On the other hand, it has been argued that poor IPR regime tends to adversely affect the investment climate and hence the probability of MNE investments. Empirical studies have generally shown that the strength of IPP promotes arm's length licensing but they have generally no significant effect on internalized technology transfers viz. FDI. Even the location of R&D investments abroad by MNEs was found to be not significantly affected by strength of IPP. Thus the contention that stronger norms of IPR protection will facilitate greater inflows of FDI in the country is rather weak in either theoretical or empirical terms.

IPRs and Economic and Technological Development in East Asia

The rapid growth at the rate of 5.5 per cent in per capita GDP sustained over the 1960-90 and even more impressive growth rate exports in the East Asian economies, viz. Japan; South Korea, Taiwan, Hong Kong and Singapore (first tier Asian nies), Malaysia, Thailand, and Indonesia (second tier nies) and China, generally termed as the 'East Asian Miracle', has attracted a large volume of literature. While some analysts have attempted to dismiss the East Asian achievement as a result of factor accumulation along the production function, voluminous empirical evidence is now available to corroborate that a substantial proportion of East Asian growth was contributed by growth of total factor productivity (TFP) that has averaged between 2 to 4 per cent per year over 1960-89 thus contributing over a third of the growth of output in these countries. Furthermore, evidence is now available to confirm that the assimilation of foreign technology was a 'critical component of the Asian Miracle'. There seems to be a general consensus that the East Asian success owes a lot, in general, to their ability to imitate, absorb, assimilate, replicate or 'duplicative imitation' of foreign inventions. The existing evidence on the role of IPRs regime in promoting growth is largely anecdotal. Although the literature is not explicit in acknowledging its role, the soft IPP regime adopted by these countries in the period of duplicative imitation or reverse engineering has played and important role in facilitating the firm level technological learning as becomes clear from the case studies of Japan, Korea and Taiwan.

Japan

Japan is known to have greatly benefited from intellectual property generated in other developed countries in the early stages its development. in Japan the patent protection has been designed with an ultimate objective of contributing to the industrial development and not as an end by itself and contains several features that have helped the absorption of spillovers of foreign inventive activity by domestic enterprises. For instance, food, beverage, pharmaceutical products and chemical compounds were excluded from the scope of patent protection until 1975 to facilitate the process innovations. Japanese IPR system provides for utility models to encourage minor adaptations or improvements over the imported machinery or equipment by domestic inventors, and protection of industrial designs that only needed to demonstrate novelty and not inventiveness. The utility models and industrial designs have allowed Japanese firms to receive protection on technologies that were 'only slightly modified from the original invention'. JPS also employs the first-to-file principle rather than the first-to-invent principle incorporated in the US law, pre-grant disclosure, compulsory license, and (until 1988) narrow claims. All these features have been designed to favour adaptations by domestic enterprises. Almost all of the utility models and industrial design have been granted to nationals. Quantitative studies have confirmed that the weaker patent system employed by Japan has facilitated absorption, transfer and diffusion of technology and contributed to the TFP growth during the period 1960-93. The scope of patent system was expanded to cover chemical and pharmaceutical products only in 1975 to provide protection to technological capability that had developed adequately by then.

South Korea

South Korea adopted the patent legislation only in 1961. However, the scope of patenting did not cover patenting of products and processes to manufacture food products, chemical substances and pharmaceuticals. The US pressure pushed Korea to strengthen its IPR regime in 1986, and extend product patent protection to new chemical and pharmaceutical products, adopt a comprehensive copyright law, and extend the patent term from 12 to 15 years. Korea has also followed an IPR regime that facilitated adaptations and imitative duplication of foreign technologies by domestic enterprises through utility models and industrial designs. That the soft IPR regime adopted initially was a part of conscious policy of the government to facilitate imitation by domestic enterprises has been documented well in the literature on Korean technological capability.

Taiwan

Taiwan has also employed a weak IPR policy to facilitate local absorption of foreign knowledge through reverse engineering on the lines of Japan and South Korea. In fact Taiwan's government seemed to openly encourage counterfeiting as strategy to develop local industries until 1980s. Taiwan allowed patents on food, beverages, micro-organisms, and new uses for products, only in 1994 under heavy US pressure. Like Japan and Korea, Taiwan also provides for utility models and design patents.

To sum up, the East Asian countries have absorbed substantial amount of technological learning under weak IPR protection regime during the early phases. Their patent regimes facilitated the absorption of innovation and knowledge generated abroad by their indigenous firms. They have also encouraged minor adaptations and incremental innovations on the foreign inventions by domestic enterprises and developed a patent culture through utility models and design patents. The other case that is viz. that of India, although following a weak patent regime since 1970, is different in one crucial respect from the East Asian countries in that it did not provide an encouragement to adaptive and minor inventive activity of domestic enterprises with utility models and design patents. In the chemicals and pharmaceuticals it did not prove a constraint as the process patents in the absence of product patents essentially served the purpose of encouraging process adaptive activity of domestic firms. As a result, the domestic chemicals and pharmaceutical industries have developed in their capabilities considerably over the past three decades. However, in the engineering industries and others, there was not a mechanism for encouraging minor adaptations of domestic firms. This difference could perhaps explain not so encouraging performance of Indian enterprises in other industries. Furthermore, IPR regime is only one of the determinants of the technological capability building. The domestic technological effort in absorbing the foreign technologies and innovations in East Asian countries has been vastly more substantive and has been sustained over a much longer period compared to India that attempted to build capabilities with softer patent regime only since the mid-1970s.

IPP Regime Change and Development of Local Capability: The Indian Case

India had inherited The Patents and Designs Act 1911 from the colonial times that provided for protection of all inventions and a patent term of 16 years. However, a few domestic chemical and pharmaceutical enterprises that tried to develop their own technology in the 1960s were prevented to work their technologies by foreign patent owners using broad and vague provisions of the Patent Act. Under pressure from domestic industry, government adopted a new Patents Act in 1970 that reduced the scope of patentability in food, chemicals and pharmaceuticals to only processes and not products. The term of process patents was reduced to 7 years in food, drugs and chemicals and to 14 years for other products. The compulsory licenses could be issued after three years. It is by now widely recognized that the 1970 Act has facilitated the development of local technological capability in chemicals and pharmaceutical industry by enabling the process development activity of domestic firms as confirmed by a number of quantitative studies. The gradual build up of technological capability of Indian enterprises is visible from a rising trend of residents in patent ownership in India, and in terms of the ability of India to raise her share in the US patents. India ranked seventh amongst all developing countries in terms of US patents obtained (ahead of Brazil, China and Mexico) and fourth in the chemicals sector and in biotechnology (in 1998).

In particular, the rapid evolution of Indian pharmaceutical industry since the mid-1970s highlights the fact that weak IPRs regime could be instrumental in building local capabilities even in a poor country such as India. In 1970 much of the country's pharmaceutical consumption was met by imports and the bulk of domestic production of formulations was dominated by MNE subsidiaries. By 1991, domestic firms accounted for 70 per cent of the bulk drugs production and 80 per cent of formulations produced in the country. With their cost effective process innovations, Indian companies have emerged as competitive suppliers in the world of a large number of generic drugs. A steady growth of India's exports of drugs and pharmaceuticals has transformed the industry from being one being highly import dependent to one that generates increasing export surplus for the country. The share of pharmaceuticals in national exports has increased from 0.55 per cent in 1970-71 to over 4 per cent by the 1999/00. India's share in world exports of pharmaceuticals has risen by 2.5 times over the 1970 to 1998 period making her the second largest exporter of pharmaceuticals after China among developing countries. Inter-firm comparisons show that domestic enterprises are more dynamic in terms of growth of investment and output, export-orientation, R&D activity, technology purchases and labour productivity compared to MNE subsidiaries. The development of process innovation capability of Indian enterprises has enabled them to introduce newer medicines within a short time lag of their introduction in the world market. The drug prices in India at a fraction of those prevailing in the developed countries are among the cheapest in the world making them affordable to poor masses. The technological capabilities of Indian companies and institutions have attracted leading MNEs to start R&D joint ventures, commission contract research and set up R&D centres.

Thus the Indian pharmaceutical industry has evolved from one dependent upon imports and some formulation activity in the late sixties to one that is able to introduce some of the most sophisticated products indigenously produced within a relatively short lag and at a fraction of the cost, and export a growing proportion of its produce. It is a remarkable achievement especially because it has been accomplished within two decades of the change of patent regime. The case study of India, besides those of the East Asian countries, further highlights the critical importance of fine-tuning and calibrating the IPR regime to the level of development of the country.

Implications of the TRIPs Regime for Developing Countries

The full implementation of the TRIPs Agreement is likely to have an important bearing on the patterns of development in developing countries. The process of acquisition of local technological capability by developing countries is likely to suffer a set back. The strengthening of IPRs regime may further limit the access of technology by developing country enterprises. A number of local enterprises in developing countries will come under pressure to close down or form alliances with larger firms, resulting in a concentration of the industry and dependence on imports may go up. Drug prices are likely to go up upon introduction of product patents with substantial welfare losses to developing countries. TRIPs will lead to a substantial increase in flow of royalties and license fees from developing countries to developed countries. It is by no means clear that strengthening of IPRs will increase inventive activity even in the developed world especially for solving the problems and diseases faced by developing countries. A strengthened IPP regime may actually slow down the pace of technological development by stifling the flow of R&D spillovers that are important inputs in research.

Issues for National and International Action to Moderate the Adverse Effect

Among the policy responses that developing country governments can take at the national level include exploiting the policy spaces available in the TRIPs Agreement fully. These include: incorporating the provisions of compulsory licensing in the IPR legislation, incorporating the research exception, early working exception or 'Bolar' provision, allowing parallel imports or grey-market imports, incorporating breeders exceptions and farmers exceptions in *sui generis* plant variety protection. In addition effective competition policy could help in dealing with possible abuse of monopoly power by patent owners. Price controls could also be useful for keeping prices of essential drugs under check. The experience of several East Asian countries suggests that petty patents and industrial design patents could be effective means of encouraging domestic enterprises to undertake minor adaptive innovations and foster a innovation based rivalry among them. Finally, developing countries should resist the attempts of developed countries to evolve TRIPs plus patent regime and ever-greening of patents.

Among the areas for international action include: building a consensus on the moratorium on further strengthening of IPR regime, granting flexibility to low income developing countries below a certain level of per capita income in implementing the provisions of TRIPs, incorporating specific provisions for transfer of technology, and adopting differential pricing strategies for developed and developing countries. Finally, one of the ways of compensating the low income countries for the adverse effects of strengthened IPR regime is to provide increased technical assistance and international R&D funding to local enterprises to help them build local capabilities. One possibility in this respect could be that developed countries donate (a substantial proportion of) technology license fees collected from low income countries to a fund created in the respective countries to assist inventive activities of domestic enterprises. Furthermore, the additional funding for research on tropical diseases recommended by CMH, for instance, could be made available exclusively to eligible and competent institutions and companies of low income countries to help moderate some of the adverse effects on the inventive activity in these countries.

1. Introduction

There has been a lot of controversy on the role of intellectual property protection (IPP) regime especially the patent system in fostering innovation, technology and industrial development of a country. IPP is expected to encourage innovation by rewarding the inventor with the grant of monopoly rights over the commercial exploitation of their inventions for a specified period. On the other hand, strong IPP regime may inhibit diffusion of knowledge and even technology development in the countries that are technology followers. The history suggests that countries have fine-tuned their IPP regimes as per their developmental requirements. Typically, countries in Asia and in other regions have had softer IPP regimes in the early stages of their development and these regimes have been strengthened as the countries developed and became significant producers of innovations and new technology themselves. In particular, some countries, such as India, have successfully developed cost-effective processes to produce life saving drugs with softer patent regimes. This enabled the national health system to provide affordable medicines to masses of poorer people.

Against this backdrop, the on-going attempt to harmonize and strengthen the IPP regimes worldwide, as a part of the TRIPs Agreement, is widely seen to be adversely affecting the technological activity in developing countries by choking the knowledge spillovers from industrialized countries to developing countries. Furthermore, the implementation of the provisions of TRIPs Agreement threatens the access and affordability of poor people to lifesaving drugs by pushing up their prices. This has been highlighted by the recent controversy regarding the availability of AIDS drugs in South Africa.

In this context, this paper critically reviews the literature on the role of IPP regime with a particular reference to the Asian countries to draw policy options for consideration by the Commission. The structure of the paper is as follows. Section 2 summarizes some global patterns and trends in technology generation and transfer as a background for the analysis of the paper. Section 3 presents a selective review of literature on relationships between IPRs, technology and development from a developing country perspective. It covers empirical literature on the role of IPP regime in influencing innovative activity, trade, FDI and licensing activity specially in developing countries. Section 4 examines the evidence on the role played by IPP regimes in technology and economic development in three East Asian countries that are known for a rapid accumulation of technological capability viz. Japan, South Korea and Taiwan. Section 5 presents a case study of a poorer country trying to build technological capability especially in pharmaceutical industry to provide affordable medicines to its poor masses with switchover from a strong to a weaker IPR regime as India did in 1970. Section 6 summarizes the implications of the on-going attempts towards standardization and harmonization of IPR regimes world-wide as a part of TRIPs Agreement on technology and economic development in developing countries, in the light of above evidence. Section 7 concludes the paper with some remarks on the policy options for national IP regimes in developing countries and for the international community.

2. Patterns and Trends in Global Innovative Activity

The global technology generation or innovative activity is known to be highly concentrated in a handful of technologically advanced developed countries. An extreme form of concentration is apparent from some indicators[1] of technological inputs (e.g. R&D expenditure) and output (e.g. US patents, earnings of technology license fees and FDI outflows) compiled in Table 1, with just ten countries accounting for the bulk of all technological activity in the world. The top ten countries account for as much as 84 per cent of global resources spent on R&D activity annually, they control 94 per cent of the technological output in terms of patents taken out in the US, and receive 91 per cent of global cross-border royalties and technology license fees. Hence, the concentration in terms of technological output is even more uneven than for technological inputs. The control over technology is reflected in their 74 per cent share of global FDI outflows.

Table 1: Major Source Countries of Technologies in the World, 2000

Country	R&D Expenditure#		US Patents taken, 1977-2000		Technology fees received#		FDI Outflows	
	$ billion PPP $	% of total	'000	% of total	$ billion	% of total	$ billion	% of total
USA	212.8	40.8	1337	57	33.8	42.2	139.3	12.1

[1] R&D expenditure is considered as the most important input indicator of the technological activity. One of the technology output indicator considered is patents obtained by inventors from different countries at the US Patents and Trademarks Office over the past 20 years period (1980-2000). Since inventors from anywhere in the world like to register a patent in the US, the world's biggest market and one providing most stringent and longest duration of patents (20 years), US patents are widely considered as surrogates of technological output especially for the purposes of international comparisons. However, it is important to keep in mind that this measure may be biased in favour of industrialized countries as much of the innovative activity in developing countries is of adaptive type and may not yield patentable inventions. Secondly, considerable administrative costs of obtaining a US patent may discourage some inventors especially those in developing countries from applying for them. Another indicator of technological activity is the actual receipts of royalties and technological fees which indicate the amount of disembodied technology exported and hence measure the importance of a nation as a supplier of technology. FDI outflows are also governed to a large extent by the strength of created assets of their enterprises such as the ownership of technology (see kumar 1998, for more details).

Japan	90.1	17.3	429.4	18	6.9	8.6	32.9	2.9
Germany	42	8.0	173.8	7	11.9	14.9	48.6	4.2
France	28.1	5.4	68.2	3	2.2	2.7	172.5	15.0
UK	22.6	4.3	67.4	3	5.8	7.2	249.8	21.7
Italy	12.1	2.3	29	1	1.6	2.0	12.1	1.1
Canada	11.4	2.2	48.4	2	1.3	1.6	44.0	3.8
Netherlands	7.5	1.4	22	1	6.2	7.7	73.1	6.4
Sweden	7.1	1.4	22.9	1	0.4	0.5	39.5	3.4
Switzerland	4.8	0.9	31	1	2.8	3.5	39.6	3.4
Subtotal 10	438.5	84.0	2229.1	94	72.9	91.0	851.3	74.0
World	522	100.0	2364.9	100	80.1	100.0	1149.9	100.0

#belongs to 1997.
Source: updated from Kumar (1998).

The relative position of countries in terms of different indicators varies. It is curious to find, for instance, that Japan accounts for 17-18 per cent of global R&D expenditure and US patents, but shares only 8.6 per cent of global technological receipts (and only 3 per cent of FDI outflows). Similarly, The Netherlands and Switzerland command a much higher proportion of global royalties than their share of R&D expenditure or patents. The discrepancy between the share in technological activity and returns in terms of royalties could be on account of different focus of the technological effort of different countries. The technological effort of Japanese corporations seems to be geared towards obtaining competitiveness of their products in domestic and export markets more than for supporting the transfer of technology and production (see Kumar 1998).

The US patent ownership data as summarized in Table 2 suggests that a few countries are beginning to obtain US patents in increasing numbers over the years. These countries include Taiwan, South Korea, Israel, Hong Kong, South Africa, Mexico, Brazil, Mainland China, Argentina, Singapore, Venezuela, India, among others, collectively account for 5.7 per cent of US patents granted during 1996-2000 compared to 1.4 per cent during the 1977-87. However, the bulk of this 5.7 per cent share is accounted for Taiwan (which accounts for 2.54

Table 2: Emerging Sources of Technology in terms of Ownership of US Patents, 1977-2000

Country	Patents granted during the period, and percentage share							
	1977-87		1987-90		1991-95		1996-2000	
	Numbers	%	Numbers	%	Numbers	%	Numbers	%
Taiwan	1039	0.15	2496	0.66	7760	1.41	19153	2.54
South Korea	236	0.03	704	0.19	4113	0.75	14045	1.86
Israel	1302	0.19	1156	0.31	1849	0.34	3550	0.47
Hong Kong	577	0.08	480	0.13	1018	0.18	1842	0.24

S. Africa	827	0.12	485	0.13	549	0.10	614	0.08
Mexico	393	0.06	174	0.05	234	0.04	374	0.05
Brazil	245	0.04	156	0.04	299	0.05	435	0.06
China P. Rep	25	0.00	171	0.05	257	0.05	464	0.06
Argentina	206	0.03	78	0.02	136	0.02	225	0.03
Singapore	40	0.01	58	0.02	224	0.04	727	0.10
Venezuela	105	0.02	88	0.02	142	0.03	156	0.02
India	111	0.02	64	0.02	144	0.03	424	0.06
East and Central Europe	4684	0.69	1207	0.32	994	0.18	1143	0.15
Subtotal	9790	1.43	7317	1.95	17719	3.21	43152	5.72
Others	1473	0.22	652	0.17	902	0.16	1731	0.23
Total	682639	100.00	375946	100.00	551902	100.00	754391	100.00

Source: based on data presented in US Patents and Trademarks Office (2001), *TAF Special Report: All Patents, All Types - January 1, 1977 - December 31, 2000,* Washington DC.

%) and South Korea (with 1.86 %), although a few countries e.g. Israel, China, Hong Kong, Singapore, India are showing an increasing trend of patenting in the US. The rise of innovative activity in Taiwan and Korea is not only reflected in increasing number of US patents owned but also in emerging technology exports which are as yet small in value terms but have grown rapidly over the past few years (see Kumar 1998, among others). Therefore these countries together with Japan make important cases for analyzing the role played by IPRs in their technology development.

3. IPR Regime and Economic Development: The Evidence

There are three ways that the strength of the IPR regime could affect economic growth indirectly: IPR regime may affect the innovative activity that in turn is the source of total factor productivity improvements and thus contributes to growth. The IPR regime could affect the inflows of FDI and technology transfers and which could impinge upon the growth. Given the international dimension of IPR regimes, there could be implications for international trade of countries, for instance, on the ability of countries to export certain goods. Finally, the changes in IPR regimes may imply some redistribution of income between the countries and between communities within the country.

There are a few studies that have addressed the issue of effect of IPR regime on growth directly. However, the observed effects could be subject to the causality problem as developed countries are likely to have stronger IPRs regime than the poorer ones. In other words, the level of development is likely to be a determinant for strength of IPR regime rather than the other way round. Ginarte and Park (1997) in a study covering 110 countries for the period 1960-90 corroborated that either the level of economic development or factors correlated with it e.g. the level of R&D activity, market environment, and international integration explain the strength of patent protection provided by countries. Furthermore, Maskus and Penubarti (1995) find the relationship between IPR protection and level of development to be non-linear suggesting that patent protection tends to decline in strength as economies move beyond the poorest stage into a middle-income stage in which they have greater abilities to imitate new technologies (for a cross-section of 99 countries)[2]. Therefore, the finding of Gould and Gruben (1996) that found a significant positive effect of the strength of patent protection (as measured by Rapp and Rozek, 1990) on growth of 79 countries (after controlling for investment rates and human capital development) particularly for open economies could be subject to causality bias. The indirect nature of the possible effect of IPRs on growth is also confirmed by Park and Ginarte (1997). Thompson and Rushing (1996) empirically observe that universally imposed minimum standards for patent protection are not likely to contribute to increased growth in developing countries. However, stronger patent protection could contribute to economic growth rates once a particular level of development has been achieved. In a further refinement to their earlier results, Thampson and Rushing (1999) find that patent protection could be positively associated with improvement in total factor productivity, and hence growth, in wealthy or developed countries.

Therefore, the IPR regime could affect economic growth and development through other variables such as innovative activity, FDI inflows and technology transfers. In what follows the evidence on the effect of IPR regime on innovative activity and FDI and technology transfer and trade is reviewed.

IPRs as Determinants of Innovative Activity

The main argument offered in favour of tighter and more stringent laws to protect intellectual property and patent rights is to provide better conditions for appropriability of innovations. However, the existing empirical literature suggests [Cohen 1995, for review] that the effectiveness of patent protection varies from industry to industry and is most effective only in chemical and pharmaceutical industries. A study by Mansfield (1986) showed that around 65 per cent of pharmaceutical and 30 per cent of chemical inventions would not have taken place but

[2] Evenson (1992) refers to the emerging countries as ‘technology draft’ countries as they focus on technology imitation, reverse engineering, and adaptation.

for patent protection. In the case of most other industries patent protection was not important. In the case of most of the engineering industries, and in particular, electrical & electronic goods, and instruments etc. patent protection was not found to be essential for the introduction of inventions. This finding was confirmed by most of the subsequent studies. For instance, a survey conducted by Levin et al. (1987) showed that product patents were found to be highly effective as means of appropriating returns only in five of 130 narrowly defined lines of businesses. These five included drugs, organic chemicals, pesticides. Shankerman (1991) in an analysis of French patent renewal data for the period 1969-72, concludes that while patents may be a significant source of returns to innovative enterprises, they are not the major ones. The main reason for limited effectiveness of patents is the ability of competitors to legally 'invent around' patents. Gallini (1992) finds that longer patent life pushes the rivals to invent around the patent inventions. Hence, optimal patent life are sufficiently short to discourage imitation. These studies also revealed that secrecy to be more effective than patents in protecting process innovations. Besides in the case of several high technology industries like aerospace and industrial machinery the complexity of the products made reverse engineering very costly and imitation difficult even without patent protection (Cohen 1995). Hall (1991) using a game theoretic model of a R&D race to analyze the effect of weakening patents has on the timing and profitability of R&D, found that in general, a second innovation (or inventing around) would occur later than it would have if the IPR policy had not been weakened. Scherer and Weisburst (1995) examined the impact of strengthening of pharmaceutical patent protection in Italy since 1978. They concluded that the regime change had little or no impact on the trend of inflation-adjusted R&D expenditures or on the introduction of new chemical entities. Hence, they expressed their scepticism on the prospect of the trend of lengthening of patent protection with TRIPs Agreement in significantly raising innovative activity especially in developing countries.

Cohen and Levinthal (1989), in their comprehensive model explaining R&D intensity, considered technological opportunity as well as appropriability as determinants and also assessed the net impact of the spillovers of R&D. Technological opportunity is a function of technological and research output in that area as well as the output of other R&D units which the patent owners wish to protect by reducing the spillover effects. On the other hand the spillover effect is one of the notable inputs to R&D. The analysis showed that the positive absorption incentive associated with spillovers seemed to increase relative to the negative appropriability incentive in the case of many industries. A more detailed analysis conducted to examine whether the spillovers on balance actually encouraged R&D in some industries found that in the case of chemicals and electrical and electronics, R&D intensities increased with spillovers. Therefore, the available evidence does not indicate that further tightening of patent laws would increase expenditures on R&D. On the contrary, strong patent laws could even hurt subsequent R&D effort by restricting spillovers.

In this context it might also be useful to recall that Schumpeter had argued for a short-term monopoly profits to encourage innovation and not for a legal institutionalized monopoly position. He had emphasized that monopoly offered no cushion to sleep on and hence the temporary state of monopoly resulting from the possession of a new technology. In the medium and long term the firm would be subject to the threat of competition and the advent of better or improved products from rivals. Hence, the need for the firm to safeguard its market position through continuous innovative activities. It was this process that prevented the original creator of a new technology from being complacent and prompted the monopolist to be constantly creative. A legal protection as provided by the patent system for a rather longer term of twenty years, therefore, erodes the threat of potential competition and hence, the need for continuous improvement (see Kumar and Siddharthan 1997).

The importance of foreign R&D spillovers as a determinant of R&D activity could be even more critical in developing countries where much of the R&D activity is of an adaptive nature. A number of studies have empirically demonstrated the ability of rather weaker intellectual property rights in stimulating domestic innovative activity in developing countries to absorb spillovers of foreign R&D. Fikkert (1993) in a study of Indian enterprises found evidence of their R&D activity absorbing considerable foreign R&D spillovers facilitated by weak Indian patent regime. He suggested that a 'weak patent regime may allow spillovers simultaneously to promote R&D and to have a positive direct effect on productivity' and concluded that the adoption of a 'stronger patent regime may not be optimal from either the short- or long-run perspectives'. Similarly, Kumar and Saqib (1996) found Indian chemical industry enterprises to be among the more innovative ones in the Indian industry. They attributed this to the weak patent laws viz. absence of product patents in India which enabled Indian enterprises to undertake alternative process development.

The importance of spillovers from innovative activity in developed countries for domestic technological effort in developing countries facilitated by softer IPRs has also been corroborated by other studies. Haksar (1995) estimated marginal products of R&D and technology imports and their spillover effects using the Reserve Bank of India data for 642 Indian firms distributed across 65 industries for 1975-1990 period. His finds both local R&D and disembodied technology imports generating positive spillovers. In the pharmaceutical industry the return to R&D were found to be particularly large and was explained in terms of highly successful adaptive R&D effort of Indian firms directed at development of alternative processes of known drugs made possible by the absence of patents on pharmaceutical products.

The above review of literature suggests that the evidence on the role of IPRs as a determinant of innovative activity is quite weak. In fact stronger IPRs may actually affect the innovative activity adversely by chocking the absorption of knowledge spillovers that are important determinants of innovative activity. Mazzoleni and Nelson (1998) is a survey of theoretical and empirical studies also conclude that 'there is reason for concern that the present movement towards stronger patent protection may hinder rather than stimulate technological and economic progress.'

IPRs, FDI Inflows, Technology Licensing and Trade

There has been a considerable controversy on the role of intellectual property protection in determining inward FDI flows and their effect on technology licensing and trade. In the OLI theory of international operations of firm (see Dunning 1993, among others), exports, FDI and arm's length technology licensing are considered as alternative modes of servicing a foreign market by firms. Stronger protection increases the value or revenue productivity of a firm's intellectual property such as technology, brand and trade names. Stronger protection should help exporters by making imitation and counterfeiting more difficult. The favourable effect of stronger IPRs in foreign countries on exports has generally been confirmed empirically by a number of studies [see Ferrantino 1993, Mascus and Penubarti 1995, and Smith 2001][3]. However the effect of IPR strength on FDI and licensing is not that straight forward. By reducing the transaction cost of transfer of knowledge by MNEs to foreign countries, stronger protection may encourage arm's length licensing of the knowledge and reduce the need for undertaking FDI (see, for instance, Mascus 1998, Yang and Mascus 2001). On the other hand, it has been argued that poor IPR regime tends to adversely affect the investment climate and hence the probability of MNE investments (Mansfield, 1994). Relatively little empirical verification of these contentions that has been made has generally shown an insignificant influence of the

[3] However, Braga (1995) finds the effect of stronger IPRs on trade flows to be ambiguous. Mascus (1998) found a significant negative effect of foreign patent protection on exports of US parents shipped to their affiliates.

extent of IPP on inward FDI (see Correa 2000a, for a review). Frischtak (1989) and Bosworth (1980) did not find a significant role of IPRs in influencing the pattern of FDI and technology transfers respectively. Ferrantino (1993) found no discernible impact of a country's adherence to IPR agreements on the arm's length exports or subsidiary sales (i.e. FDI) of US firms. But subsidiaries in countries adhering to IPRs had a greater chance of sourcing more components from the US than from the host countries. The affiliates in countries belonging to the Paris Convention are also likely to have higher payments of royalties and licence fees than others. The greater dependence on parents for sourcing components also creates greater potential for transfer pricing. Since the 'U.S. is generally a low tax regime compared to LDCs, this suggests that strong international IPRs may indirectly cause a diversion of tax revenue from LDCs to the US treasury' (p.329). Kondo (1994) found no consistently significant relationship between the strength of patent laws in terms of four alternative indicators and the levels of and changes in US FDI in a sample of 33 countries over a 15 year period. Lee and Mansfield (1996), on the other hand, in a sample of 14 countries (observations pooled over three years) find the perceived weakness of intellectual property protection adversely affecting the volume as well as the composition of US FDI inflows to the countries. However, given the small size of sample, a rather subjective measurement of intellectual property regime (based on firm's perception), and low t-values of the coefficients, the findings could be considered only as indicative unless replicated in larger samples. In a study covering 27 less developed countries for the period 1975-90, Sayoum (1996) finds that IPR factors to be significant in explaining variation in inward FDI and the effect was particularly strong for emerging countries. Mascus (1998a) found that strength of patent protection had a negative effect on the sales and assets of affiliates of US MNEs, although only the coefficient was statistically significant only in the second case. However, the impact of patent protection affiliate sales and assets was positive and significant in the case of developing countries sub-sample (out of a cross-section of 46 countries for 1989-92 period).

Kumar (2000) examined the role of an index of the strength of patent protection (as measured by Ginarte and Park 1997) in explaining the sales and value addition of affiliates of US and Japanese affiliates in 74 countries in seven broad branches of industry and at three points of time in the framework of an extended model of location of foreign production. The strength of patent protection regime although with a positive sign never had a statistically significant coefficient for affiliate sales or value added in the case of US MNEs. In the case of Japanese MNEs, the results were sensitive to inclusion of dummy variables identifying the two tiers of Asian NIEs.

The coefficient of patent rights was not significantly different from zero in a full sample test when the regional dummies are not included. When the Asian NIEs are separated with the dummy variables, than the coefficient of patent rights becomes statistically significant with a positive sign. This suggests that Japanese MNEs have tended to overlook the relatively weaker IPR regime prevailing in the East and South East Asian countries for their outward investments. Outside East and Southeast Asia, Japanese investments are concentrated in the European Union and North America—countries having stronger IPR regime. Hence, one gets a positive significant coefficient. In the sub-sample estimations for Japanese affiliate sales in developing countries, patent rights variable comes up with a significant coefficient with a negative sign. That could be explained in terms of high concentration of Japanese investment in developing countries in those countries that have weaker IPR regime. The coefficient of the strength of patent protection is never significantly different from zero while explaining the value added of US and Japanese affiliates. The strength of patent regime does not appear to be a significant factor in determining the patterns of US or Japanese FDI. Some further analysis of the same data set at the level of seven broad sectors, currently in progress and reported in Kumar (2002b) suggests that strength of patent protection does not influence the patterns of US affiliate sales in any of the seven branches of manufacturing except the miscellaneous industry where it had a significant but negative coefficient. Smith (2001) finds that foreign patent rights increase US affiliate sales (i.e. FDI) as well as licenses. However, the effect is larger in the case of arm' length licensing than for FDI. These conclusions are consistent with those of Yang and Mascus (2001) who find that patent rights promote arm's length trade and they have a less significant effect on internalized technology transfers viz. FDI.

The issue of IPR protection links more directly with R&D activity in the context of globalization of R&D activity of MNEs. MNEs may be apprehensive of locating their key R&D centres in countries with weak patent regimes. However, where the overseas R&D is directed to local adaptations and to providing other support to the local production of the MNE, and not directed to new product development, the patent regime may not be of much consequence to it. Kumar (1996) in a study explaining R&D intensity of affiliates of US MNEs in 54 countries in 1977, 1982, and 1989, found that strength of patent protection (Rapp and Rozek index) had a significant positive influence on R&D intensity of affiliates located in developed countries and has a negative coefficient in a developing country sub-sample which is not statistically significant. Thus stronger patent protection does not appear to be a prerequisite even for R&D investments by MNEs in developing countries. Kumar (1999) provides case study evidence suggesting that MNEs have been locating R&D centres, R&D joint ventures and contracting research in India in the field of chemicals and pharmaceuticals despite the patent regime not recognizing product patents in these sectors. Therefore, availability of abundant trained low cost human resources and scale of ongoing R&D in their own fields appear to be more important considerations for location of R&D in developing countries than the strength of IPR regime. These hypotheses were verified in a more recent study (Kumar 2001) that explained R&D intensity of affiliates of US and Japanese MNEs in 74 countries in seven branches of industry and at three points of time, 1982, 1989, and 1994. This study found that the strength of patent protection (Ginarte and Park index) offered by the country remained statistically insignificant in explaining R&D intensity of US and Japanese affiliates throughout. The bulk of the variation in R&D intensity was explained by the abundance of R&D manpower and its relative cost, scale of national technological effort and technological capability of the host country especially in the field of the affiliate (Kumar 2001).

It would appear from the above that the contention that stronger norms of IPR protection will facilitate greater inflows of FDI in the country is rather weak in either theoretical or empirical terms. The theory suggests that stronger IPRs may tilt the balance between exports, FDI, and licensing in favour of exports and arm's length licensing. The empirical evidence has been mixed generally supporting no strong effect of the strength of patent protection on FDI inflows, their composition and even overseas R&D activity of MNEs. As Mascus (2000b) puts it, if strong IPRs were able to provide sufficient incentives for firms to invest in a country, 'recent FDI flows to developing economies would have gone mainly to sub-Saharan Africa and Eastern Europe. In contrast, China, Brazil and other high-growth, large-market developing economies with weak protection would not have attracted nearly as much FDI'.

4. IPRs and Economic and Technological Development in East Asia

The rapid and sustained growth and development in the East Asian economies, viz. Japan; South Korea, Taiwan, Hong Kong and Singapore (first tier Asian nies), Malaysia, Thailand, and Indonesia (second tier nies) and China, generally termed as the 'East Asian Miracle', has attracted a large volume of literature [see for instance, World Bank 1993, Amsden 1989, Wade 1990, among many books and papers]. The growth rate of per capita income over the 1960-90 for these economies averaged over 5.5 per cent, making it the fastest growing region in the world sustaining such rates of growth over such a long span of time. Japan and Asian nies have been able to expand their share in world exports from 8 per cent in 1965 to 13 per cent in 1980 and 18 per cent in 1990, suggesting that their exports have expanded much faster than any other region's. Their share in world's manufactured exports has grown from 11 to 21 per cent over the same period. In particular rapid transformation of Korea and Taiwan from technologically backward and poor economies into affluent and relatively modern economies by early 1990s has been truly remarkable.

Some analysts have attempted to downplay the East Asian achievement as a result of factor accumulation along the production function (see for instance, Krugman 1994, Young 1995)[4]. However, since then a number of studies have corroborated that a substantial proportion of East Asian growth was contributed by growth of total factor productivity (TFP) and it was not a result of merely factor accumulation [see for instance, Singh and Trieu 1996, Nelson and Pack 1999, Thomas and Wang 1996, Esterly 1994, Lau 1999, Pack and Page 1994, among others]. The total factor productivity growth in Japan, Korea, Taiwan, Hong Kong and Thailand has averaged between 2 to 4 per cent per year over 1960-89 thus contributing over a third of the growth of output! (World Bank 1993: figure 1.11).

A large volume of literature has also been concerned with the explanation of the rapid TFP growth in the East Asian countries. It is now widely accepted that the assimilation of foreign technology was a 'critical component of the Asian Miracle' (Nelson and Pack 1999; also see Westphal 2000, Kim 2000, Amsden 1989, Wade 1990, Hobday 1995, Lall 2000, among many others). There seems to be a general consensus that the East Asian success owes a lot, in general, to their ability to imitate, absorb, assimilate and replicate foreign innovations. Kim (2000) highlights the role of 'duplicative imitation' in the Korean industries initially in the light industries such as textiles, toys, consumer electronics in the 1960s and in such heavy industries such as automobiles, steel, shipbuilding and machinery in the 1970s. Hobday (1995) provides case studies of firm level learning in Korea as well as other East Asian countries. Singh and

[4] A similar attempt to write off the success of East Asian countries was made following the East Asian crisis of 1997-98. However, all the countries recovered quickly from the crisis by 2000 (except for Indonesia). The crisis resulted from the lack of prudent norms governing the financial sector rather than from the lack of technological capabilities that have contributed to the TFP growth and in turn to the growth of output (see Nelson and Pack 1999).

Trieu (1996) provide econometric evidence suggesting that R&D expenditures in Japan, South Korea and Taiwan have contributed to TFP growth.

The existing evidence on the role of IPRs regime in promoting growth is largely anecdotal. Although the literature is not explicit in acknowledging its role, the soft intellectual property protection regime adopted by these countries in the period of duplicative imitation or reverse engineering has played and important role in facilitating the firm level technological learning. Below we attempt to put together some evidence for Japan, Korea and Taiwan on the role weak IPRs regime adopted by these countries have facilitated their technological and economic development.

Japan

Japan is known to have greatly benefited from intellectual property generated in other developed countries in the early stages its development. In fact the two international treaties on the IPRs viz. the Paris Convention (1883) for industrial property and the Berne Convention (1886) for copyrights "were negotiated, in part because of frustration over alleged infringements in the 'newly industrialising countries' of the day, such as the United States and Japan" (Maskus 1998b: 347). Furthermore, in Japan the patent protection has been designed with an ultimate objective of contributing to the 'development of industry' and not as an end by itself (Kotabe 1992). In tune with this objective it has contained several features that have helped the absorption of spillovers of foreign inventive activity by domestic enterprises. For instance, although Japanese Patent System (JPS) was established in 1885 by the Patent Monopoly Ordinance that was replaced by the Patent Ordinance of 1888, the food, beverage, pharmaceutical products and chemical compounds were excluded from the scope of patent protection until 1975 to facilitate the process innovations. In 1905 the Utility Model Law was introduced to provide protection to adaptations or improvements over the imported machinery or equipment by domestic inventors that were considered too minor to be patented primarily. As many as 99.9 per cent of utility models have been granted to Japanese nationals over the 1905-79 period (Watanabe 1985:237). Furthermore, the JPS provides for protection of industrial designs which only needed to demonstrate novelty and not inventiveness. The utility models and industrial designs have allowed Japanese firms to receive protection on technologies that were 'only slightly modified from the original invention'(Mascus and McDaniel 1999). JPS also employs the first-to-file principle rather than the first-to-invent principle incorporated in the US law, pre-grant disclosure that lays open or publishes the patent applications for inspection or opposition for eighteen months, provides for compulsory license if a patent has not been worked (i.e. used in manufacture) in Japan continuously for more than three years or in public interest, and (until 1988) required the patent applications to be limited to a single narrow claim. All these features have been designed to favour adpatations by domestic enterprises. That they have been used to encourage technology adaptations by domestic entrepreneurs is clear from the fact that in 1980 Japan had awarded 49000 utility models to its nationals compared to just 533 to foreigners. Similarly Japanese nationals were granted 31000 industrial design patents vis-à-vis 600 to foreigners (Evenson 1991). There have also been complaints of discrimination by JPO and foreign applicants appear to face longer pendency periods than do domestic applicants in Japan (Kotabe 1992).

Mascus and McDaniel (1999) in a systematic quantitative study have found that the above features namely utility models, design patents, compulsory licenses, first-to-apply, narrow claims, among others, that make JPS considerably weaker than the US patent system, for instance, have facilitated absorption, transfer and diffusion of technology by allowing reverse engineering and contributed to the TFP growth during the period 1960-93. The scope of patent system was expanded to cover chemical and pharmaceutical products only in 1975. Kotabe (1992:150) attributes the regime change to the growing international pressure. However, it was probably motivated by the realization that by 1970s, Japanese enterprises had developed their technological capability adequately and hence needed protection for their own innovative activity. In October 1970 the Japan Patent Association surveyed its member firms on whether they favoured introduction of chemical product patents. About 60 per cent of the respondents favoured product patents and only 9 per cent opposed. With this strong support from the industry, the Japanese government began the process of amending Japanese patent law to provide for product patents for chemicals and pharmaceuticals. The amendment was adopted by the Diet in May 1975 and became effective from January 1976 (La Croix and Kawaura 1996).

South Korea

South Korea adopted the patent legislation only in 1961. The Korean patent law was amended in 1981 to conform with the Paris Convention that provided for multiple claims for related inventions in a single application. However, the scope of patenting did not cover patenting of products and processes to manufacture food products, chemical substances and pharmaceuticals.

The US government initiated an investigation on Korea under Section 301 of the Trade Act threatening trade sanctions on Korean exports for its failure to provide protection to US products. That pushed Korea to strengthen its IPR regime. The revised patent, copyright, and software legislation was passed by the National Assembly on 31 December 1986 and became effective in July 1987 (US GAO 1987). The new law extended product patent protection to new chemical and pharmaceutical products, adopted a comprehensive copyright law, and extended copyright protection to computer software. The patent term was also extended from 12 to 15 years (La Croix and Kawaura 1996). Korea has also followed an IPR regime that facilitated adaptations and imitative duplication of foreign technologies by domestic enterprises through utility models and industrial designs. It is evident from the fact that 92 to 95 per cent of all utility models and industrial designs have been granted to its nationals (WIPO statistics). The delibrate softening of IPR regime by the government to facilitate imitation by domestic enterprises has been acknowledged in the literature on Korean technological capability. Lee (2000:284), for instance, observes that during the imitation stage, the 'government tried to minimize IPR protection to help domestic firms use foreign intellectual property. Laws and regulations were formulated in such a way as to meet minimal international standards. Furthermore, enforcement of the law was less than strict'. Kim (1997) provides highly illustrative case studies of several industries documenting firm level successes in absorbing technology and other knowledge with the help of duplicative imitation or reverse engineering and gradually emerging as innovators in their own right. The softer patent regime adopted by the country facilitated this process of reverse engineering. La Croix and Kawaura (1996) in an event study of the effect of the new patent law on the market valuation of Korean pharmaceutical firms listed on the stock exchange found a cumulative decline of –74 per cent over the 14 months period. Korea's ability to absorb foreign innovative activity through duplicative imitation has helped it to grow rapidly during the 1960-1980s. The real GDP expanded by 9.5 per cent per year during the 1965-1980 period and by 8.6 per cent during 1980-87 period. Despite the new Patents Act of 1986 according product patents for chemicals and pharmaceuticals, Korea continued on the priority watch list of the US government under Special 301 till 1993 for enforcement concerns. In February 1993 Korea launched a comprehensive new plan to strengthen IPRs protection and enforcement followed by a new Patent Act in 1995. Nevertheless, Korea has often been regarded as being weak in protecting IPRs (Suh 2000)

In view of the role played by soft patent regime in Korea's development, Kim (2000) infers that current trend of strengthening of IPR protection will pre-empt duplicative imitation of foreign technologies by developing countries of today. Reverse engineering of foreign products for duplicative imitation will be more difficult and costly for developing countries than it was for Korea in the 1960s and 1970s. China, for instance, faces enormous pressure from the United States to honour IPRs which Japan, Korea and Taiwan did not face in their early industrialization stage'.

Taiwan

Taiwan has also employed a weak IPR policy to facilitate local absorption of foreign knowledge through reverse engineering on the lines of Japan and South Korea. In fact Taiwan's government seem to openly encourage counterfeiting as strategy to develop local industries. In the mid-1980s an estimated 60 per cent of world's pirated or counterfeit goods were allegedly originating in Taiwan (*Business Week*, 16 Dec. 1985). Wade (1991:268-9) documents a number of cases of government's tacit approval of counterfeiting.

> In a late 1970s case, several factories were found to be manufacturing circuit fuse breakers with forged Westinghouse and Mitsubishi labels. When Mitsubishi complained to the authorities, the firms were fined all of US$600. The government publicly denied that this was a serious case, while privately saying that "political factors" made it impossible to take tough action. Those political factors were the adamant opposition of most Taiwan firms and industry associations to any signs of tough enforcement, since they saw themselves as handsome beneficiaries of non-enforcement. And the government itself tended to view counterfeiting as a shortcut to industrial success. As recently as 1983 an unattributed government document entitled "Intellectual Property Rights Protection, a Republic of China Perspective," said with remarkable candor, "The R.O.C. government has viewed imitation as a necessary process in the evolution of human civilization and believed that commercial counterfeiting is an inevitable phenomenon in most developing countries. Local officials were cognizant of the negative aspects of counterfeiting although they made little effort to accommodate overseas interests or enhance domestic enforcement efforts when such aspects were seen to be outweighed by the positive development of the industrial base (Wade 1991: 268-9).

Lax treatment of IPRs in Taiwan attracted the attention of the US government. In March 1983, the US government instituted bilateral consultations on IPRs with Taiwan. As a result of growing US pressure, Taiwan amended its copyright law in 1985 to strengthen penalties for piracy, provide criteria for recognizing foreign firms' standing before the Taiwanese judiciary in copyright cases, and extend protection specifically to new media, including software. This followed enactment of a new patent law in 1986 extending protection to chemicals and pharmaceutical products [US GAO 1987]. However, these legislations and their enforcement were considered inadequate by the US government. Under heavy pressure from the US Taiwan promulgated its new Patent Law on January 21, 1994 that allows patents on food, beverages, micro-organisms, and new uses for products, all of which were previously excluded under the government's social policy. In addition the duration for new patents was extended from 15 years to 20 years. Like Japan and Korea, Taiwan also provides for utility models (for 12 years duration under the new law) and design patents (term 10 years under new law). However, many concerns have continued to remain. These include elimination of imprisonment penalties for patent infringement while they continue for violations of utility models and design patents primarily held by Taiwan nationals. There is a provision for patent marking under which a patent owner who fails to mark the patent certificate number on the patented article or packaging cannot claim damages from infringement (http://www.state.gov/e/eb/rls/rpts/eptp).

Lessons from the East Asian Experience

To sum up this section, the East Asian countries viz. Japan, Korea and Taiwan have absorbed substantial amount of technological learning under weak IPR protection regime during the early phases. These patent regimes facilitated the absorption of innovation and knowledge generated abroad by their indigenous firms. They have also encouraged minor adaptations and incremental innovations on the foreign inventions by domestic enterprises and developed a patent culture through utility models and design patents. As the local technological capabilities matured and the domestic industry sought stronger protection for guarding their own inventions, the IPR regime was strengthened in Japan in mid-1970s. In the other two countries, the IPR regime had to be strengthened under US pressure. The other case that we examine in the following section, viz. that of India, although following a weak patent regime since 1970, is different in one crucial respect from the East Asian countries in that it did not provide an encouragement to adaptive and minor inventive activity of domestic enterprises with utility models and design patents. In the chemicals and pharmaceuticals it did not prove a constraint as the process patents in the absence of product patents essentially served the purpose of encouraging process adaptive activity of domestic firms. As a result, the domestic chemicals and pharmaceutical industries have developed in their capabilities considerably over the past three decades. However, in the engineering industries and others, there was not a mechanism for encouraging minor adaptations of domestic firms. This difference could perhaps explain not so encouraging performance of Indian enterprises in other industries (as observed by Mascus 1998b). Furthermore, IPR regime is only one of the determinants of the technological capability building. The domestic technological effort in absorbing the foreign technologies and innovations in East Asian countries has been vastly more substantive and has been sustained over a much longer period compared to India that attempted to build capabilities with softer patent regime only since the mid-1970s. Before this India's patent regime was comparable to those prevailing in the developed countries.

5. Case of India

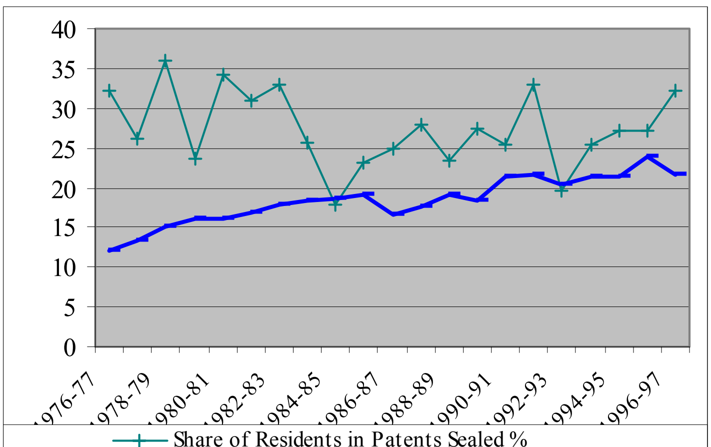
India had inherited The Patents and Designs Act 1911 from the colonial times that provided for protection of all inventions except those relating to atomic energy and a patent term of 16 years from the date of application. However, a few domestic chemical and pharmaceutical enterprises that tried to develop their own technology in the 1960s ran into trouble with foreign patent owners. A number of cases highlighted that foreign patent owners were neither using their patents for domestic manufacture nor allowing them to be used by local firms[5]. That led to a build-up of pressure in the late 1960s for a new patent law. Desai (1980) in a questionnaire survey of 53 firms conducted in 1969 found that by and large foreign firms were against any liberalization of patent laws, Indian firms were not against patents but wanted greater access to patented know-how especially when patent owners not allowing their patents to be used. The conflict of views was sharper in chemicals and pharmaceuticals where patents had been used to prevent entry of Indian firms. Therefore, a new Patents Act was adopted in 1970 that reduced the scope of patentability in food, chemicals and pharmaceuticals to only processes and not products. Since virtually any chemical compound

[5] Desai (1980) documents two of such cases. In one case Hoeshst prevented Unichem Laboratories from producing tolbutamide using a technology licensed from Haffkine Institute of Bombay which had patented the process. The major difference was A handful of chemical and pharmaceutical firms which tried to develop their own technology ran into trouble with foreign patents in the sixties. In a case that became famous, * Unichem Laboratories produced tolbutamide on licence from Haffkine Institute of Bombay which had patented the process. The major difference between the patents was that the Hoechst patent specified at a certain point that sulphur was to be eliminated from a thiouria 'in a conventional manner', and at another point that the elimination was to be done by 'a heavy metal oxide or a salt thereof'. The Haffkine Institute patent specified elimination by hydrogen peroxide. The judge disallowed the defendants' plea that the Hoechst patent was so general as to cover millions of products of which only 220 had been synthesized by Hoechst and still fewer pharmacologically tested, and ruled that the two patents referred to the same invention and that Unichem had infringed Hoechst's patent. In another instance aluminium phosphite, a concentrated fumigant, was patented and imported by a foreign firm. In the payments crisis on 1966 the Directorate-General of Technical Development asked the firm to produce it, but the firm said the process was too difficult to be tried in India. Thereupon Excel Industries produced the fumigant in 2.5 months and marketed it at half the cost of imports. The foreign firm then sent Excel a notice to cease infringement of its patent. After the Unichem judgment the Patents Office began to reject a larger proportion of applications on the grounds of vagueness or incompleteness. The proportion of examined applications so rejected went up from 5 per cent in 1968 to 11 and 16 per cent in the next two years. Chaudhuri (1984) documents many more such cases of foreign firms trying to undermine the building up of local production capability by domestic firms.

can be made by a variety of processes, the scope of patent protection was greatly reduced. The term of process patents was reduced to 7 years in food, drugs and chemicals and to 14 years for other products. The compulsory licenses could be issued after three years.

The Indian Patents Act of 1970 has continued to govern the IPR regime in India over the past 30 years except for recent amendments brought to provide for exclusive marketing rights (EMRs) in tune with India's obligations under WTO's TRIPs Agreement. India joined the Paris Convention and the Patent Cooperation Treaty only in 1999. India has a ten years transition to provide product patents viz. till the end of 2004. It is by now widely recognized that the abolition of product patents in chemicals and pharmaceuticals has facilitated the development of local technological capability in chemicals and pharmaceutical industry by enabling the domestic firms in their process innovative activity. A number of quantitative studies have shown that the innovative activity of Indian domestic enterprises was facilitated by the softer patent regime under the 1970 Act (see Fikkert 1993, Haksar 1995, Kumar and Saqib 1996). The gradual build up of technological capability of Indian enterprises is visible from a rising trend of residents in patent ownership in India (Figure 1). Improved technological capability is also reflected in terms of the ability of India to raise her share in patents granted by the US patents office from 0.02 per cent in 1977-87 period to 0.06 per cent during 1996-2000 (see Table 2). Although still having marginal share in the US patent grants, India has not fared badly compared to other developing countries. In 1998, it ranked seventh amongst all developing countries in terms of the magnitude of US patents obtained, behind Taiwan, South Korea and Israel—the three leading nations—but ahead of Brazil, China and Mexico. Interestingly, in the chemicals sector—which accounts for the bulk of all patents—and in biotechnology—one of the cutting edge sectors—India ranks fourth amongst developing countries. Moreover, in biotechnology, the gap between India and countries ahead of it is not large (Subramanian, 1999).

Figure 1: Composition of Patent Ownership in India, 1976-98



Source: based on India, Department of Scientific and Industrial Research data

In particular, the rapid evolution of Indian pharmaceutical industry since the mid-1970s highlights the fact that weak IPRs regime could be instrumental in building local capabilities even in a poor country such as India. In what follows we take a look at some indicators of evolution of technological capability of Indian pharmaceutical enterprises. In 1970 much of the country's pharmaceutical consumption was met by imports and the bulk of domestic production of formulations was dominated by MNE subsidiaries. Of the top ten firms by retail sales in 1970 only two were domestic firms and the others were MNE subsidiaries. In 1996 six of the top ten firms in the industry are Indian firms. By 1991, domestic firms accounted for 70 per cent of the bulk drugs production and 80 per cent of formulations produced in the country (Lanjouw 1998).

The increasing technological capability is reflected in terms of rising exports of drugs and pharmaceuticals. With their cost effective process innovations, Indian companies have emerged as competitive suppliers in the world of a large number of generic drugs that are now outside the patent protection. That has resulted in a steady growth of India's exports of drugs and pharmaceuticals. Thus the industry has evolved from being one being highly import dependent to one that generates increasing export surplus for the country. The faster growth of pharmaceutical exports has resulted in their share in India's exports rising from 0.55 per cent in 1970-71 to over 4 per cent by the 1999/00 (Table 3). Emerging revealed comparative advantage of India in pharmaceuticals is apparent from Table 4 which shows that India's share in world exports of pharmaceuticals has risen by 2.5 times while her share in all merchandize exports has stagnated at about 0.6 per cent throughout the 1970 to 1998 period. India ranks second after China among developing countries in export of pharmaceuticals and is ahead of such technologically advanced countries as Mexico, South Korea, Brazil, Israel (Table 5).

Table 3: India's Trade in Pharmaceutical Products, 1970-71 to 1999-2000 (Current prices)

In Rs. Crores (10 millions)

Year	*Trade in medicinal and pharmaceutical products*	*Pharmaceutical*

	Exports	Imports	Trade balance	exports as a % of India's total exports
1970-71	8.5	24.3	-15.8	0.55
1971-72	9.6	26.6	-17	0.60
1972-73	10.3	23.2	-12.9	0.52
1973-74	15.1	26.4	-11.3	0.60
1974-75	23	34.2	-11.2	0.69
1975-76	22.2	36.3	-14.1	0.55
1976-77	24.2	42.2	-18	0.47
1977-78	31.2	63.6	-32.4	0.58
1978-79	56.5	79.2	-22.7	0.99
1979-80	87.5	73.9	13.6	1.36
1980-81	67.4	84.6	-17.2	1.00
1981-82	122	84.4	37.6	1.56
1982-83	112.2	88.8	23.4	1.27
1983-84	155.2	146.9	8.3	1.59
1984-85	234.2	137.1	97.1	1.99
1985-86	157.9	177.2	-19.3	1.45
1986-87	161.3	213.8	-52.5	1.30
1987-88	326.1	167.8	158.3	2.08
1988-89	473.7	236.4	237.3	2.34
1989-90	849.6	399.7	449.9	3.07
1990-91	1014.1	468.4	545.7	3.11
1991-92	1550.1	558.5	991.6	3.52
1992-93	1533	813.2	719.8	2.86
1993-94	2009.7	808.8	1200.9	2.88
1994-95	2512.3	937.2	1575.1	3.04
1995-96	3408.7	1358	2050.7	3.21
1996-97	4341.8	1089.2	3252.6	3.65
1997-98	5419.3	1447.1	3972.2	4.17
1998-99	6256.07	1615.2	4640.87	4.48
1999-2000	6631.45	1502.3	5129.15	4.07

Source: RBI (2000), *Handbook of Statistics on Indian Economy*, Bombay: the Reserve Bank of India

Table 4: India's Pharmaceutical exports in World Trade, 1970 to 1998

(Current prices) In US$ million

Year	*Share of India in World Exports*	
	All Merchandize	*pharmaceuticals*
1970	0.6	0.4
1975	0.5	0.4
1980	0.4	0.8
1985	0.5	0.8
1990	0.5	1.2
1995	0.6	1.0
1997	0.6	1.1
1998	0.6	1.0

Source: India, *Economic Survey 2000/01* and the UN *International Trade Statistics Yearbook* 1998, United Nations

Table 5: Major Exporters of Medicinal and Pharmaceutical Products in the World

Countries	**1994**	**1995**	**1996**	**1997**	**1998**
Germany	8739.1	10268.3	10711.8	11655	14036.7
United Kingdom	6080	7720	8320.1	8940.2	9666.6
Switzerland	6324.9	7589.8	8411.2	8208.5	9854.4

USA	6184.5	6554	7330.1	8230.5	9660.8
France	5415.4	6864.4	7244.7	7900.8	9314.5
Belgium	3333.1	4120.6	4301.6	4885.5	5481.8
Italy	2759.3	3630	4299.3	4430.3	4897.8
Netherlands	2780.7	3973.8	3437.9	3770.6	3519.6
Sweden	2467.5	2546.2	2943	3057.6	3567.5
Ireland	1847.6	2105.8	2782.8	3356.7	4745.4
Denmark	1615.1	2160.8	2214.6	2272.4	2213.3
Japan	1547.9	1843.7	1889.4	1952.4	1915.1
China	1185.3	1582	1516.1	1536.2	1692.3
Spain	1061.2	1164.9	1414	1516.9	1702.6
Austria	1054	1333.7	1374.5	1324.9	1343.1
Hong Kong, SAR	832.9	975.3	1020.1	967.5	882.4
India	**585.8**	**724.2**	**814**	**947.2**	**901.1**
Canada	504.7	611.1	683.4	957.7	1052.1
Australia	534.3	618.8	737.7	784.5	768.6
Singapore	494.8	601.2	616.2	616.6	592
Mexico	296.7	399.4	552.4	636.8	715.9
Slovenia	283.1	318.8	357.7	402	387.8
Israel	276.4	255.3	334.3	416.7	396.6
Hungary	249.4	276.6	281.4	357.3	311.6
Korea, Republic of	218.5	259.4	279.5	289.8	292.3
Poland	200.1	223.8	256	294.6	196.7
Norway	190	210.1	225.4	217.9	224.2
Finland	192.1	214.4	204.9	214.5	231.4
Argentina	111.9	140.9	198.8	282.3	298
Czech Republic	150.3	185.6	218.1	213.7	210.1
Brazil	132.8	167.6	189.1	217.3	248.1
Portugal	94.7	143.6	169.3	171.7	205.9
Jordan	138.9	147.4	151.4	153	87.3
Croatia	133.4	137.2	139.4	156.6	148.9
Colombia	55.7	95.1	126.7	175	190.7
Slovakia	120.2	138	131.5	105.3	89.4
Russian	97.6	117.1	128.6	116.5	113.1
Thailand	87	126.1	105.5	107.2	101.7
Turkey	78.1	63.2	96.9	113.6	120
Greece	73.7	77.8	87.3	89.5	132.8

Source: UN *International Trade Statistics Yearbook* 1998, United Nations

Indian exports of pharmaceuticals received a boost in the late 1980s when a number of drugs went off the patents and Indian companies manufacturing them with cost-effective processes entered the international markets after obtaining FDA approval. Therefore, in the late 1980s, as much as 61 per cent of India's pharmaceutical exports comprised bulk drugs. However, subsequently some of the larger and more dynamic Indian enterprises such as Ranbaxy Laboratories, Dr Reddy's Labs, Cipla and Cadila, have started marketing their own formulations in different countries with the help of a growing network of overseas offices and subsidiaries set up in key international markets. As a result the share of bulk drugs in total exports of pharmaceuticals has come down to around 40 per cent (Table 6).

Table 6: Composition of India's Pharmaceutical Exports

(Current prices) In Rs. Crores

Year	*Bulk Drugs*		*Formulations*		*% share of bulk drugs*	*Total exports*	
	Value	*As a % of bulk drugs production*	*Value*	*As a % of formulations produced*		*Value*	*As a % of total production*
1980-81	11.28	4.70	35.1	2.93	24.32	46.38	3.22
1981-82	15.45	5.35	69.34	4.84	18.22	84.79	4.92
1982-83	11.34	3.29	54.6	3.29	17.20	65.94	3.29
1983-84	18.46	5.20	61.46	3.49	23.10	79.92	3.78
1984-85	29.25	7.76	99.5	5.45	22.72	128.75	5.84
1985-86	33.36	8.02	106.59	5.48	23.84	139.95	5.93
1986-87	87.16	19.03	102.12	4.77	46.05	189.28	7.29
1987-88	139.71	29.11	88.25	3.76	61.29	227.96	8.06
1988-89	242.87	44.16	157.29	4.99	60.69	400.16	10.82
1989-90	350.5	54.77	314.2	9.19	52.73	664.7	16.37
1990-91	413.4	56.63	371.4	9.67	52.68	784.8	17.17
1991-92	722.6	80.29	508.7	10.60	58.69	1231.3	21.60
1992-93	856.6	74.49	553.7	9.23	60.74	1410.3	19.72
1993-94	1029.6	78.00	771.8	11.19	57.16	1801.4	21.91
1994-95	1260.7	83.05	924	11.64	57.71	2184.7	23.11
1995-96	1098	57.13	1239	13.58	46.98	2337	21.16
1996-97	1581	72.32	2509.2	23.91	38.65	4090.2	32.26
1997-98	2173	82.84	2805	23.24	43.65	4978	33.88

Source: Department of Chemicals and Petrochemicals, various Annual Reports

USA is the biggest market for India's pharmaceutical exports accounting for 10-12 per cent of exports. The export basket of India includes generic drugs like Ibuprufen, Sulphamethoxazole, Metronidazole, Amoxycilline, Ampicilline, Mebendazole, Beta Ionone, Erythromycin, Pappain, Potassium Iodide, Brucine Salts, Cephalexin, Ethambutol Hydrochloride, Trimethoprim etc.

A study comparing the performance of MNE affiliates and domestic enterprises in Indian pharmaceutical industry over the 1990s based on a balanced sample of 76 firms (60 domestic and 16 MNE subsidiaries) found the domestic enterprises are more dynamic in terms of growth of investment and output, export-orientation, R&D activity, technology purchases from abroad and in terms of labour productivity (defined as the net value-added per rupee spent on labor), as shown in Figures 2-5 (Kumar and Pradhan 2002). However, MNE affiliates enjoyed considerably higher profit margins because of their greater focus on more value adding formulations and their well-established brand names (Figure 7).

Figure 2: Export intensity of Pharmaceutical Enterprises in India

(exports to sales ratio in %), 1989-2000

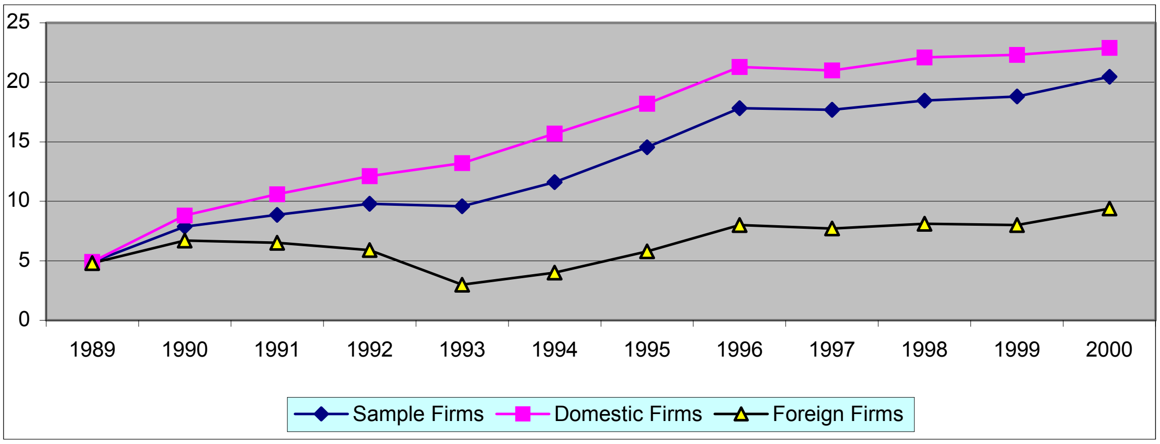


Figure 3: Exports to Imports ratio

(%) 1989-2000

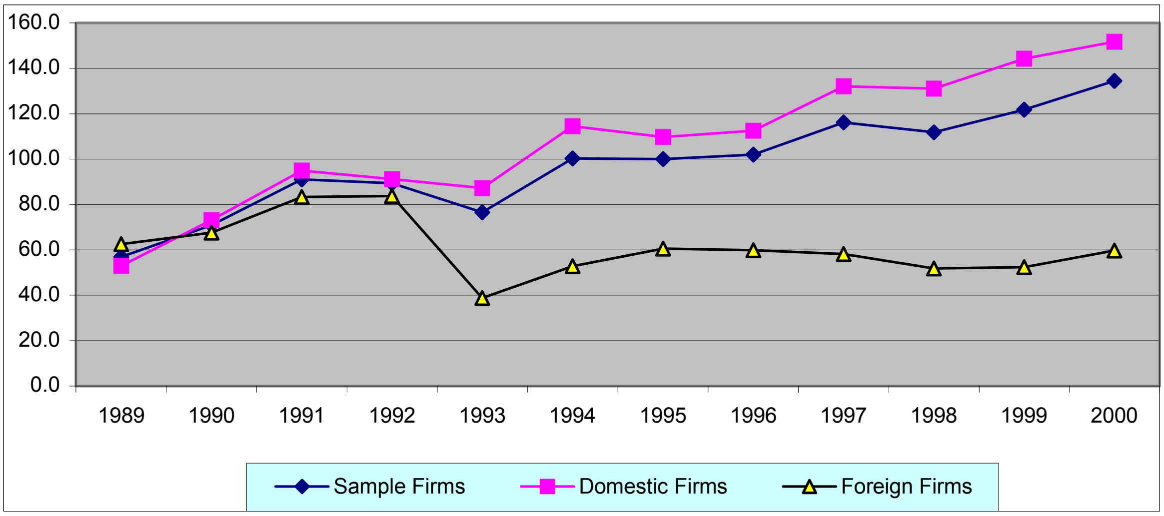


Figure 4: R&D intensity

R&D Expenditure to Sales Ratio in %, 1989-2000

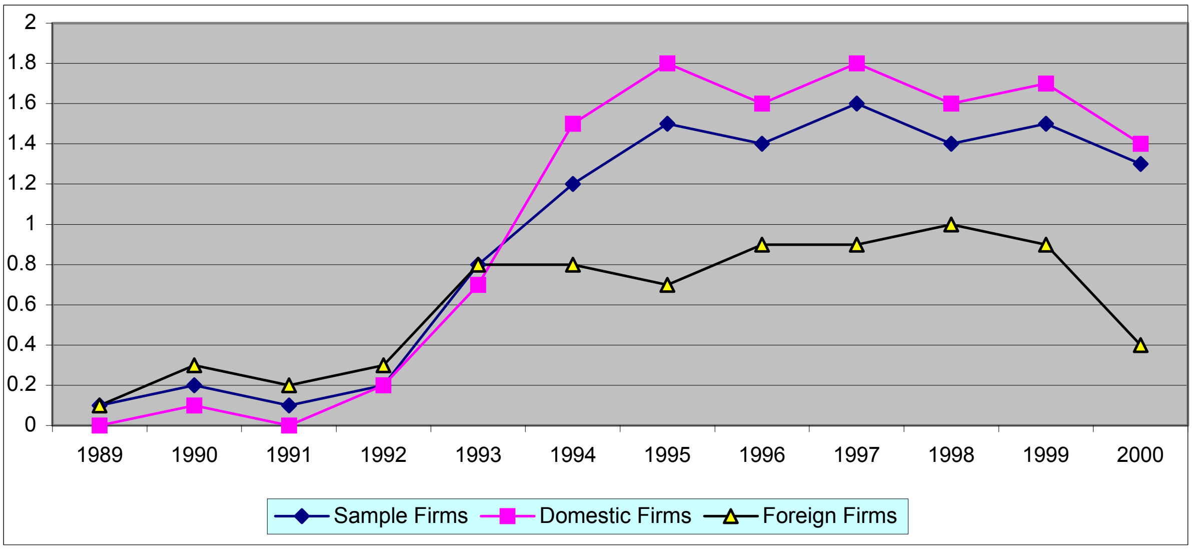


Figure 5: Intensity of Technology Purchases from Abroad

Royalty Payments to Sales (%), 1989-2000

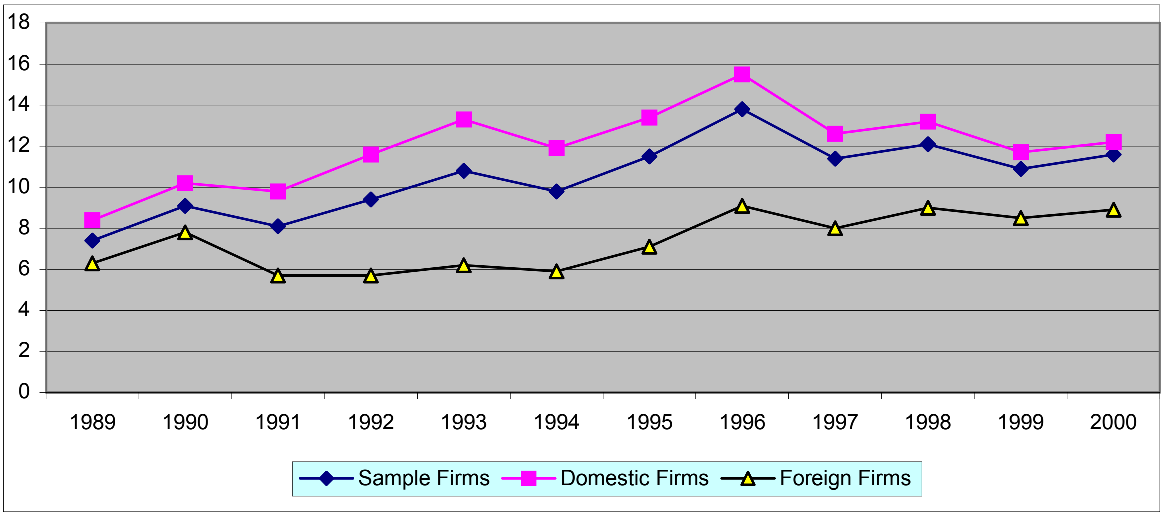


Figure 6: Labour Productivity in Indian Pharmaceutical Industry

Net Value Added per Rupee Spent on Labour, , 1989-2000

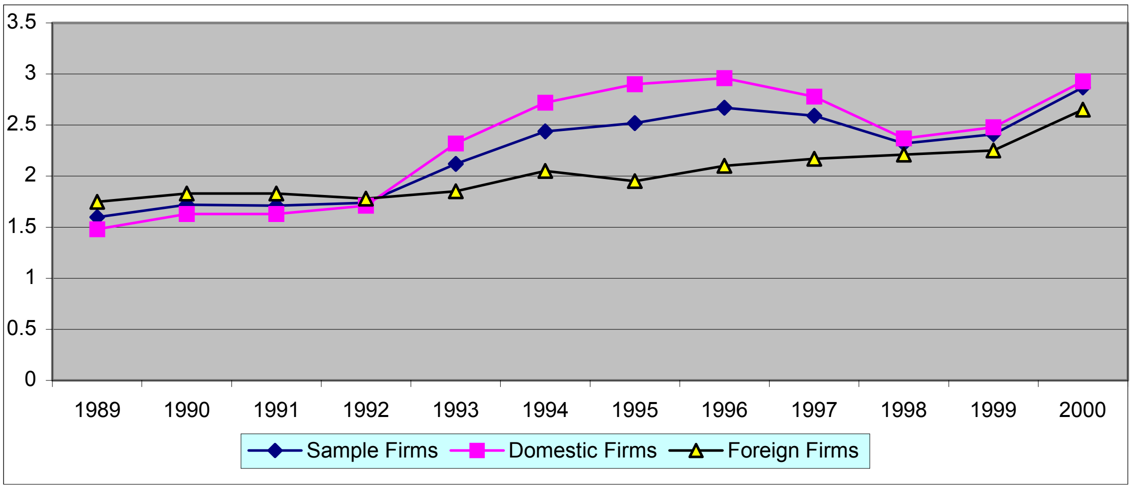
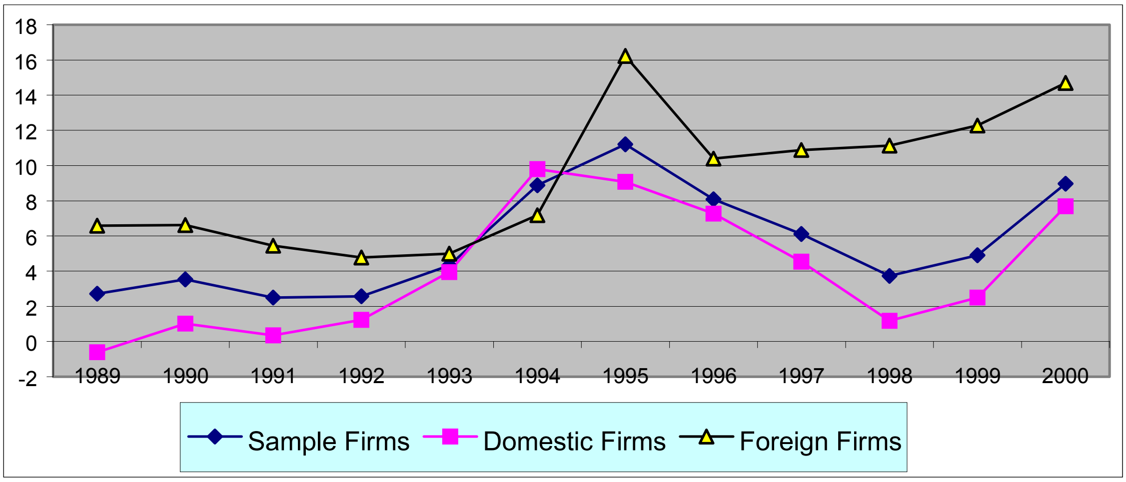


Figure 7: Profit Margins in Indian Pharmaceutical Industry

Profit before taxes as a proportion sales, %, 1989-2000



Source: Kumar and Pradhan (2002).

The development of process innovation capability of Indian enterprises has enabled them to introduce newer medicines within a short time lag. Table 7 shows that most of the drugs could be introduced within 4-5 years of their introduction in the world market. Table 7 also shows that the prices of these drugs in India have been much cheaper compared to rest of the world. For instance, Ranitidine, Famotidine, Astemizole, Ondansetron sell in the US market at about 50 times the Indian prices! The cheaper prices of drugs have made them affordable to the masses of poor in the country and thus have served an important social cause of providing access of modern medicine to poorer people.

Table 7: Introduction of New Drugs and Relative Prices Patentable Drugs in India

Brand & Dosage (pack)	Year				Prices (in Rs in 1994)				Times costlier		
	World Introduction	Indian Marketing Approval	Introduction lag	European Patent Expiry	India	Pakistan	USA	UK	Pakistan	USA	UK
Antibiotic/ Antibacterial											
Ofloxacin 200mg (4 tab)		1990		2001	92	117.2	408.1	217.3	1.3	4.4	2.4
Ciprofloxacin 500mg (4 tab)	1985	1989	4	2001	28.4	234.6	438.2	291.5	8.3	15.4	10.3
Norfloxacin 400mg (10 tab)	1984	1988	4	1998	39	125.5	903.7	254.4	3.2	23.2	6.5
Pefloxacin 400mg (4 tab)		1991		1998	15.6	59.4			3.8		
Anti-ulcer											
Ranitidine 300mg (10 tab)	1981	1985	4	1997	18.5	260.4	1050.7	484.4	14.1	56.7	26.1
Famotidine 40mg (10 tab)	1984	1989	5	1999	18.6	260.4	1004.2	503.5	14	54	27.1
Omeprazole 20 mg (10 tab)		1991		1999	29		1270.5	671		43.8	23.1
Cardiac care											
Lisinopril 5mg (10 tab)				1999	35		264.6	181.3		7.6	5.2
Enalapril Maleate 5mg (10 tab)	1984	1989	5	1999	15.9	37.2	316.9	148.8	2.3	19.9	9.4
Ketoconazole 200mg (10 tab)	1981	1988	7	1997	57.9	222	1082.9	277.2	3.8	18.7	4.8
Anti-histamine											
Astemizole 10mg (10 tab)	1986	1988	2	1999	12	120.9	647.5	142.6	10.1	54	11.9
Others											
Ondansetron HCI 4mg (6 tab)				2005	39.5		2247	1287.9		56.8	32.6

Source: constructed on the basis of Lanjouw (1998), Watal (2000) with other supplementary information.

The technological capabilities of Indian companies have grown to a point when leading MNEs have started to take note of it. For instance, Eli Lilly established a joint venture with Ranbaxy in the mid-1990s for development of a cost effective process for synthesis of Cefaclor, among other products, taking advantage of the latter's process development capabilities. Similarly, Bayer contracted Ranbaxy to develop single doses formulations of its proprietary Ciprofloxacine. A number of leading MNEs have also contracted Indian public funded R&D institutions for synthesis of new molecules and process development. These include Abbot Laboratories, Parke Davis, and Smith Kline and Beecham, among others, that have commissioned Indian Institute for Chemical Technologies, Hyderabad and National Chemical Laboratories, Pune (Kumar,1999, for more details). Astra (now Astra-Zeneca) has set up a full fledged R&D centre in Bangalore to draw upon trained manpower and research infrastructure available in the country, despite the fact that Indian patent regime does not provide product patents.

Thus the Indian pharmaceutical industry has evolved from one dependent upon imports and some formulation activity in the late sixties to one which is able to introduce some of the most sophisticated products indigenously produced within a relatively short lag and at a fraction of the cost, and export a growing proportion of its produce to emerge as a net foreign exchange earner. It is a remarkable.achievement especially because it has been accomplished within two decades of the change of patent regime. The case study of India, besides those of the East Asian countries, further highlights the critical importance of fine-tuning and calibrating the IPR regime to the level of development of the country.

6. Implications of the TRIPs Regime for Developing Countries

The international environment with respect to intellectual property has changed considerably with the conclusion of the TRIPs Agreement. The TRIPs Agreement accommodates the demands of the industrialized countries for higher international standards of protection by mandating the extension of patentability to virtually all fields of technology recognized in developed country patent systems, by prolonging the patent protection for a uniform term of twenty years, and by providing legal recognition of the patentee's exclusive rights to import the patented products. The patent rights are enjoyable without discrimination as to the place of invention, the field of technology and whether products are imported or locally produced. All the signatories to the trade negotiations are, therefore, obliged to harmonize their IPR regime and to provide product patents for pharmaceuticals and chemicals. The coverage of the patent protection has also been expanded by the provision for patents on micro-organisms and protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof.

The full implementation of the TRIPs Agreement is likely to have an important bearing on the patterns of development in developing countries. In what follows we briefly review some of the important dimensions of these effects.

a) Local Technological Capability Building

The strengthening and harmonization of IPR regimes worldwide has considerable implications for the process of acquisition of local technological capability by developing countries. The provision of product patents on chemical and pharmaceutical products, for instance, would adversely affect the process of innovative activity of the developing country enterprises in the manufacture of chemicals covered by patents. The development of new chemical compounds is generally beyond the capability of most developing country enterprises in view of the huge resources involved. Therefore, they focus attention on process innovations for the known chemicals and bulk drugs. This imitative duplication or reverse engineering activity is an important source of learning in developing countries. Indeed, most industrialized countries of today and newly industrialized countries encouraged local learning through soft patent laws and the absence of product patents in chemicals in the early stages of their development as highlighted earlier. It means that the poorer countries of today will not be able to benefit from an important source of total factor productivity growth (viz. absorption of spillovers of foreign inventions) that was available to countries that have developed already. In that respect the TRIPs Agreement is highly inequitable.

The probability of stronger IPR regime encouraging innovative activity in developing countries is very small. In fact the adoption of utility models or petty patents and design patents has a greater potential in encouraging local technological activity rather than implementation of the provisions of TRIPs in poorer countries.

b) Industrialization, Technology Transfers and Trade

Recent trends suggest a reversal of trend of the growing importance of arm's length licensing as a mode of technology transfer as MNEs prefer to internalize the technology transactions (see

Kumar 1998). The strengthening of IPRs regime may further limit the access of technology by developing country enterprises. Kim (1997) provides a number of examples of Korean corporations being denied technology licenses by patent holders in the Western world forcing them to reverse engineer the products. A number of local enterprises in developing countries will come under pressure to close down or form alliances with larger firms, resulting in a concentration of the industry [World Bank 2002:137]. Dependence on imports may go up. Mascus and Penubarti (1997) for instance, find that TRIPs could affect import volumes significantly; e.g. in Mexico, the anticipated rise in manufactured imports could be of the magnitude of $ 6.3 billion, amounting to 9.4 per cent of its real manufactured imports in 1995 (as cited in World Bank 2002:132).

c) Prices of Medicines and Loss of Consumer Welfare

A number of studies have examined the effect on prices of medicines after introduction of product patents and have simulated welfare losses for consumers in developing countries. It is widely believed that drug prices will go up upon introduction of product patents as happened in China which introduced them in 1993 [May 2000:99; also see Lanjouw 1998, Scherer and Watal 2001, and Panagariya 1999]. Nogues (1993) finds the welfare losses to 6 developing countries (Argentina, Brazil, India, Mexico, Korea and Taiwan) from introduction of product patents to be between US$ 3.5 billion to $10.8 billion depending upon the assumptions. The gains to the patent owners from such introduction would range between $ 2.9 billion to $ 14.4 billion. The welfare loss to India could be between $ 1.4 billion to $ 4.2 billion in a year. Watal (2000) simulates the likely increase in pharmaceutical prices and decrease in welfare in India with the introduction of product patents in 22 existing pharmaceutical products and finds that weighted mean drug price in India could increase between 26 per cent (for a linear demand function) to 242 per cent (with a constant elasticity-type demand function). An earlier study by Subramanian (1994) had found the maximum price increase of 67 per cent for India following the introduction of product patents. Fink (2000) finds the range of price increase between 182 to 225 per cent. That suggests that introduction of product patents would affect prices of medicines significantly and unless new drugs are more efficient, there will be a decline in the health levels of population (May 2000). The recent case of huge differences between prices of HIV Aids drugs sold by patent holders in South Africa and their generic substitutes just provides an further evidence to the potential of price increases following the introduction of product patents. It may be argued that the vast majority of drugs are out of patent protection and hence will not be affected. Yet the

AIDS drugs controversy shows that effective treatment for many of scourges of the day such as cancer, cardiac failures, renal problems, among others, may be affected.

d) Income Transfers from Developing Countries

Given the near complete domination of developed countries on technology generation as evident from the 95 per cent ownership of US patents (Table 1), the strengthening and harmonization of IPRs regime will lead to a substantial increase in flow of royalties and license fees from developing countries to developed countries. McCalman (1999) quantifies the impact of patent harmonization finds that it has the capacity to generate large transfers of income between countries, with US being the major beneficiary. World Bank (2002: Table 5.1) updates the computations of McCalman and suggests that the net patent rents derived by the US (in 2000 US$) could add up to over $ 19 billion, to Germany $ 6.7 billion, and Japan $ 5.7 billion. Among the developing countries, China could see an outflow of patent rents of the order of $5.1 billion, India $ 903 million, Israel $ 3.8 billion.

Furthermore, the extension of IPRs to plant varieties could further increase the outgo of royalties for the breeder lines of the seed companies even though the basic raw material for the development of these varieties, viz. genetic diversity which is largely found in developing countries and is supposedly the work of generations of farmers in these countries, is generally available to them free.

e) Impact on Global Technological Activity and Availability of Drugs

One of the arguments in favour of a stronger IPR regime is based on the premise that expenditures on R&D were significantly determined by appropriability conditions. Hence, ensuring adequate appropriability with more stringent IPR protection was deemed to be a necessary condition for sustaining the pace of innovation in the global economy. The empirical literature, however, does not support this presumption as patent protection was found to be instrumental for only a small proportion of innovations. On the other hand, studies show that spillover effects of R&D activity of other firms to be a lot more important in inducing firms to undertake R&D compared to appropriability. The R&D outputs of other firms form valuable inputs for the R&D efforts of these firms. Hence, tightening of IPRs is likely to affect innovative activity adversely by stifling these spillovers. Therefore, it is by no means clear that strengthening of IPRs will increase innovative activity even in the developed world especially for solving the problems and diseases faced by developing countries. As World Bank (1999) cautions 'there is now a risk of excessively strict IPRs adversely affecting follow-on innovations and actually slowing down the pace of (technological development)'. Furthermore, the research priorities of MNEs are determined by the purchasing power and very little R&D is currently done on tropical diseases (World Bank 2002). Unless some steps are taken by the international community, such as those discussed by the recent report of WHO's Commission on Macroeconomics and Health (CMH), the pattern is not likely to change significantly in the future.

7. Issues for National and International Action

The preceding discussion suggests that the ongoing trend of strengthening and harmonization of IPR regime is going to affect the process of development of poorer countries in a significant manner by choking an important contributor of growth that has been variously described as imitative duplication, reverse engineering or knowledge spillovers from abroad. It is also likely to affect the prices of a large number of important drugs and thus affect the health systems in poorer countries. It would lead to income transfers from poorer to richer countries. It is likely to adversely affect the manufacturing activity in developing countries and may increase their imports but does not guarantee increased in FDI inflows, access to technology or R&D investments in tropical diseases. These challenges require a response at the national policy levels as well as a response from the international community. In what follows, we outline some of the policy responses that could help in moderating the adverse effects of TRIPs Agreement on developing countries.

Policy Responses to be taken at the National Level

a) Incorporating the Provisions of Compulsory Licensing in the IPR Legislation

Developing countries should build adequate provisions for compulsory licensing in their IPR legislation in order to safeguard them from possible abuses of monopoly power obtained by patent owners. The compulsory licenses are permitted under Article 31 of the TRIPs Agreement. The Agreement does not limit the grounds upon whch compulsory licenses may be granted and only sets forth the conditions to be applied in the case of granting (see Correa 2000b). This includes specification of grounds of compulsory licensing and the reasonable rates of licensing fees (Scherer and Watal 2001, for a detailed analysis). Recent withdrawal of proceedings by the US against Brazil's compulsory licensing provisions show that intelligently crafted domestic patent laws can meet national objectives and yet be TRIPs compatible (Raizada and Sayed 2001).

b) Incorporating the Research Exception

Developing countries could incorporate provisions allowing researchers to use a patented invention for research, in order to understand the invention more fully. Experimentation on a patented invention is clearly admissible as an exception to exclusive rights under Article 30 (Correa 2000b).

c) Early Working Exception or 'Bolar' Provision

It is possible to make provision for allowing manufacturers of generic drugs to use the patented invention to obtain marketing approval without patent owner's permission and before the expiration of patent. This facilitates the generic manufacturers to market their products as soon as the patent expires. This provision is sometimes called the regulatory exception or Bolar provision under Article 8 (WTO 2001). The US, Canada, Australia, Israel and Argentina have adopted Bolar exception in their patent legislation (see Correa 2000b).

d) Resisting the Attempts to Evolve TRIPs Plus Regime and Ever-greening of Patents

Developed countries are constantly putting pressure on developing countries to implement stricter patent legislation than required under TRIPs, exclude compulsory licensing, parallel imports provisions and include provisions that would result in increasing the life of the patent (ever-greening), as well as grant data exclusivity to them. The TRIPs Agreement however, is clear that a new use for an old formulation does not constitute an inventive step (Art. 27(1)). Therefore, member countries are within their rights not to permit the practice of ever-greening of patents.

e) Allowing Parallel Imports or Grey-Market Imports

Since 'exhaustion of rights' issue cannot be raised in the dispute settlement under TRIPs Agreement, developing countries should allow parallel imports or grey-market imports. The experience of several countries suggests that substantial costs savings could result from such imports because of differential pricing strategy practiced by MNEs depending upon the extent of competition in different markets.

f) Competition Policy

The patent system grants temporary monopolies to the firms that introduce innovations. The national competition or antitrust policies are needed to prevent the build up of excessive monopoly power of certain enterprises and to deal with possible abuse of monopoly power emanating from patent protection. The TRIPs Agreement (Articles 8 and 40, Section 8) explicitly provides for appropriate measures to prevent the abuse of IPRs or the resort to anti-competitive practices (also see Roffe 1998). Apparently in the US, 'compulsory licensing has been specified as a remedy in more than 100 anti-trust cases making available some 40,000 to 50,000 patents at reasonable or no royalties' (Scherer as cited in Nogues 1990).

g) Incorporating Breeders Exceptions and Farmers Exceptions in sui generis Plant Variety Protection

TRIPs Agreement allows flexibility to the member countries to exclude plant varieties from the scope of patent protection and instead opt for an effective *sui generis* system. In order to minimize the adverse effect on the plant breeding programmes and protecting small and marginal farmers from buying seeds who typically save them for the next crop, developing countries could build provisions for exceptions for farmers and plant breeders. They should also participate effectively in the mandated Reviews of the Agreement under Article 27.3(b) to protect their interests.

h) Price Controls for Essential Drugs

To protect the poor masses from the price increases following the introduction of product patents, governments may impose regulation of prices of essential drugs. To keep the price controls effective, transparent formula for evolving them could be made providing for a reasonable mark-up over the cost. Indian experience shows that price controls have proved to be effective means of keeping prices of life saving essential drugs under check. However, given the possibility of transfer pricing manipulation, there may be complications in administering price controls for imported drugs.

i) Introduce Utility Models and Industrial Design Patents

The experience of several East Asian countries suggests that petty patents and industrial design patents could be effective means of encouraging domestic enterprises to undertake minor adaptive innovations and foster a innovation based rivalry among them.

Policy Responses at the International Level

The recent controversy concerning the HIV AIDS drugs in South Africa, among other factors, has helped to focus attention of the international community on the possible adverse effects of the implementation of TRIPs Agreement on poorer countries. Over the past year a number of international initiatives have been taken to deal with the matter. These include establishment of the Commission on Macroeconomics and Health by the WHO and Commission on IPRs by the British Government. WHO and WTO organized a Workshop on Differential Pricing and Financing of Essential Drugs at Hosbjor, April 2001. The Fourth Ministerial Meeting in Doha in November 2001 adopted a Declaration on TRIPs Agreement and Public Health. UNDP's *Human Development Report 2001* as well as World Bank's *Global Economic Prospects 2002* reports focused on the IPRs and their impact for developing countries. However, these initiatives are yet to lead to a concrete outcome addressing the many problems that are raised by the TRIPs Agreement. In what follows we summarize a few avenues for possible international action.

a) ***Moratorium on Further Strengthening of IPR Regime***

There is tendency in some developed countries to treat provisions of TRIPs as the minimum standards and are constantly attempting to evolve stronger norms through unilateral or bilateral approaches. A consensus needs to be built on the need to put a moratorium on such approaches for the next couple of decades or so.

b) ***Granting Flexibility to Developing Countries in Implementing the Provisions of TRIPs***

Most of the adverse effects concerning TRIPs on poor countries arise not because of IPR regimes but from the attempt to harmonize them across the countries at different levels of development (Panagariaya 1999). Thhere is also a discussion whether TRIPs should fundamentally belong to WTO (Mashelkar 2001). However, the least that could be done is allowing flexibility to developing countries to implement the provisions of the Agreement as and when their level of development has reached a certain stage. This could be achieved if a consensus among the developed countries is built on the differential need of developing countries for IPR regime[6]. A possible revision of TRIPs could incorporate a provision that grants to developing countries a flexibility to implement the TRIPs obligations until they reach a per capita income of the level of US$ 1000, for instance. Another possibility could be to shorten the term of product patents applicable to low income countries. This way the

[6] Barton 1999 and Sachs 1999 (as cited by Correa 1999) have acknowledged the need for a differential standard for developing countries. Mashelkar (2001) calls for 'TRIPS Plus Equity and Ethics'.

Agreement would have incorporated development dimension. The Commission's work could be instrumental in building such a consensus.

c) ***Incorporating Specific Provisions for Transfer of Technology***

The TRIPs Agreement pays an inadequate attention to the transfer of technology. Access to technology is increasingly become difficult for developing countries, as observed earlier. There is need for defining conditions, norms and practices for facilitating transfers of technology for production of essential drugs and other critical inputs.

d) ***International Funding R&D Activity in Low Income Countries***

One of the ways of compensating the low income countries for the adverse effects of strengthened IPR regime is to provide increased technical assistance and R&D funding to local enterprises to help them build local capabilities. One possibility in this respect could be that developed countries donate (a substantial proportion of) technology license fees collected from low income countries to a fund created in the respective countries to assist inventive activities of domestic enterprises. Furthermore, there is need to address the issue of funding R&D on special problems and tropical diseases that concern low income countries. It has been widely acknowledged that global pharmaceutical industry has neglected research on tropical diseases (WHO 2001). The CMH has recommended a donor commitment of $ 27 billion per annum for the health needs of low-income countries including $ 3 billion per annum for R&D for diseases of the poor. It is arguable that this funding of $ 3 billion could also help to moderate some adverse effects on the inventive activity in low-income countries if it is awarded to institutions and enterprises based in these countries. Therefore, an additional recommendation could be made in conjunction with those of CMH that the funds would allocated to eligible and competent institutions and companies of low income countries.

e) ***Differential Pricing***

There has been a lot of discussion on the possibility of improving the access of poorer countries to patented medicines through differential pricing (see WHO/WTO 2001). There are a number of practical issues concerned with the differential pricing that need to be resolved (see Mashelkar 2001). However, this is certainly one of the options to be explored.

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