

RIS A Think-Tank of Developing Countries

RIS is a New Delhi-based autonomous policy think-tank supported by the Government of India and devoted to trade and development issues. Its work programme focuses on policy research and capacity building on multilateral trade and financial negotiations, regional economic cooperation in Asia, South-South cooperation, new technologies and development, and strategic policy responses of developing countries to globalization, among other issues. The work of RIS is published in the form of research reports, books, discussion papers, policy briefs and journals.

RIS has networked effectively with other prominent policy think-tanks, government agencies, industry bodies and international organizations in Asia and other parts of the world for collaborative research and joint activities. It has a consultative status with UNCTAD, and has been accredited to the Summit Meetings of NAM and WTO Ministerial Conferences. It has conducted policy research and other activities in collaboration with other agencies, including UN-ESCAP, UNCTAD, UNU, Group of 77, SAARC Secretariat, Asian Development Bank (ADB), the World Bank, and the South Centre.

For more information about RIS and its work programme, please visit its website: www.ris.org.in.

— Policy research to shape the international development agenda



RIS
Research and Information System
for Developing Countries

Core IV-B, Fourth Floor
India Habitat Centre
Lodhi Road
New Delhi-110 003, India.
Ph. 91-11-2468 2177-80
Fax: 91-11-2468 2173-74-75
Email: dgoffice@ris.org.in
Website: <http://www.ris.org.in>
Website: <http://www.newasiaforum.org>

RIS Discussion Papers

FDI and Spillover Effects in the Indian Pharmaceutical Industry

Annika Bergman

RIS-DP # 113



RIS
Research and Information System
for Developing Countries

**FDI and Spillover Effects in the Indian
Pharmaceutical Industry**

Annika Bergman

RIS-DP # 113

August 2006



RIS
Research and Information System
for Developing Countries

Core IV-B, Fourth Floor, India Habitat Centre
Lodhi Road, New Delhi – 110 003 (India)
Tel: +91-11-2468 2177/2180; Fax: +91-11-2468 2173/74
Email: dgoffice@ris.org.in

RIS Discussion Papers intend to disseminate preliminary findings of the research carried out within the framework of institute's work programme. The feedback and comments may be directed to the author(s). RIS Discussion Papers are available at www.ris.org.in

Table of Contents

1. Introduction	1
1.1 Objective	3
1.2 Layout	3
2. Theoretical aspects of Foreign Direct Investment and spillover effects.....	4
2.1 Spillover effects from FDI	4
2.1.1 Different forms of spillover effects	4
2.1.2 Inter and intra- industry spillovers	5
2.2 Negative spillover effects	10
3. The Indian pharmaceutical industry in a historical perspective.....	11
3.1 The Indian pharmaceutical industry	11
3.1.1 The history of the Indian pharmaceutical industry	12
3.2 Foreign Direct Investments in the pharmaceutical industry	14
4. Transmission channels of spillover effects in the	15
Indian pharmaceutical industry	
4.1 Competition	17
4.2 Imitation and demonstration effects	18
4.3 Transfer of technology	19
4.4 Research and Development	21
4.5 Labour training and human capital	23
4.6 Industrial management	26
4.7 Summary of spillover effects from FDI	29
5. Econometric study of spillover effects	32
5.1 Data and methodology	32
5.2 Econometric results	35
5.3 Testing of the model	36
5.4 Discussion	37
6. Summary and Concluding remarks	40
References	46
Appendix	50

FDI and Spillover Effects in the Indian Pharmaceutical Industry

Annika Bergman*

Abstract: Foreign Direct Investment (FDI) is widely considered to be beneficial for the host economy since it can result in positive externalities (spillover effects) through various transmission channels, for instance, transfer of technology, increased competition and imitation effects. This study analyses intra-industry spillover effects of FDI in the pharmaceutical industry in India. A literature review, interviews and an econometric analysis are carried out in order to examine FDI's impact on the industry. The Indian pharmaceutical industry has developed through a range of governmental incentives and, foreign firms that have invested in the industry, have additionally contributed to the growth. The results are mixed. Spillover effects are visible in many of the spillover channels from FDI and the regression results show that firms with foreign ownership experience higher productivity levels. However, the correlation between FDI and productivity in domestic firms is insignificant, due to various reasons depending on whether the benefits from FDI are materialized, local firms' absorptive capability and factors such as the market structure, competitiveness, trade and technological policies. It is in the interest of the state to provide public policies and a sound economic environment to encourage benefit from FDI.

Keywords: Foreign Direct Investments, FDI, spillover effects, India, pharmaceutical industry

1. Introduction

Foreign Direct Investment (FDI) is often seen as a major element in the host country's industrial development and growth and its increasing role in international production has raised interest in its effects on the host economies. Besides providing capital inflow, the FDI can offer foreign

* University of Lund, Lund, Sweden. Email: annika.bergman@gmail.com. This paper was prepared during her stay at RIS as a Research Intern during 2005/06.

technology, managerial skills and improvement of the international competitiveness of domestic firms. Many standard models of Multinational Corporations (henceforth MNCs) assume that they possess superior assets such as knowledge, patents, trademarks and exclusive technology, which might “spill over” to the host economy and firms. The positive externalities from FDI, often referred to as spillover effects, are assumed to cause the domestic companies’ productivity level to increase. By reason of the scope of spillover effects from foreign firms, many governments have been taking action to stimulate foreign investments. India is one of many developing countries that have started an economic liberalization reform in the recent decade. Promotion of FDI forms an integral part of India’s new economic policies and the inflow of FDI has increased since it started to liberalize its economy in the beginning of the 1990s.

This is a study of FDI and spillover effects in the pharmaceutical industry in India. Horizontal productivity spillover effects of MNCs to the domestic Indian pharmaceutical firms are analyzed and potential transmission channels through which spillover effects might occur are studied. The pharmaceutical industry is severely technological and capital intensive and India is one of very few developing countries that have a comparative advantage in the industry. India’s pharmaceutical industry is an example of successful development in a highly science based technology sector. The government of India has promoted industrial development through a wide range of policies to strengthen the domestic industry. The growth in the industry since India’s independence in 1947 makes it interesting to study foreign firms’ impact on the development, since they have been a part of the foundation.

The impact of FDI on the host economy is widely discussed in the academic literature, since empirical studies have shown both positive and negative results of spillover effects. It is therefore important to analyze the role of existing FDI in a country to make FDI more effective for the local economy. Public policies in this field are therefore also analyzed. India strengthened its patent regime in 2005 and an increase of FDI into India in the pharmaceutical sector is expected. The potential increase of foreign participation in the pharmaceutical industry makes it interesting and important

to study public policies, which can be decisive for whether spillover effects take place or not.

1.1 Objective

The purpose of this paper is to analyze what impact FDI has on India’s domestic pharmaceutical industry through spillover effects. It will mainly focus on the intra-industry spillover effects and channels through which spillover effects might occur from the FDI to the local industry. Interviews and a literature review have been carried out for this purpose. A regression analysis is also carried out to determine if foreign ownership has any effect on the productivity of the domestic firms, i.e. if spillover effects exist in the pharmaceutical industry.

The main questions, that this study attempts to answer, are the following:

- Are there spillover effects observed from FDI in the Indian pharmaceutical industry?
- What characteristics do spillover effects in the Indian pharmaceutical industry have?
- Does foreign ownership in the Indian pharmaceutical sector affect the productivity of domestically owned firms in the industry?

1.2 Layout

The paper starts with a theoretical section, which defines FDI, spillover effects and governmental policies from a theoretical point of view. In section three, the characteristics of the pharmaceutical industry are clarified. The history and development of the pharmaceutical industry in India are also described. Section four focuses on FDI in the pharmaceutical industry in India. Additionally, the market structure and the competitive environment in the industry are brought to light. In section five, a qualitative analysis is carried out and the transmission channels, through which spillover effects may be generated from FDI in the pharmaceutical industry, are observed. In this section, the first and second questions stated in this paper are examined and discussed. Section six focuses on the third question and an econometric study is carried out, in order to determine if there are any productivity spillovers from FDI in the industry. Lastly, conclusions are presented in section

seven. Also, recommendations are made on how public policies in India can facilitate spillover effects in the pharmaceutical industry.

2. Theoretical Aspects of Spillover Effects

The following section will give a definition of Foreign Direct Investment¹ and the theoretical aspect of why firms decide to invest abroad as well as the host country's motive to attract FDI. The theory of spillover effects and transmission channels, through which spillover effects might arise, are identified. Earlier empirical research will be clarified and different outcomes in earlier research are explicated. Finally, public policies, which are sometimes used to maximize spillover effects, are described.

2.1 Spillover effects from FDI

FDI is often seen as a catalyst for a country's development and economic growth, which is the reason for attracting FDI to the country. There is extensive economic literature that stresses the importance of FDI and its spillover effects to the host economy. Reasons for the importance of FDI is not only the fact that the foreign investor finances the "hardware" such as investment in new plants and equipment, but FDI can be a major transfer of technology, knowledge and capital for the host industries. With FDI comes financial and managerial resources, access to larger markets, technical assistance and strategic assets; for instance, brand name, which can give the host firms, domestic and international, comparative advantage. Spillover effects may take place when the entry or presence of foreign firms leads to productivity and efficiency benefits in the host country's local firms (Blomström & Kokko, 1997). A positive spillover occurs when "*local firms benefit from the foreign investment enterprise superior knowledge of product or process technologies or markets, without incurring a cost that exhausts the whole gain from their improved performance*" (UN-ECE, 2001, p. 2).

2.2.1 Different forms of spillover effects

There are several ways spillover effects from FDI have been examined in previous work. One can study spillover effects from two main approaches; the direct and the indirect approach. One common way to examine spillovers is through statistical studies, where spillover effects are *directly linked* to foreign presence (Blomström *et al.* 1999). The aim of the direct approach

is often to relate productivity measures of domestic firms to the presence of the MNC. The most frequent method used is to estimate production functions, in order to evaluate how foreign presence affects the productivity in an industry (industry level studies) or the productivity of locally owned firms (micro level studies). Econometric studies of spillover effects may reveal the overall impact of foreign presence on the productivity of domestic firms, but they are usually general and do not say how the effects come about (Blomström & Kokko, 2003). In previous studies different techniques and variables have been used for the econometric models, which can be an explanation for the different outcomes (Görg & Greenaway, 2001).

A case study, which identifies potential transmission channels of spillover effects, is another way to study spillover effects. This way to analyze spillover effects is an *indirect approach*, the objective being "*to identify channels through which FDI spillovers might be realized and then evaluate the robustness of those channels*" (Blomström *et al.* 1999, p.14). Through case studies, different aspects of the interaction between the MNCs and host country residents that are related to spillover effects are examined (Blomström *et al.* 1999). Case studies provide much detailed information about the different channels in one sector, but it can be difficult to draw general conclusions from them.

2.2.2 Inter- and intra industry spillover effects

The spillover effects of foreign firms to the local industries can be divided into two groups; inter- and intra-industry spillover effects. *Inter-industry (vertical) spillovers* occur through foreign companies' impact on the local suppliers. Vertical spillovers take place when the foreign firm and a local supplier, in different industries, are engaged in a long-term relationship. Inter-industry spillovers appear through creation of linkages between the foreign company and domestic firms and it is a process that is usually multi-sectorial. Spillovers occur when the local suppliers have to meet the demand from the foreign firm in the form of higher quality, price and delivery standards (Smarzynska, 2002). Another implication of inter-industry spillover effects is the increased demand by the MNC for local intermediate inputs, thus increasing production possibilities in the host economy. If the foreign firms use intermediate goods, produced by domestic firms, spillover

effects may arise when FDI allows domestic suppliers to expand their production and thus reduce their average costs due to increasing returns to scale (Barrios, 2000). Moreover, if there is a technology gap between the foreign and the domestic firms, there is potential for technological improvement in the host economy. The local firms must upgrade their products in order to meet the foreign firm's demand for advanced products.

Intra-industry (horizontal) spillovers result from the presence of MNCs in a particular sector and its influence on the host industry's competitors. Five transmission channels, through which intra-industry spillover effects might occur, are (i) competition (ii) demonstration and imitation effects (iii) transfer of technology and R&D (iv) human capital and labour turnover (v) industrial management² (Blomström *et al.* 1999).

Competition

It is likely that an MNC has advantages that overcome potential entry barriers when entering a new market.³ Advantages, such as financial means, capital, R&D and technological domination, consequently increase the competitive environment in the host economy (Görg & Strobl, 2001). Increased competition in an industry forces less efficient domestic firms to take on more efficient production, which can be welfare enhancing for the economy. The superior technology of the foreign firms may stimulate domestic efforts to compete, which may, for example, lead to new innovations. Since MNCs are likely to have a technological advantage, local firms might be forced to invest in additional human and physical capital, in order to raise productivity and to be able to compete with MNCs. The entry of a foreign affiliate can create or intensify competitive pressure on local firms and stimulate them to use existing resources more efficiently.

If monopoly or oligopoly dominates the industry, the entry of foreign companies can break the inefficient market structure. In addition, if the competitive environment in the host country is high, the MNCs must bring in relatively new and sophisticated technology from their parent firm to keep their market share. Consequently, the scope for further spillover effects is increased. Sjöholm (1999) finds more extensive spillover effects of FDI in industries where the domestic competitive environment in the industry is high.

Since the MNC produces in competition with domestic firms, the latter must use their technology more efficiently; consequently elimination of inefficient firms is the result of FDI. However, increased competition could be negative for the domestic firms, if the market is populated with inefficient domestic firms, since the MNCs can sweep them out (Taymaz *et al.* 2004).

Demonstration and imitation effects

MNCs have advantages due to their possession of proprietary technology, management and marketing skills. Through FDI, these skills are brought into the host economy. Domestic firms can consequently observe the foreign firms' techniques and later imitate them. Demonstration and imitation spillover effects represent "learning by watching effect" (Blomström *et al.* 1999). Due to the foreign firms' superior knowledge and technological advantages, spillover effects can occur through adoption of such new technology and knowledge. Technological spillover effects may occur through imitation, reverse engineering and copying of foreign companies' products or production processes. Knowledge is rarely available on the market but through reversed engineering or hiring foreign employees, with the "proper" skills, it is possible for the local firm to copy products and production processes. Imitation of already existing products might lead to technological progression for the local companies.

Imitation is a primary transmission mechanism of FDI to local firms and especially reverse engineering for technology transfer of new products and processes in a North-South perspective. Any upgrading of local technology deriving from imitation could result in productivity spillover from foreign to the local firms (Görg & Greenaway, 2001). Additionally, MNCs tend to export lots of their products, and thus there is scope for spillover effects through imitation of how to enter export markets, international marketing techniques and distribution networks (Görg & Greenaway, 2001).

Transfer of technology and R&D

Technology can be characterized as "technical knowledge applied in the production of any article of commerce" (Naravana, 1984, p. 87). Many standard models of MNCs assume that they possess knowledge assets, for

instance patents, trademarks and exclusive technology. MNCs are usually Research and Development (R&D) and capital intensive, hence a potential source of intra-industry spillover is the transfer of production and process technology from MNCs to the domestic companies. The foreign firms make the domestic players aware of the existence of the technology and the MNCs are likely to speed up the domestic firms' technology. Enhancement in technology enables firms to increase productivity and build competitiveness in new areas (Mansfield & Romeo, 1980).

Technology and productivity gaps between the foreign and local firm may stimulate spillover effects. If a technology gap exists we should expect to find some differences in productivity and innovations between foreign owned and domestic firms. If the local firm is less productive than the foreign firm, there is a scope for it to catch up, by imitating the technology of foreign leaders. Blomström (1986) found that multinationals acted as a catalyst for the Mexican manufacturing sector and that there was productivity convergence between Mexican and American firms in several industries. However, there is a risk that the MNCs' advanced technology is beyond the local firm's absorptive capacity, which could lead to adverse consequences for the domestic firms' market position (UN-ECE, 2001).

Another activity, that could stimulate spillover effects and technology transfer, is the R&D performance that the MNC may undertake in the host country. The MNCs are often very R&D intensive, but generally concentrate most of their research activities in the parent affiliate, which limits the scope of spillover effects. The focus of R&D that is carried out in the foreign affiliate is often a modification of the parent technology, so it suits the foreign market (Blomström *et al.* 1999). The spillover effects from R&D are therefore usually generated outside the host country and brought in through the FDI.

Investment in human capital and labour turnover

Foreign investors may provide a form of training for their employees that cannot be replicated in domestic firms or purchased from abroad. The theoretical literature on foreign investment states that foreign firms possess intangible assets, which cannot easily be sold, such as managerial skills

(Haddad & Harrison, 1993). Evidence indicates that MNCs offer more training to managers and employees than domestic companies. A local employee who has been trained within the MNC may add more profitability to the domestic enterprises since skilled workers, managerial talent, and scientists are usually scarce in developing countries (Aitken & Harrison, 1999). Therefore, the local economy can gain from the presence of an MNC, whose knowledge might become available to local firms through, for instance, labour turnover. Labour turnover is a spillover mechanism that may benefit the local industry, since circulation of the labour force enables some original knowledge to transfer between the foreign and domestic firms. Katz (1987) shows that numerous managers in local firms, in Latin America, started their careers in foreign companies. According to Dunning (1970), the foreign company's management and technological skills from the parent company can be seen as a "brain-drain in reverse" to the local economy, as they gain particularly scarce and needed entrepreneurial skills.

Industrial management skills

Dunning (1970) argues that the foreign firms' superior managerial and organizational skills can be beneficial for the host economy. If resources are more efficiently used, than under domestic management, local firms are likely to raise managerial incentives and make efficiency-enhancing investments in their firms, due to the risk of a loss of market share to the foreign firms.

Additionally, FDI can play a significant role in the host economy in terms of introducing marketing and promotional techniques in an industry. Well-developed marketing and distribution networks are important factors for success. Firms from developing countries often lack resources for advertisement and promotional activities; subsequently they have problems competing with the multinationals. Firms from developing countries generally compete in international markets on the basis of price-cutting and focus on low-end markets (Kumar & Siddharthan, 1994). Quality consciousness is an important factor for success in the international markets and brand building is a significant part in successful marketing and expansion of product consciousness for consumers. For instance, a well-established marketing strategy is

important in export activities. Firms, which invest in promotion, are expected to do better in the international markets than others, due to the importance of building brands and trade names. Kumar & Siddharthan (1994) found a positive relationship between advertising and export behaviour. The MNCs usually have better knowledge and experience of international markets, and can therefore help the domestic firms to achieve more in export activities (Görg & Greenaway, 2001). Through imitation of or collaboration with foreign companies, the domestic firms can learn different industrial management techniques and the importance of marketing tactics, and thus expand domestically or internationally.

2.2 Negative spillover effects

Despite the theoretical assumptions of positive spillover effects, the empirical results of earlier studies of FDI impact on the productivity of domestic firms are mixed, i.e. positive, negative and insignificant results (Görg & Greenaway, 2001).⁴ Aitken & Harrison (1999) argue that FDI can have negative effects on the domestic firms' productivity, which may be large enough to offset the positive impact from FDI. The so-called "market stealing effect" refers to when foreign firms enter a host economy and their technology advantages take over the domestic market shares. The MNCs' advantages draw demand away from the domestic firms' products; hence the domestic firms' productivity decreases. Examples of studies that show negative spillover effects are Aitken & Harrison (1999) and Haddad & Harrison (1993).

There are several explanations for the mixed results of earlier studies of spillover effects, such as different measuring techniques and unreliable data used in the studies (Görg & Strobl, 2001). The varied results are also argued to depend on characteristics of the host country and the investing firms. Explanations such as "absorptive capability" of the host economy, domestic market competition, ownership structure of foreign firms and technology gap between foreign and domestic firms in the industry can explain the different outcomes. Absorptive capability refers to the fact that FDI may be more beneficial for an industry if the domestic firms have a minimum level of technological development and human capital (Blomström & Kokko, 2003).

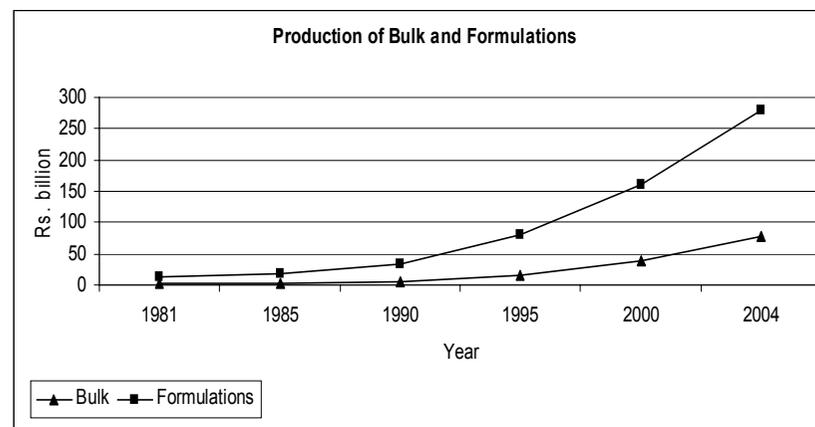
3. The Indian Pharmaceutical Industry

The pharmaceutical industry is classified as one of the most high-tech and capital-intensive industries in the world. Developed countries accounted for 92.5 per cent of the world's export of pharmaceutical products in 2001 (Authors own calculation from UN-Comtrade). The technology and capital intensity of the industry, the risk, high costs in research activities and dependence on a well functioning intellectual property regime, explains why the pharmaceutical industry is mainly located to the developed economies. However, India is one of the few developing countries with a large production base in pharmaceutical products.

3.1 The Indian pharmaceutical industry

India's trade in pharmaceutical products has increased a lot since the liberalization reforms and it has comparative advantages in trade with pharmaceutical products, both bulk drugs and formulations.⁵ The Indian pharmaceutical industry ranks very high among developing countries, in terms of technology and quality, and is today in the front rank of India's science based industries (DIPP, 2005). The growth of the Indian pharmaceutical industry has been remarkable. As we can see in Figure 3.1 production in the Indian pharmaceutical industry has increased a lot between 1981 and 2004.

Figure 3.1 India's production of bulk and formulations 1981- 2004



Source: Data from OPPI (2005).

3.1.1 The history of the Indian pharmaceutical industry

The development of the Indian pharmaceutical industry can be divided into three phases, which are presented below.

The initial stage (1947-1970)

From 1947 to 1970; the Indian pharmaceutical industry was small in terms of number of firms and production capacities. In the 1950s the Indian pharmaceutical industry was mainly based on imported bulk, which was later processed into formulations in India. The Indian government wanted to get rid of the industry's dependency on the import of bulk drugs and encouraged indigenous production of new drugs in order to become self-sufficient. The government invested a lot in the pharmaceutical industry and the *public sector* is a large part of the industry. India received technical assistance and financial means from international organizations, such as the WHO and UNICEF, to set up plants and strengthen the domestic industry. The public unit Hindustan Antibiotics Ltd. was established in 1954 and was provided with technical support, purchasing of equipment and machinery from the WHO and UNICEF. The Indian Drugs and Pharmaceuticals Ltd. (IDPL), another public sector firm, got free access to import technology from overseas and developed more modern manufacturing facilities (Naravana, 1984). Many leading entrepreneurs got their training in public sector units and institutions. For instance, the founder of Dr. Reddy's, one of the largest pharmaceutical firms in India today, worked at the IDPL, before he took off to start his own firm.

Multinationals are, in addition to the public sector, a part of India's pharmaceutical foundation. Foreign companies entered the Indian market merely as trading companies with small investments. The new industrial policies emphasized the importance of foreign capital and industrial know-how. The Indian government carried out liberal FDI policies and incentives to invite foreign firms to start manufacturing facilities in order to get an inflow of know-how in the sector. The leading pharmaceutical companies from the West came to India and established manufacturing facilities. Subsequently, the multinationals brought in technology and international manufacturing practices (ICRA, 2004). Domestic firms were encouraged to tie up with foreign firms, with participation in capital, and there were collaboration agreements in the private sector.

The import substitution stage (1970-1985)

Until 1970, multinational corporations dominated the Indian pharmaceutical industry. During the 1970s, there were new drug policies introduced in India, which created a major opportunity for Indian domestic firms to grow. Import substitution and self-reliance were the objective in the pharmaceutical industry in the years to come. A number of policies and regulations were carried out to expand the domestic pharmaceutical industry in order to become self-reliant and to keep prices of pharmaceuticals low. The government made a distinction between domestic and foreign firms, where Indian firms were given production incentives while the foreign firms faced tighter control. The 1978 drug policy imposed conditions on foreign-controlled firms to make sure they created linkages within the economy. There will be a further description of the linkages between foreign and domestic firms in section four. In this period, the production of both bulk and formulation increased, and the industry more than doubled during the 1970s. The Indian companies took advantage of the new policies and produced molecules that were still under patent elsewhere. The Indian firms developed better production and marketing skills; consequently the multinationals' market share started to decline. Despite the tighter controls for foreign firms, they still had a large share of the production in India during this time (Dhar & Rao, 2002).

The liberalization stage (1985-today)

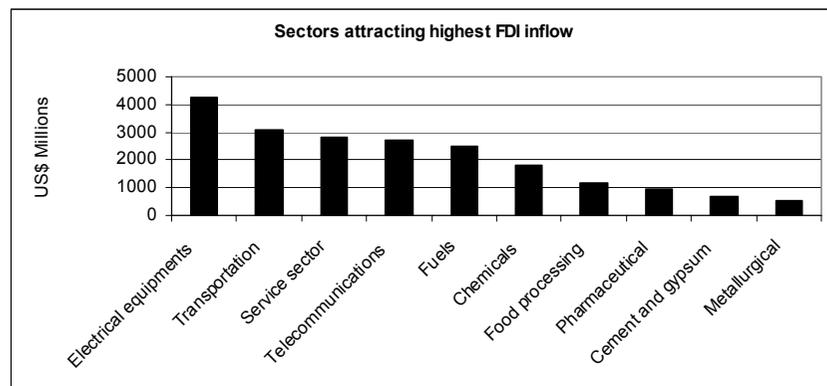
In the 1980s, Indian policy makers realized that the competitiveness of the pharmaceutical firms suffered from growing technological obsolescence due to the highly protected market. The government therefore highlighted the importance of modernization of the industry. Another limiting factor for the domestic industry was the marketing channels, which were mainly dominated by the MNCs (Kumar, 1998). In the mid 1980s, the Indian government attempted to improve efficiency in the industry. A new drug policy was implemented in 1986, which was more favourable towards foreign firms. Trade barriers were reduced and so was price control. Supported by the IMF and the World Bank, India started to liberalize its economy in 1991. A series of economical reforms were declared and implemented. Industrial deregulation was intended to reduce the role of the government in directing industrial activity where the private sector could

operate. The liberalization of the Indian economy affected the pharmaceutical industry in several ways. The public units that had a production monopoly in certain drugs were opened up for competition and privatized (Aggarwal, 2004). Also, the requirement for a certain ratio in bulk drug production was removed and equity share and approvals of FDI in the industry were relaxed and the number of drugs under price control was relaxed. In the last decade, a new direction in the Indian pharmaceutical industry has taken place. In 1995, India joined the WTO TRIPs agreement⁶ with enforcement of Intellectual Property Rights (IPR). India was granted a transition period of ten years to implement the new patent laws. The business focus shifted among many Indian companies and the trend of focusing on R&D commenced. The new patent regime is argued to have a large impact on the future of the Indian pharmaceutical industry.⁷

3.2 Foreign Direct Investments in the pharmaceutical industry

The inflow of FDI into India has increased in the last fifteen years. The pharmaceutical industry attracted 2.11 per cent of total FDI inflows during these years (SIA, 2003). In Figure 3.2 we can see the industries that attract most FDI in India. The pharmaceutical industry was the 8th largest sector attracting FDI inflows between 1991 and 2003. The FDI stock in the pharmaceutical industry was 3 per cent of the total FDI stock in India in 2001 (Bhaumik *et al.* 2003).

Figure 3.2 Sectors attracting highest FDI in India 1991- 2003



Source: Department of Industrial Policy and Promotion (2006).

Most of the major pharmaceutical MNCs have a presence in the country. Nonetheless, FDI in the pharmaceutical industry is rather low (GoI, 2005). The investment climate according to some of the MNCs is not complete, which explains why FDI in the pharmaceutical industry in India is limited. According to Pfizer⁸ (2005) there has been a perceptible difference in the climate for investment during the last decade, but more needs to be done to make the policy environment more investor friendly. There are several factors, such as bureaucratic milieu, price controls and lack of intellectual property laws, which explain the lack of investments.

Production costs have risen in the pharmaceutical industry by reason of increased complexity of the chemical structure of drugs. Outsourcing production or research activities can lead to cost reduction for the company and many foreign pharmaceutical companies outsource parts or their entire production in India. Labour unions, rigid labour laws, and a lot of red tape in India make outsourcing more attractive to foreign companies than having their own manufacturing units. Today, GlaxoSmithKline outsources 70 per cent of its production and Novartis 100 per cent of its production.⁹ Pfizer and Organon have sold out some or all of their manufacturing units in India,¹⁰ since they find it more profitable to outsource their production to local manufacturers instead of producing in their own factories. Outsourcing may lead to reduction in the investment required and offer better financial returns. According to the MNCs interviewed, it is more economically efficient to use contract manufacturers since the plant is already set up, and the firms do not have to deal with strikes and Indian labour laws. The reason for the outsourcing and disinvestment of the foreign firm Organon was “*to focus entirely on its core business of marketing, distribution and sales of formulations, whilst continuing with its quality control facilities for overseeing the quality of its products*” (Organon Director’s report, 2004).

4. Transmission Channels of Spillover Effects in the Indian Pharmaceutical Industry

Spillover effects of FDI in the Indian pharmaceutical industry will be clarified in the following section. The spillover effects are analyzed based on the transmission channels mentioned in section two. The focus will be mainly on the intra-industry spillover effects.¹¹ Table 4.1 contains a summary

Table 4.1 Spillover channels and productivity gain of domestic firms

Driver	Sources of Productivity Gain
Competition	<ul style="list-style-type: none">● Faster adoption of new technology● Reduction in inefficiency
Demonstration and imitation	<ul style="list-style-type: none">● Improvement of new production methods● Improvement of new management practices
Transfer of technology and R&D	<ul style="list-style-type: none">● Adoption of new technology● Scope of productivity convergence
Human capital and labour turnover	<ul style="list-style-type: none">● Tactical knowledge● Increased productivity of labour
Industrial management skills	<ul style="list-style-type: none">● Increased access to international markets● Increased knowledge in promotional activities● Adoption of higher quality standards

Source: Author's summary, derived from Görg & Greenaway (2001, p.3).

of the transmission channels and the source of productivity gain of domestic firms. These will be in focus when analyzing the externalities from FDI.

As earlier described in the theoretical section, there are two general ways to evaluate spillover effects; the indirect approach through case studies of transmission channels and the direct approach through a statistical estimation. Spillover effects are difficult to measure and the most frequent way to analyze them is econometrically. Case studies of specific industries are not as common due to difficulties, drawing general conclusions about spillover effects in other industries. Nevertheless, a case study of the transmission channels in the pharmaceutical industry is carried out here to get a deeper understanding of how spillover effects can occur in a specific industry. Hence, in section six, an econometric study is carried out.

Several interviews were conducted to examine spillover effects that might have taken place in the industry. Eleven firms were chosen for the interviews. In order to get a wide perspective of the matter, firms of different sizes were chosen; two small/ medium scale domestic companies, four large domestic companies and five foreign companies.¹² The large domestic and the foreign firms (except AstraZeneca) are all among the top performing firms in India, according to total sales. For a presentation of the firms, see Appendix, Table III. In order to analyze the foreign companies' effects on

the local economy and expectations of FDI, interviews with the Organization of Pharmaceutical Producers of India (OPPI) and the Government of India¹³ (GoI) were carried out.

The section is organized into six parts, each describing and analysing the different spillover channels in the pharmaceutical industry. The last part contains a summary of the spillover effects. Externalities from FDI in the industry are analyzed from a past, present and future perspective.

4.1 Competition

Foreign firms have been a part of the Indian pharmaceutical industry since its initial stage. When the first MNCs entered the Indian market, they basically had a monopoly in the industry, and thus there were no spillover effects in terms of increased competition. Today, the domestic industry is well developed, which means that MNCs and the local firms compete at the same level. In 1992, thirteen companies of the top twenty had foreign origins (Felker *et al.* 1997), but today the number of MNCs at the top has decreased because of lower profit margins and increased competition from domestic firms. The presence of MNCs in India has a large impact on the competitive environment in the Indian pharmaceutical industry and stimulates the domestic firms to upgrade their technology and investments in marketing (GoI, 2005).

The business environment in the Indian pharmaceutical market is today highly competitive with a large number of players. Features such as costs, research orientation, product portfolio, production capability and marketing and distribution network are important factors for a firm to succeed and be able to compete effectively in the pharmaceutical industry. The MNCs in India are characterized by advantage in many of these factors, while their domestic competitors have an advantage in production capacities and costs. Since the foreign firms do not have cost advantage in production, they invest large sums in marketing and fieldwork to promote drugs. Today the domestic companies seem to have adopted the MNCs' marketing expertise and strategies to be able to compete. The domestic firms are more or less forced to try to keep up with the MNCs' marketing abilities and the local firm's increased market share indicates they have been doing well.

The spillover effects from competition can be expected to increase in the future. The Indian economy is getting increasingly liberalized and the government of India wants to raise FDI further in the pharmaceutical industry in order to stimulate competition. *“The foreign firms contribute to the increased competition in the industry. If the industry is not competitive, development of products and firms is not likely to occur at the same speed as in a competitive environment”* (GoI, 2005).

With the introduction of the product patent regime in 2005, more research-based pharmaceutical companies are expected to establish their presence in India. Many of the domestic firms are strong enough to face increased competition in the new setting, but the firm must have reached a certain level to be able to compete with the foreign companies and also with the largest domestic firms. The enhanced competitive environment in the new patent regime may be difficult for the small-scale producers. Many of the small-scale producers are lacking production/product quality and many are also inefficient. According to one small-scale producer, the government support, in terms of help with up-gradation, is not enough. It will be tough for the small firms to handle the competition and transition to the new patent regime. There is therefore risk of a “market stealing effect”, negative spillovers, with increased pressure from the new scenario in the Indian pharmaceutical industry. It is likely that many small-scale firms have to lower their production or shut down since they cannot handle the competition. Nevertheless, spillover effects from competition lead to the reduction of inefficient firms, and in the short term unproductive firms are likely to be swept off the market. On the other hand, in the long term, the industry is likely to develop because of better allocation of resources.

4.2 Imitation and Demonstration Effects

The Indian pharmaceutical industry is basically built upon imitation and demonstration effects through reverse engineering of foreign developed molecules and technology. The MNCs that entered the Indian pharmaceutical industry after independence introduced new drugs and technology into the country. The public policies that were implemented in the 1970s allowed copying and diffusion of technological knowledge and expertise from foreign firms (Felker *et al.* 1997). Drug innovations are relatively easy to copy and

technology might leak out through staff turnover or as codified formulas (Felker *et al.* 1997). Foreign firms in India have “unwillingly” contributed to the industry’s development through domestic firms imitating their products. Imitation of already existing products has led to know-how adoption and technological development for the local Indian companies. Consequently, the spillover effects from imitation of foreign firms’ technology and knowledge seem to have been large in the Indian pharmaceutical industry.

Today, basically all Indian companies are generic firms. Many of the larger domestic firms possess advanced technology and it can be argued that the spillovers from imitation are not as strong as in the past. However, there is still scope for spillover effects through imitation if the MNCs introduce new technology in the Indian industry. With a strong patent regime for protection of intellectual property rights, spillover effects through imitation are less likely to be generated in the future. The adoption of the new patent regime is likely to limit the imitative R&D carried out in India, which might affect the development in the industry in the short run. In the long run however, it is argued that an effective protection of IPR is necessary for the industry to grow further. India has innovative capabilities and increasing numbers of domestic firms are investing in R&D for developing new molecules. Spillover effects through imitation are probably going to decrease but with the establishment of more foreign firms, new technology is entering the country and, through collaboration, demonstration effects can still occur. Furthermore, spillovers from imitation and demonstration effects can also be found in marketing and management practices. See the upcoming section “spillovers from industrial management practices”.

4.3 Transfer of Technology

Spillover effects, in terms of technology transfer, can be created if the MNCs use more advanced technology in their production processes than domestic firms. Thus, technology and productivity gaps between the foreign and local firm may stimulate spillover effects. If the local firm is less productive than the foreign firm there is scope for it to catch up. Technology in the pharmaceutical industry is often very complex and the need for up-grading the technology is large due to the rapid pace of new drug discovery

and strict requirements of safety and efficiency (Naravana, 1984). Foreign pharmaceutical affiliates in India receive up to date technology from their parent firm, both in managerial practices and in manufacturing facilities, which could stimulate spillover effects.

Spillover effects in terms of technology transfer from MNCs in the Indian pharmaceutical industry seem to have taken place at an early stage. The Indian government wanted to build a strong pharmaceutical industry and welcomed the entry of MNCs in order to strengthen the domestic industry through their sophisticated technical know-how. The foreign companies had modern managerial skills and sophisticated technical knowledge. In the industry's early stage, foreign pharmaceutical companies invested more in India than the public and large Indian firms (Naravana, 1984). The MNCs contributed to technology advancement in the industry, mainly through imitation, and the enhancement in technology from foreign firms enabled domestic firms to increase productivity and build competitiveness in new areas (various interviews).

Today, the largest Indian domestic firms have advanced technology and science-based facilities, so the technology gap between the foreign and the large domestic players is narrow. There has been a production convergence between the foreign and large domestic firms. The MNCs in India use similar advanced technology to the top domestic players (GoI, 2005). Hence, the scope for technology transfer is limited. Certainly the foreign companies' technology is far more advanced than many of the small-scale companies in the industry, but so is the top Indian firms' technology. Nonetheless, the technology and knowledge gap in terms of innovative R&D between MNCs and Indian firms is still wide, but will be discussed ahead in this section.

Previous studies of spillover effects have shown that MNCs provide technical assistance to their suppliers in order to raise their product quality (Smarzynska, 2002). This is also found to be the case in India's pharmaceutical industry. Subsequently, technology transfer takes place between some foreign firms and their suppliers in the pharmaceutical industry. As we saw in section four, many of the MNCs in India outsource

all or parts of their production, and have not established manufacturing units of their own. For instance, the foreign firm Novartis outsources 100 per cent of their production and according to the director; Novartis upgrade their suppliers' technology and share good manufacturing practices with the suppliers. Some of the suppliers are given inputs so they can upgrade the production facilities to international standards. According to Shahani (2005-12-09), it is more economically beneficial to outsource the technology to suppliers than manufacture themselves. Nevertheless, producing for a multinational firm requires a high standard of production facilities. Novartis' quality personnel check the outsourcing plants regularly, which give incentives for the suppliers to upgrade, and keep up the quality and technology in order to be competitive. Spillover effects in terms of quality awareness for products and production processes are hence being generated.

Considering the pharmaceutical industry's high-technology intensity, there seems to be limited technology transfer taking place in India. The MNCs in India made technology available to the domestic industry at an early stage, but today technology transfer is rather limited (various interviews). Since the MNCs do not conduct much R&D in India, the domestic firms' (the larger ones) technology is equally developed as the MNCs. Nevertheless, there might be more technology transfer in the future when the IPRs are protected. According to Pfizer, newer technology will most likely become available to domestic firms when there is a strong patent regime, mainly through collaborations between MNCs and domestic firms (D'Souza, 2005-12-20). It is possible that under the new patent laws, MNCs will start to outsource even patented drugs in India; consequently there will be larger scope for technology transfer spillovers in the future.

4.4 Research and Development

R&D performance, which the MNCs may undertake in the host country, can generate spillover effects. R&D intensity in the Indian pharmaceutical industry is rather low and the spillover effects from MNCs in terms of innovative R&D seem to be negligible. Again, the weak patent regime is one of the main reasons why MNCs have limited R&D facilities in India. The foreign firm Ciba established an R&D centre in 1964 but they closed down in 1982 because of imitation by domestic firms. The spillover effects

in India from R&D are hence mainly generated outside the host country and might be brought into the country through the foreign company (D'Souza, 2005-12-20). Today, Europe, the US and Japan account for 93 per cent of the global R&D expenditure (ICRA, 2004) and most of the MNCs' R&D centres are located in the parent affiliate. For instance, Novartis has its R&D centres located in Basel, Boston and Singapore (Shahani, 2005-12-09).

In India, the MNCs' share in R&D is very low and the average intensity was 0.3 per cent of the annual turnover in 1990 and in 2001 it increased to 0.7 per cent (Pradhan, 2003). Larger numbers of foreign firms conduct R&D in India today and the average intensity has slightly increased, but is still very low. On the other hand, Indian firms have increased their R&D a great deal in the last years. With the new patent regime in place, the business models have begun to change and the larger Indian firms have started to shift towards innovative research¹⁴ and invest heavily in R&D. The focus of the R&D that is being performed by the MNCs' affiliates in India is, for example, on data research and modifying the parent technology so it suits the foreign market. Most research that is undertaken by MNCs in India is considerably basic compared to the research that is performed in the parent firm. Research of new molecules is not carried out because of the risk of imitation. Consequently, spillover effects in terms of R&D are limited.

Today, there is a vast gap between Indian firms and global companies in terms of R&D.¹⁵ An Indian company has never introduced a new product, based on newly discovered molecules, in the market. To do so, the need of financial means is immense and the risk is large. Cooperation with an MNC can therefore help Indian firms in the research process. Thus, there seem to be some potential spillover effects in R&D through *collaboration* between foreign and domestic firms. For example, Ranbaxy and GlaxoSmithKline (GSK) have a joint research project going on. Ranbaxy does research in the first stages of the innovation process and then GSK takes over. The companies share everything in terms of knowledge and methods carried out in the research process (Ahuja, 2005-11-10). Ranbaxy is the largest and one of the most advanced pharmaceutical firms in India and the research carried out in the collaboration research is parallel to Ranbaxy's knowledge

level, so that the potential spillover effects generated is limited. On the other hand, collaboration projects such as this are expected to be beneficial for the domestic firm since the MNCs bring in financial means and at the same time help Indian companies to gain international credibility and move up the learning curve (Gulati, 2005-11-10).

R&D centres in the Indian pharmaceutical industry have begun to emerge, which increases employment opportunities and also reverses the brain drain from India.¹⁶ The R&D centres attract Indian scientists who earlier migrated to developed countries to find suitable work opportunities. With the new patent regime and enhanced work pool of skilled labour, it is very likely that MNCs will begin innovative research in India in the future. R&D activity is very competitive, which can benefit the domestic industry in terms of increased focus on innovation and improvement. If the foreign companies start to develop R&D units in India, the competition is likely to increase among the players in the industry. Further spillover effects in terms of competition in R&D activities will possibly be generated in the future. As more domestic companies engage in various parts of the R&D, the knowledge gap between the firms will decrease and the absorption capability of spillover effects increase.

Lee and Mansfield (1996) point out that weak intellectual property protection and forced licensing of technology are likely to discourage FDI and technology transfer. All the foreign firms interviewed for this study point out the weak patent regime as the main reason for disinvestments in the pharmaceutical industry in India.¹⁷ The intellectual capital protection is not strong enough, both in regard to product patent and data protection. Even though India is a WTO member there is an additional concern about appropriate and speedy implementation of the intellectual property regime for product patents (various interviews). In addition to the weak IPR protection, the price regime with its price control is also a reason for foreign companies not to invest heavily in the industry.

4.5 Labour training and human capital

Well trained employees can be a source of a firm's productivity gain when the resources are used more efficiently. Training and development of

employees across all levels is a key investment area for many of the MNCs. The aim of investment in training is to make each employee highly productive (Bhujle, 2005-12-06). The pharmaceutical MNCs in India have collectively thousands of employees, who enrol in training programmes. According to several of the firms interviewed, the MNCs provide more and better training than the average domestic firms (various interviews with both foreign and domestic firms). Thus, there seem to be spillover effects generated in terms of human capital in the Indian pharmaceutical industry.

Many of the MNCs provide a great deal of in-house training and offer programmes for everyone from top employees to floor staff in the firms. For instance; *AstraZeneca* has taken some strategic steps towards human resource development, with particular “*focus on creating a strong performance driven culture and improving the capability of its employees*” (*AstraZeneca India Ltd. Directors report, 2004*). A part of *AstraZeneca*’s human resource development plan is to train employees abroad. Each year some of the employees are transferred to other *AstraZeneca* affiliates to work. The international transfer can be a future asset for the employees and the firm, since new ideas are exchanged in the different affiliations. It is favourable for the employees, in terms of internationalization, to receive knowledge and system and corporate culture in foreign countries. Many of the MNCs in India seem to send their employees to other foreign affiliates, for training in various departments of the cooperation.

GlaxoSmithKline invests lots in human resources to strengthen the competence of their workforce in India. They have trained many people in management positions and factory workers have received on the job training in Good Manufacturing Practices (GMP), safety and productivity (Sanglikar, 2005-12-06). Manufacturing Operational Excellence (OE) training and development activities are held at the factories, focusing on building awareness, knowledge management and training of staff in manufacturing practices to increase productivity of the plants (GSK Directors report, 2004). According to GSK, the multinationals have helped to develop the Indian pharmaceutical industry in terms of educating people, especially in marketing and scientific communication skills, but also in finance, machinery operations and maintenance (Sanglikar, 2005-12-06). Through the MNCs’ presence

in the industry the domestic firms get access to new ideas and the local workers gain more knowledge about international practices. The multinational affiliates in India follow the parent companies’ training schemes, which are often well developed, and it can be argued that this advantage has benefited the Indian industry as a whole in terms of increased know-how.

The multinationals in India spend more money on employee costs than their domestic counterparts. In Table 4.2 we can see that the employee costs, as percentage of income, for domestic vs. multinationals in the pharmaceutical industry.

The explanation of the higher employee costs is the higher wages paid by the multinationals. Additionally, the MNCs invest a lot in training of employees in promotional activities. The fact that the MNCs focus a lot on the productivity of their employees creates a strong competitive environment in the industry. In order to keep up with the multinationals, the domestic firms must invest in their work force too. The employee cost for domestic firms has increased in the last decade. An explanation for the increased costs could be that domestic firms invest more in their employees. Another reason for the increased costs could be that more qualified employees are hired due to larger investments in R&D; consequently, higher wages are paid.

The training that the MNCs provide can be an asset for domestic firms through possible *labour turnover* between firms. Spillover effects occur through labour turnover and the circulation of the labour force enables some original knowledge to transfer between the foreign and domestic firms.

Table 4.2 Employee costs (as % of income) in the Indian pharmaceutical industry

	1997	1999	2001	2002	2004
Domestic firms	7.2	7.5	7.2	7.5	7.7
MNCs	11.4	10.6	11.4	12.0	11.0

Source: ICRA (2004).

There seems to be some labour turnover between firms in the pharmaceutical industry, between public-domestic and foreign firms (various interviews). To illustrate one example; Mr. Iyer, the present managing director of AstraZeneca India, has worked in the pharmaceutical industry for more than twenty years. Initially he worked for GlaxoSmithKline in the commercial management team for many years, after he worked for a local firm, ICI Pharmaceuticals India, which later merged with Nicolas Piramal. Mr. Iyer had a key business position at Nicolas Piramal for a couple of years before he got the head manager position of AstraZeneca India (AstraZeneca Annual report, 2004). The different positions of Mr Iyer show one example of the movement within the industry. There is no doubt that he has brought knowledge from one firm to another. On the other hand, with more investment in training, the MNCs have more incentive to keep their employees within the firms and also the higher wages paid by MNCs can result in less labour turnover.

A high level of education makes the absorption capacities of spillover effects larger (Kozlov, 2001). The Indian workforce is very well educated and thus the comprehensive educational level in India increases the possibility for spillover effects from MNCs since it is easy for the employees to benefit from more advanced foreign management skills and technology.

4.6 Industrial management

The local industry can benefit from FDI through the superior industrial management skills that the MNCs possess¹⁸ (Dunning, 1970). Because of the threat of market loss, foreign companies can raise managerial incentives in host-country enterprises. A well functioning industrial management is very important for a firm's growth and efficient management can increase the productivity of the firm significantly. Aggarwal (2004) finds that insufficient marketing infrastructure and lack of information affect Indian domestic pharmaceutical firms negatively in terms of export performance. The lack of marketing skills forces Indian firms to produce for the domestic market instead of expanding into the global market. It can, therefore, be argued that spillover effects in terms of marketing infrastructure are especially important for firms that want to expand internationally.

The spillover effects in the industrial management area seem to be immense in India's pharmaceutical industry. In all the interviews with both

foreign and domestic companies, the firms emphasized the advantage of the foreign companies' industrial management skills. The pharmaceutical industry is highly dependent on a *marketing and distribution network*. The industry's sales promotion is essentially intended for the physicians, who prescribe the products to the patients and not for the consumer directly. *Medical Sales Representatives (MSRs)* consequently have a large influence on doctors, who often rely on the MSRs regarding new drugs in the market. This calls for a detailed system of medical knowledge and the marketing representatives need to be well trained, technically qualified and specialized in the products and their effects on the patients (Naravana, 1984). Marketing and promotional performance strongly affects the outcome of the pharmaceutical firms. The MNCs in India have very well developed marketing techniques and have been able to capture large shares of the market due to their aggressive marketing performances.

According to GSK, the foreign pharmaceutical firms have contributed a great deal to the domestic industry in terms of management, organizational and marketing practices. *"The MNCs have brought the latest manufacturing techniques and marketing practices into the pharmaceutical industry in India"* (Sanglikar, 2005-12-06). For instance, GSK was the firm that introduced medical promotion activities such as the MSR system in India (Sanglikar, 2005-12-06). By introducing new marketing ideas and management techniques that were unknown in India, spillover effects to local firms were created.

The marketing and selling costs¹⁹ have always been higher for MNCs than for domestic firms in India. Table 4.3 shows the expenses for domestic firms vs. MNCs.

Table 4.3 Marketing costs (as % of income) in the Indian pharmaceutical industry

	1997	1999	2001	2003	2004
Indian firms	6.5	7.5	8.7	9.6	9.3
MNCs	10.1	11.0	11.0	11.2	10.3

Source: ICRA (2004).

One reason for the MNCs' higher costs is their concentration in formulations, which traditionally require more promotional activities than bulk manufacturing.²⁰ We can see that the marketing costs have increased for the domestic players in India. This trend could be explained by increased focus on formulation and improved sales infrastructure. The enhanced importance of brand building, due to the new patent regime and increased export of products, could also explain the increased costs. Many Indian companies have increased their presence around the globe, both in developed and developing countries, which require an established distribution network, participation in international trade fairs and marketing.

In 1970 the MNCs held 80 per cent of the market and in 2001 only 24 per cent (Aggrawal, 2002). One explanation for the expansion of domestic firms is that they have learned the importance of brand building and marketing techniques. The presence of MNCs in India has contributed to the strength in marketing techniques, directly through marketing collaboration and indirectly through imitation and competition (Bhujle, 2005-12-06). Today, the largest domestic firms have very well developed management skills and do not differ much from the MNCs in India.

Another aspect of benefits from the MNCs, in terms of industrial management, is their consciousness of *quality standards*. The foreign companies have always been aware of quality and safety aspects of manufacturing pharmaceuticals. According to Naravana (1984) all foreign companies in India, and domestic units collaborating with foreign firms, are said to be safe from a quality perspective. If a domestic pharmaceutical firm wants to expand beyond the domestic market it must learn international standards in regard to the products and production processes. To be able to export to the regulated markets (in developed countries) the firm must have reached a certain standard in quality control. Authorities in regulated markets, which are in control of quality of products and manufacturing facilities, are very strict. It is difficult and expensive to navigate through the tough regulatory regimes in the developed countries (*Business India*, 2005). Extensive company reports for documentation of production processes and products are required to start exporting and thus expand into regulated markets. Today, the largest Indian companies have comprehended the

importance of documentation and are able to comply with health and safety requirements in different countries, thus continuing to expand into the regulated markets (*Business India*, 2005). The presence of foreign firms in India has contributed to increase the awareness of quality standards in the domestic industry. Since the foreign firms demand high quality bulk and good manufacturing practices, they indirectly (or directly in some cases) put pressure on the domestic suppliers to increasing their standards and supply of good quality bulk. Spillover effects in terms of quality standards are, therefore, generated in the industry.

Because of the lack of resources and financial means numerous small and medium scale firms wish to link up with foreign firms in order to get "free" access to international markets. Domestic firms that are in collaboration with foreign companies can improve their own standards through the international linkages that the foreign firms can provide (OPPI, 2005). There is scope for the small-medium scale firms to benefit from collaboration with foreign firms in the future. Many firms perform co-marketing and it is quite common that medium range companies, that do not have the resources to market globally, tie up with one of the global majors. The large domestic firms in India are very developed in terms of industrial management and therefore, spillover effects generated to the large firms are likely to be limited in the future.

4.7 Summary of spillover effects from FDI

Apart from the capital inflows and additional employment that the pharmaceutical multinationals have brought to India, there seem to be quite a few spillover effects in the industry. In the following Table 4.4 the spillover effects are summarized, from a past, present and future perspective.

In the *past*, the MNCs more or less had a monopoly in the pharmaceutical industry and hence very few spillover effects in terms of competition. Also, since the MNCs performed limited R&D in India, there were no externalities. Most spillovers effects from independence until the liberalization reform seem to be in terms of imitation and management techniques. The domestic firms' marketing skills were not developed and the MNCs gained market shares due to their aggressive marketing techniques.

Table 4.4 Summary of the spillover channels in the Indian pharmaceutical industry

Spillover Effects	Past			Present			Future			
	Weak	Medium	Strong	Weak	Medium	Strong	Weak	Medium	Strong	
Competition	X					X				X
Human capital		X			X			X		
Imitation			X		X				X	
Transfer of Tech.		X		X				X		
R&D				X				X		
Management						X			X	

Note: The summary is divided into three time periods; *past* (from India's independence to the liberalization reform), *present* (since the liberalization started in 1991) and *future*. The impact of spillover effects are evaluated as *weak* (no or very few spillovers), *medium* (some spillovers have occurred) and *strong* (lots of spillovers).

The MNCs brought in new management and promotion practices that were finally imitated by domestic players. The domestic industry has also grown due to possibilities of imitating foreign developed drugs. Spillover effects in terms of imitation are, therefore, large, both in product development and imitation of marketing and documentation techniques. Spillover effects in terms of human capital or transfer of technology seem modest.

Today, the presence of foreign firms enhances the competitive environment in the industry and spillover effects are generated through the elimination of inefficient firms and faster adoption of technology. Today, the large domestic firms and the MNCs in India are equally developed and the technology gap is narrow. However, there seems to be some technology transfer between MNCs and their suppliers. Additionally, the MNCs invest a lot in training and positive externalities in the form of development of human capital seem to be generated. Furthermore, the MNCs are highly aware of quality standards for products and production processes, which seem to have “spilled over” to the domestic industry. Based on the fact that the domestic firms’ market share have expanded a great deal, one can argue that spillover effects in terms of imitation of marketing techniques and quality awareness have taken place.

Spillover effects could be argued to continually be generated in the *future*. Due to the new patent laws and enhanced investment climate, FDI is expected to increase in India. Also multinationals innovative R&D is expected to take off in the Indian pharmaceutical industry. In recent years, domestic players have invested more in R&D than ever before, and competition in terms of R&D can stimulate further competition and growth in the industry. Moreover, increased collaboration with foreign firms in terms of R&D is likely to generate future spillovers. Partnerships between multinationals and Indian firms seem to be the viable way forward. Due to the high costs in developing a new molecule on global bases, the Indian firms are facing a difficult future. However, developing time and costs for R&D are increasing, and multinationals can save money through collaboration with an Indian firm. We have witnessed many collaboration projects taking place in the industry between foreign and Indian firms, and the partnerships are expected to increase considerably in the nearest future (OPPI, 2005).

However, the presence of FDI in the pharmaceutical industry does not mean automatic spillover effects. Spillover effects depend on the development of the local firms and the efforts of domestic firms to invest in learning and imitation. The Indian pharmaceutical industry has a vast pool of skilled labour, physical infrastructure, and a large distribution network with suppliers. India's pharmaceutical industry can, therefore, be argued to have a high absorptive capacity, especially the large firms in the organized sector.

5. Econometric Study of Spillover Effects

An econometric analysis, which estimates the correlation between FDI and domestic firms' productivity, is a common way to determine if spillover effects exist. To examine if productivity spillovers from FDI in the Indian pharmaceutical industry have taken place a regression analysis will also be carried out in this study.

The questions to be answered in the econometric analysis are:

- Do firms with foreign ownership show higher levels of productivity than domestic firms?
- Does foreign ownership in the pharmaceutical sector affect the productivity of domestically owned firms in the industry; hence do spillover effects from foreign presence exist?

5.1 Data and methodology

As this is a study of horizontal productivity spillovers within the pharmaceutical industry, only intra-spillover effects are accounted for. Firm level panel data is used for the analysis. The data comes from the Prowess database,²¹ provided by the Centre for Monitoring Indian Economy. The Prowess database contains 300 pharmaceutical firms, which are included in the organized sector. However, only firms for which there is information about productivity, sales, capital stock, foreign ownership and employment are included in the sample. Firms with negative value added are excluded. The sample used in the study consists, therefore, only of 43 firms, which includes 34 domestic and 9 foreign firms. Firms with more than 10 per cent foreign equity are considered foreign.²²

The firms included in the sample account for 49.6 per cent of the total value of output in the organized sector, which should be large enough to draw conclusions about spillover effects in the industry. The sample includes no small-scale firms²³ but medium and large firms, with 35 employees in the smallest firm to 6797 in the largest. As a result of the sample, conclusions drawn about spillover effects are only applicable to the larger firms in the industry.

Table 5.1 describes the sample. One year, 2004, will be used for the analysis.

As we can see in the table, the average foreign firm has a larger number of employees, their output is larger and they also pay higher wages than the average domestic firm. However, the net sales of domestic firms are higher. Many of the larger domestic firms export a large part of their production, which might explain the higher sales. The foreign firms have less fixed assets than the domestic firm. As mentioned earlier, the foreign firms outsource parts of their production, and have, therefore, less investments in fixed capital.

A regression analysis is carried out to examine the correlation between firm productivity and foreign presence in the same industry. The model used is similar to most of the empirical literature. A log linear production function is estimated and the model and the explanatory variables are similar

Table 5.1 Description of the sample used in the regression

Variable	Total sample	Ave. sample	Ave. Dom. firm	Ave. For. firm
Employment	58291,0	1355,6	1311,7	1521,1
Net sales	17072,0	397,0	1430,4	466,5
Output	17317,5	402,7	387,4	460,6
Fixed assets	5343	124,3	141,8	57,9
Wages	1443,1	33,56	28,75	51,74

Source: Prowess database (Author's own calculations).

Note: In Rs. Crores.

to those estimated by Aitken and Harrison (1999), Haddad and Harrison (1993) and Barrios *et al.* (2002). The Ordinary Least Square (OLS) technique is used to estimate the equation below.

The following model will be used in the regression analysis:

$$\ln Y_{it} = \alpha + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \beta_3 \ln SIZE_{it} + \beta_4 F_firm_{it} + \beta_5 F_sector_{it} + \sum_{it} \epsilon_{it} \quad (1)$$

Y_{it} stands for firm i 's output. In the model, i and t refer to firm and time respectively. The domestic firm i 's productivity is assumed to be dependent on several factors. As a measurement for productivity, value added is used as a proxy. Firm i 's productivity is assumed to be dependent on its capital intensity (K_{it}) and is defined as the value of fixed assets at the beginning of the year, labour (L_{it}) is proxied by remuneration, $SIZE_{it}$ is measured as the ratio of firm sales to total sales for the largest firm in the sector (in accordance with Haddad & Harrison, 1993).

Two measurements of foreign ownership are used.²⁴ The first variable; F_firm_{it} is the share of foreign equity at the firm level. If foreign ownership in a plant increases the plant's productivity, we should observe a positive coefficient of this variable. The second variable is F_sector_{it} , which measures whether the presence of foreign ownership within the industry increases the productivity of domestic firms within the same industry. This is the main variable of interest and it is intended to control for the degree of foreign presence and hence potential productivity spillovers arising from the foreign firms. F_sector_{it} is defined as foreign equity participation averaged over all firms in the sector, weighted by each firm's share in sectorial employment.

$$F_Sector_{it} = \frac{\sum_i FS_{it} * Emp_{it}}{\sum_i Employment_{it}} \quad (2)$$

If productivity advantages of foreign firms spill over to the domestic firms, this coefficient should be positive. $\hat{\alpha}_{it}$ is a standard error term, which is assumed to have a normal distribution with zero mean and fixed variance over the sample.

5.2 Econometric results

The regression model is estimated, using the Ordinary Least Square Method (OLS) and the results are given in Table 5.2.

As expected, the coefficients L_{it} and K_{it} are positive and statistically significant. Also, as $SIZE_{it}$ is positive and significant, larger firms are likely to achieve higher levels of productivity.

Regarding the coefficients determining the effects of foreign ownership, the results show the following. At plant level, the F_firm_{it} coefficient is positive and the significance level is 5 per cent. This shows that firms with foreign ownership experience higher productivity than domestic firms, which is consistent with the belief of foreign firms' superior efficiency. Thus there is productivity gain for firms with foreign ownership. The higher level of productivity for firms with foreign ownership indicates that a small productivity gap exists between the domestic and foreign firms.

The coefficient F_sector_{it} is positive but statically insignificant. As a result, we cannot draw the conclusion that intra-spillover effects in the pharmaceutical actually exist, since the difference is not significant.

Table 5.2 Regression results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.139961	0.249614	4.566894	0.0001
LOG(K)	0.500608	0.092467	5.413926	0.0000
LOG(L)	0.427475	0.092216	4.635581	0.0000
LOG(SIZE)	0.200932	0.084520	2.377337	0.0227
F_FIRM	0.005309	0.002368	2.242336	0.0310
F_SEC	0.005944	0.021057	0.282291	0.7793
R-squared	0.937120	Mean dependent var		3.592669
Adjusted R-squared	0.934028	S.D. dependent var		1.839170
S.E. of regression	0.296397	Akaike info criterion		0.534554
Sum squared resid	3.250493	Schwarz criterion		0.780302
Log likelihood	-5.492901	F-statistic		316.0262
Durbin-Watson stat	2.201883	Prob(F-statistic)		0.000000

In the empirical literature there is no consensus on which variable is the most correct to measure foreign participation or spillover effects. Other measurements for the F_sector_{it} variable can be used, such as assets, sales and output. However, total assets and sales instead of employment were used in this study but do not reveal any important changes to the estimation results (see appendix Table VIII).

Consequently, according to this study there is no evidence of spillover effects in the Indian pharmaceutical industry. The possible explanation for this result is further discussed in 6.4 ahead.

5.3 Testing of the model

Several tests can be carried out in order to test the overall specification and significance of the model. An *F-test* is used to see whether we have an overall significant model. The p-value for the F-test shows, in Table 6.2, that the model is significant.

To check if the model is correctly specified, or if there is a problem of misspecification, a RESET test is used (See Hill *et al.* 2001, p. 187-188 for further details). A test of $H_0 : \tilde{\alpha}_1 = \tilde{\alpha}_2 = 0$ against $H_1 : \tilde{\alpha}_1 \neq \tilde{\alpha}_2 \neq 0$ is carried out. A failure to reject H_0 means that the test cannot detect any misspecification. However, rejection of the null hypothesis means the model is inadequate and needs to be improved (Hill *et al.* 2001). The RESET-test in our model shows an insignificant p-value of 0.889 (See appendix table V), which means we fail to reject H_0 . Hence we cannot detect any misspecifications in the model.

Problems of heteroskedasticity in the model are controlled for through White's estimators for the standard errors. White's test for heteroskedasticity is used: $H_0 : e_1$ is homoskedastic $H_1 : e_1$ is not homoskedastic. The heteroskedasticity test in our model shows an insignificant p-value of 0.575 (See appendix table VI). Thus, H_0 is not rejected and we cannot show that heteroskedasticity exists.

Lastly, to check the normal distribution of the residuals, the Jarque-Bera test is carried out. (See Hill *et al.* 2001, p. 138-139 for further details)

$H_0 : e_1$ is normal distributed $H_1 : e_1$ is not normal distributed. The p-value from the Jarque-Bera test is 0.670 and we fail to reject the null hypothesis that the residuals are normal distributed (for histogram and p-values, see appendix Table VII). Consequently, the residuals in the model are assumed to be normal distributed.

The R^2 value in the model is high, which demonstrates a good fit. The model explains 93.7 per cent of the variation in y .

5.4 Discussion

The regression shows positive and significant results in the "own-plant" variable, indicating that foreign ownership affects productivity positively. There is productivity gain for firms with foreign ownership; consequently there is a productivity gap between the foreign and domestic firms. This result is consistent with previous studies such as Haddad & Harrison (1993), Aitken & Harrison (1999) and Barrios (2000).

Since the correlation between FDI and productivity of domestic firms in the same industry is insignificant, we cannot conclude that spillovers exist in the Indian pharmaceutical industry. The results are similar to several previous empirical analyses of spillover effects. For instance, Haddad and Harrison (1993) showed insignificant, but negative results, of the spillover effects in Morocco and so did Barrios (2000) and Smarzynka (2002).²⁵

Negative or insignificant results of spillover effects can be explained by various factors. Spillover effects are difficult to measure and the *data* used for the analysis is, therefore, of importance. Many earlier studies of spillovers, which found evidence of positive effects from FDI, often used aggregated, cross sectional industry data. Görg and Strobl (2001) argue that this way of estimating spillover effects can be biased. They argue that data on firm-level, instead of industry level, is a more accurate way of measuring spillover effects because it "*allows the researcher to investigate in more detail whether spillovers take place by controlling for other factors*" (Görg & Strobl, 2001, p.6). However, when firm-level panel data is used, evidence of negative and insignificant spillovers occur more often than with aggregated industry data. In this paper, only one industry is examined

and, therefore, firm level data is used. The insignificant results in this study seem to confirm the weak evidence of positive spillovers from FDI when measured with firm-level data.

Moreover, the *level of FDI* in an industry is an important factor for possible spillover effects. If the level of FDI is relatively low in an industry, studies of spillover effects can result in insignificant outcomes (Aitken & Harrison, 1999). This could be the case in the Indian pharmaceutical industry where the FDI is quite low compared to other industries in India. For various reasons (see section four), the level of FDI is limited in the pharmaceutical sector. Many of the foreign firms outsource parts of their production and have limited fixed assets in the country. As seen in Table 6.1, the average level of fixed assets for foreign firms is much lower than for the domestic.

Many authors have also pointed out that negative (or insignificant) spillover effects can depend on the ability to absorb the positive impact from foreign firms. Blomström and Kokko (1998) conclude, after studying several empirical studies on spillover effects, “*the positive effects of foreign investment are likely to increase with the local level of capability and competition*” (p. 247).

The local *level of capability* can be demonstrated by the local firm’s development of management and production capacity. If the domestic firms’ industrial management skills are weak, the possibility of benefiting from foreign firms’ presence is limited. For instance, with no documentation or quality control, the possibility for a domestic firm to collaborate or work as a supplier to a foreign firm is unfeasible. The domestic firms must have reached a certain standard to be able to benefit from the presence of FDI. As noted earlier, the local firms’ absorption capability is high since many of the firms are highly developed.

The local level of capability can also depend on the possible *technology gap* in the industry. If the technology gap is too wide or too small between domestic and foreign firms it is argued to have implications for spillover effects. If the technology gap is too wide it might be difficult for domestic firms to benefit from FDI since the technology is too advanced. The

possibility of interaction between foreign and domestic firms is, therefore, limited, as are subsequent spillover effects. On the other hand, if the technology gap is small, there is no scope for spillover effects since the firms are operating on the same premises. Possible knowledge or technology gaps between foreign and domestic firms are therefore important to consider. As previously concluded, there is a technology or productivity gap between foreign and domestic firms in the pharmaceutical industry. However, the technology gap seems quite small, especially between foreign and large domestic firms in the sector. Since the sample used in the regression mainly consists of large firms, the result of insignificant spillover effects here can in fact be explained by the relatively small technology gap between large domestic firms and the multinationals in India.

Competition is another important factor to consider in regard to the insignificant spillover effects. As Aitken and Harrison (1999) point out, foreign firms could reduce productivity in domestic firms through competition effects or market stealing effects. If the multinationals use more efficient and technologically advanced production methods than domestic firms, the foreign firms are more productive and have lower marginal costs of production. Therefore, the foreign firms can draw demand away from the domestic firms, which have to lower their production; subsequently their average cost of production will be higher (Aitken and Harrison, 1999). This factor is quite important in regard to the Indian pharmaceutical industry since the multinationals mainly produce for the domestic market and hardly for export. The presence of foreign firms stimulates the pharmaceutical industry in terms of increased competition, but the question is whether the positive effects from foreign firms’ presence in the industry are larger than the eventual negative effects from market stealing. However, from the interviews conducted, the large domestic firms did not feel “threatened” by foreign firms potentially “stealing” market shares. On the contrary they were positive to foreign firms’ presence in the industry. As noted earlier, the foreign firms’ market share has decreased a lot since the 1970s; hence the foreign firms do not obviously “take over” the industry. Nevertheless, the foreign firms are a larger threat to the small-scale firms in India since these may not afford to keep up with the competition and up-gradation, which are necessary in a highly competitive market.

Further explanations of insignificant spillover effects could be that the MNCs protect their firm specific advantages; consequently spillovers to the domestic industry are prevented. Since the pharmaceutical industry is such a knowledge-based industry, foreign firms are most likely to try to keep technology to themselves. Especially in India, where the patent laws are weak, the incentive for firms to protect their firm-specific assets is large. The MNCs usually pay higher salaries to their employees to prevent leakage of firm specific advantages to domestic firms. This might have implications for spillover effects in the sector in terms of labour turnover and affect possible positive spillover effects. The pharmaceutical MNCs in India pay higher wages to their employees and also invest a lot in human capital through training; therefore, the scope for spillover effects may be affected. However, according to the interviews, labour turnover in higher positions is quite common in the industry. Since the labour turnover effect is not measured quantitatively, it is difficult to draw a conclusion on its proper effects on spillovers.

As always, when an econometric model and variables are constructed, there could have been a different approach. The fact that only one year is examined can have implications for the results. There might have been earlier years that could show different results. The variables chosen for the regression might also have influenced the results. Variables such as R&D expenditure, export, education and technology gap could have been controlled for; however, data availability excluded these variables. Hence, additional or different years and other variables included, or proxies used in the model, could have given different results. Also, if a larger sample with small-scale firms were included, other results might have been revealed. However, the model used in this study shows one aspect of spillover effects in the pharmaceutical industry.

6. Summary and Concluding Remarks

The main objective of this study is to examine spillover effects from FDI in the pharmaceutical industry in India. The host economy can benefit from FDI since it can play an important role in promoting economic growth and raising the technological level in industries. This study shows mixed results in terms of existing spillover effects. To answer the first question stated in this paper: “Are there spillover effects observed from MNCs in the Indian

pharmaceutical industry”? Yes, there has been positive impact from FDI in the pharmaceutical industry. From literature studies and interviews with people from the industry and governmental officials, the conclusion is that the pharmaceutical MNCs in India have positively contributed to the growth and development of the industry. In accordance with the case study of the transmission channels in industry, there seem to be a few clear spillover effects from FDI. However, the scope and existence of spillover effects seem to vary over time, depending on the development stage of the industry.

The second question this study attempts to answer is: “What characteristics do spillover effects from FDI in the Indian pharmaceutical industry have”? Spillover effects through imitation, industrial management skills and competition are particularly observable in the industry. After India’s independence, the pharmaceutical industry was very small but started to grow through the government’s initiative to develop a strong indigenous sector. The MNCs were welcome and they contributed to the industry in terms of technology and introduced new drugs in the country. India’s success in the pharmaceutical industry is mainly based on its capability to develop formulations of already discovered drugs and the industry has grown due to possibilities of imitating foreign developed molecules. Spillover effects in terms of imitation are, therefore, generated, not only in product development but also in marketing and documentation techniques. The MNCs brought in new management and promotion practices that were eventually imitated by domestic players. The foreign firms’ presence has indirectly encouraged the domestic firms to increase their managerial efforts and to adopt some of the marketing techniques used by MNCs. They have given incentives for players in the industry to upgrade and standardize processes such as quality control and documentation techniques. In addition, the existence of foreign firms seems to have intensified the competitive pressure in the industry and stimulated local firms to use accessible resources more efficiently. Competitive pressure has led to a consolidation in the industry, with many mergers and acquisitions taking place, several between foreign and domestic firms in the industry. This calls for future spillover effects being generated.

The regression analysis indicates that firms with foreign ownership exhibit higher productivity growth than domestically owned firms.

Accordingly, there is a small productivity gap in the industry and hence incentives for the domestic firms to catch up. However, the seemingly positive impact of FDI in the pharmaceutical industry is not supported by the insignificant results of the econometric analysis of productivity spillover effects in the industry. The answer to the third question “Does foreign ownership in the Indian pharmaceutical sector affect the productivity of domestically owned firms in the industry?” is consequently no. There is an insignificant relationship between higher productivity growth in domestic firms and foreign presence in the sector. Therefore, we cannot conclude from the regression that there are any productivity spillovers in the industry.

We find varied results in this study of spillover effects in the Indian pharmaceutical industry. The positive externalities from FDI we observed from analysing each transmission channel might not be large enough to affect the productivity of domestic firms in the industry. Earlier empirical studies of horizontal spillover effects have also showed insignificant results. There are many explanations brought to light in order to clarify these results, which are applicable in the Indian pharmaceutical industry as well. The explanation may be that the MNCs have not invested “enough” fixed capital in the industry. Many of the MNCs have bought already existing plants or outsource parts or all of their production. Moreover, the insignificant results indicate that the technology gap might be too small to capture significant spillover effects. Today, the large domestic firms and the MNCs in India are equally developed and the technology gap has narrowed down. Given that the sample mainly includes large firms, the spillover effects that exist in the industry may not have been captured. As we have seen in the discussion above, there are numerous explanations for the insignificant result concerning spillover effects in the Indian pharmaceutical industry. Spillover effects of FDI are difficult to compute and it is, therefore, good to include a qualitative analysis in addition to the statistical to get a deeper understanding of the effects of foreign firms in an industry. We can conclude that the presence of foreign pharmaceutical firms in India has to some extent contributed to the development of the industry over the years, but to what level is difficult to state. Nevertheless, judging by results from this and earlier studies, positive productivity spillovers from FDI should not be overestimated or taken for granted.

Spillover effects are not an automatic outcome of FDI as they depend on the development of the host industries and the domestic firms. Efforts of local firms to invest in new technology and knowledge are crucial for spillover effects. Hence, the firm’s absorptive capability and motivation to learn are essential. It is in the interest of the state to provide a sound economic environment and public policies to benefit from FDI. Especially during the 70s, the MNCs faced several policies designed to encourage collaboration with Indian firms and also production constraint with the aim of producing more advanced drugs. This differentiation and encouragement, between foreign and domestic firms, seem to have helped the domestic industry to take off. The policies in the industry were protective and the domestic industry could develop through the restrictions and requirements for MNCs.

Today the scenario is changed since India is a member of the WTO and the economy has opened up. India’s pharmaceutical industry is facing enhanced international competition and the implementation of the TRIPs shows that the domestic industry is facing a new challenging setting. India as a global player in the pharmaceutical industry requires, therefore, that the government promote an international competitive environment and a dynamic domestic industry. Although the result of the regression does not support our findings in the qualitative study, the MNCs have to some degree contributed to the development of the industry, and further spillover effects are expected in the future. The domestic industry is highly developed and an increased level of FDI in the sector should only stimulate the industry further and hence generate more spillover effects. This calls for increased promotional activities of the industry to encourage an increased inflow of FDI in the pharmaceutical industry.

In order to promote FDI and maximize future spillover effects, policies should be investor friendly with a clear developing strategy. The government of India is trying to make the pharmaceutical industry as investor friendly as possible. However, there are still factors discouraging FDI, which calls for improvement of the institutional setting. Whether the benefits from FDI materialize or not are argued to depend on factors such as market structure, competitiveness, trade and technological policies. The policies in India should encourage domestic firms to invest more in R&D and

technology up-gradation, especially the small firms. Public investments in higher education, preferably science-based, are necessary for future progress in innovative research and also in order to attract more FDI. The Indian pharmaceutical industry continues to develop and move up the value chain in terms of production and R&D. For the first time, intellectual capital is being generated in the industry. However, the Indian firms lack financial means to perform R&D at the same level as the largest global players. The foreign firms can, therefore, contribute to the Indian industry in terms of collaboration in R&D. Among the developing countries, the Indian pharmaceutical industry is one of the most advanced, in terms of technology, quality and range of medicines manufactured. Consequently, India is becoming one of the most preferential countries for foreign firms in respect of joint R&D, contract research and manufacturing. The government of India should, therefore, see the possibilities of increased foreign knowledge and the potential of spillover effects in future partnerships. Public policies that strengthen the absorptive capability in terms of R&D and regulatory standards for domestic firms, particularly for small firms, will create further development and future growth in the Indian pharmaceutical industry.

Endnotes

- ¹ A direct investment is an acquisition or construction of physical capital by a firm from one (source) country in another (host) country. FDI is generally defined as resident firms with at least 10 per cent of foreign participation (UNCTAD, 2002).
- ² In the academic literature there are many approaches to possible spillover channels from FDI. However, in this study, five of these are chosen in order to analyze further.
- ³ For instance, lack of knowledge of consumer and factor markets, regulations and favor of local governments.
- ⁴ A review of earlier empirical studies on spillover effects and productivity gain in domestic firms due to FDI, by Görg & Greenaway (2001), shows the following; fourteen studies show positive results, thirteen insignificant results and four studies show negative results on productivity of FDI.
- ⁵ Bulk drug is the active substance in the drug. Formulation is the actual produced drug, in the form of tablets or syrup, etc.
- ⁶ The WTO's TRIPs Agreement is an attempt to narrow the gaps in the way standard intellectual rights are protected around the world, and to bring them under common international rules. It establishes a minimum level of protection that each government has to give to the intellectual property of WTO members. Patent protection is active twenty years from the filing day.
- ⁷ For further discussion on the future impact of the new patent regime in India see, for instance, Lanjouw (1997).

- ⁸ Pfizer has been in India since 1950.
- ⁹ India's tax structure has provided incentives to outsource production. There has been excise duty on factory costs, which made a lot of sense to outsource. Large domestic firms outsource too, for instance, Nicholas Piramal outsource about 50 per cent of their production (Sathye, 2005-12-08).
- ¹⁰ Pfizer sold out their formulation plant in Ankleshwar in 2004 and they are going to sell their Chandigarh plant soon. Organon sold off one bulk production plant in 2003 and one formulation plant in 2004. When the disinvestment of the plants took place, they subsequently converted to manufacturing arrangement with the buyers of the plants (Organon Director's report, 2004).
- ¹¹ A proper measurement of inter-industry spillovers requires a multi-sectorial dynamic framework, which would take a much larger study.
- ¹² Small/medium firms: Get Well Life Science and Vee Excel Drugs; Large domestic firms: Nicholas Piramal, Ranbaxy, Sun Pharmaceuticals and Wockhardt; Foreign firms: AstraZeneca, Eli Lilly, GlaxoSmithKline Ltd., Novartis and Pfizer.
- ¹³ The Department of Chemicals and Petrochemicals, the Department of Industrial Policy and Promotion and the Council of Scientific and Industrial Research (CSIR) are all Government of India bodies that were interviewed. These will hereafter be referred to as Government of India (GoI).
- ¹⁴ Innovative research means discovery of New Chemical Entity (NCEs) and Novel Drug Delivery Systems (NDDS).
- ¹⁵ The largest MNCs invest about 15-20 per cent in R&D while Indian firms invest 8 per cent at the most. Before the entry of TRIPs the average investment in R&D for Indian firms was about 1.5 per cent (Felker *et al.* 1997).
- ¹⁶ R&D centers: AstraZeneca in Bangalore, Nicholas Piramal in Mumbai, Wockhardt in Aurangabad, Ranbaxy's center in Gurgaon, Lupin in Pune, Sun Pharma in Baroda (OPPI, 2005).
- ¹⁷ For a presentation of the interviewed firms, see section five.
- ¹⁸ Industrial management is a wide concept but is here used to include marketing, brand name, organization, quality control, sales and distribution network.
- ¹⁹ These include promotional expenses, advertising costs, distribution commission, trade discounts, freight and forwarding costs (ICRA, 2004, p.141)
- ²⁰ In the formulation business brand name is very important in order to grow as a company, more so than in the bulk business, where the competitiveness is mostly based on cost and quality. The formulation firms are retail-oriented and the reach of a marketing and distribution network is, therefore, very important for the company's success.
- ²¹ Prowess includes over 8,000 Indian companies. It contains detailed normalized data gathered from the audited annual accounts, stock exchanges and company announcements.
- ²² This definition of foreign firms is consistent with UNCTAD *World Investment Report* (2002). Other criteria for foreign ownership can and have in earlier studies been used (>0 per cent or 5 per cent), without altering the results (see for instance Aitken and Harrison 1999).
- ²³ The definition of a small scale firm is a unit with maximum investment of Rs. five

Crores (The Ministry of Small Scale industries, 2006).

- ²⁴ The variables F_firm it and F_sector it are constructed similarly to the ones used by Aitken and Harrison (1999).
- ²⁵ For other studies that show insignificant results of intra-industry spillover effects, see Görg & Greenaway (2001).

References

- AstraZeneca Pharma India Ltd. Annual Report. 2004. Bangalore, India
- AstraZeneca Pharma India Ltd. Directors report. 2004. Prowess database, Centre for Monitoring Indian Economy (CMIE)
- Aggarwal, Aradhna. 2004. "Strategic approach to Strengthening the International Competitiveness in the knowledge based industries: The Indian pharmaceutical industry". RIS, Discussion paper 80/2004
- Aitken, Brian J. and Harrison, Ann E. 1999. "Do Domestic Firms Benefit from Direct Foreign Investment: Evidence from Venezuela". *American Economic Review*, 89(3) pp.605-18.
- Barrios, Salvador. 2000. "Foreign Direct Investments and Productivity Spillovers-Evidence from the Spanish Experience". Fundacion de Estudios de Economia Aplicada (FEDEA), Working paper 2000-19
- Barrios, Salvador; Dimelis, Sophia; Louri, Helen; Strobl, Eric. 2002. "Efficiency Spillovers from Foreign Direct Investment in the EU Periphery: A Comparative study of Greece, Ireland and Spain". Fundacion de Estudios de Economia Aplicada (FEDEA), working paper 2002-02
- Bhaumik, Sumon K., Beena P.L., Bhandari, Laveesh. 2003. "Survey of FDI in India", Centre for New and Emerging Markets London Business School, Working paper No.6
- Blomström, Magnus. 1986. "Foreign Investment and Productive Efficiency: The case of Mexico". *Journal of Industrial Economics*, 15 (1)
- Blomström, Magnus; Globerman, Steven; Kokko, Ari. 1999. "The determinants of Host Country Spillovers from Foreign Direct Investments: Review and Synthesis of the Literature". The European Institute of Japanese Studies, Stockholm School of Economics, Working paper No. 76,
- Blomström, Magnus and Kokko, Ari. 1997. "Regional integration and Foreign Direct Investment". World Bank Policy Research, Working Paper 1750, Cambridge
- Blomström, Magnus and Kokko, Ari. 1998. "Multinational corporations and spillovers". *Journal of Economic surveys*, 12, pp.247-277
- Blomström, Magnus and Kokko, Ari. 2003. "The Economics of Foreign Direct Investment Incentives". *The European Institute of Japanese Studies*. Working Paper No. 168, Stockholm school of Economics
- Business India (2005. June 6-19, New Delhi, India
- Dhar, Biswajit and Rao, Niranjana. 2002. "Transfer technology for successful integration into the global economy: A Case study of the Indian pharmaceutical industry", UNCTAD, Working paper No.22, United Nations, New York and Geneva
- Department of Chemicals and Petrochemicals (2005-11-16) <http://chemicals.nic.in>

- Department of Industry policy and Promotion (DIPP) (2005-11-11) <http://dipp.nic.in>, Ministry of Commerce and Industry
- Department of Industry policy and Promotion (DIPP) (2006-02-17) http://dipp.nic.in/fdi_statistics/India_top_sectors.pdf, Ministry of Commerce and Industry
- Drugs and pharmaceutical industry highlights: Key Policy Recommendations and Interventions, April, 2004, Volume 27 No.4, Lucknow, India
- Drugs and Pharmaceuticals Industry Highlights: Key Policy Recommendations and Interventions, July 2005, Volume 28, No.8, Lucknow, India
- Dunning, John H. *Studies in International Investments*. 1970. The Pitman Press, Bath, George Allen and Unwin Ltd.
- Dunning, John H. . 1993. *Multinational Enterprises and the Global Economy*. Addison-Wesley Publishers Ltd., Suffolk
- Felker, Greg. Chauduri, Shekhar. György Katalin. 1997. "The Pharmaceutical Industry in India and Hungary-Policies, Institutions and Technological Development" World Bank paper No. 392
- GlaxoSmithKline Pharmaceuticals Ltd. Directors report. 2004. Prowess database, Centre for Monitoring Indian Economy (CMIE)
- Görg, Holger and Greenaway, David. 2001. "Foreign direct investments and Intra-industry spillovers". Leverhulme Centre for research on Globalization and Economic Policy, University of Nottingham, Paper prepared for United Nations Economic Commission for UNECE/EBRD, Geneva, December 3rd
- Görg, Holger and Strobl, Eric. 2001. "Multinational Companies, Technology Spillovers and Firm survival: Evidence from Irish Manufacturing". 2000/12, Centre for Research on Globalization and Labour markets, School of Economics, University of Nottingham
- Haddad, Mona and Harrison, Ann. 1993. "Are there positive spillovers from direct foreign investments? Evidence from panel data for Morocco". *Journal of Development Economics*, Vol. 42, pp. 51-74.
- Hill, Carter, R., Griffiths, William, E., Judge, George, G. 2001. *Undergraduate econometrics 2nd ed.* John Wiley & Sons Inc.
- ICRA Ltd. (Investment Information and Credit Rating Agency) (2004) "Industry watch: The Indian Pharmaceutical industry", New Delhi
- Katz, Joseph M. 1987. "Technology Generation in Latin American Manufacturing Industries". New York, St. Martens Press
- Kozlov, Konstantin and Manaenkov, Dmitry. 2002. "Firms with foreign participation and their influence on export activity in Russia: Firm level panel evidence". Center for Economic and Financial Research (CEFIR), working paper no. 17
- Kumar, Nagesh. 1998. "Liberalization and Changing patterns of FDI: Has India's relative attractiveness as a host country improved?" *Economic and Political Weekly*, 33, pp. 1321-29
- Kumar, Nagesh and Siddhartan N.S. 1994. "Technology, Firm size and export behaviour in developing countries: The case of Indian enterprises". *The Journal of Developing studies*, vol 31. No. 2, pp. 289-309
- Lanjouw, Jean O. 1997. "The introduction of pharmaceutical product patents in India: Heartless exploitation of the poor and suffering?". Economic Growth Center Yale University, Discussion paper No. 775

Lee, Jeong-Yeon and Mansfield, Edwin. 1996. "Intellectual Property Protection and US Foreign Direct Investment". *Review of Economics and Statistics*, 78, pp. 181-186

Mansfield, Edwin and Romeo, Anthony. 1980. "Technology Transfer to Overseas Subsidiaries by U.S.-based Firms". *Quarterly Journal of Economics*, Vol. 95, No.4, pp. 737-750

Ministry of Small Scale Industries 2005-11-20 <http://ssi.nic.in>

Naravana, P.L. 1984. *The Indian Pharmaceutical Industry: Problems and Prospects*. The National Council of Applied Economic Research (NCAER), New Delhi

Organisation of Pharmaceutical Producers of India (OPPI). 2005. "Speech of the President Mr. Ranjit Shahani", 39th Annual General Meeting, Sept. 24 2005, Mumbai

Organisation of Pharmaceutical Producers of India (OPPI). 2005. www.indiaoppi.org

Organon Directors report. 2004. Prowess database, Centre for Monitoring Indian Economy (CMIE)

Pradhan, Jaya Prakash. 2003. "Liberalization, Firm size and R&D performance: A firm level study of Indian pharmaceutical industry". Research Information System for Developing Countries, Discussion Paper 40/2003.

Samli, Coskun A. and Hill, John H. *Marketing Globally: Planning and Practice*. 1998. NTC Publishing Group, Chicago

Secretariat for Industrial Assistance (SIA). 2004. Destination India, Department of Industrial Policy and Promotion, Issue No.2, New Delhi

Secretariat for Industrial Assistance (SIA). 2003. SIA Newsletter-Annual Issue. (India, investment report) Department of Industrial Policy and Promotion, New Delhi

Sjöholm, Fredrik. 1999. "Technology Gap, Competitions and Spillovers from Foreign Direct Investment: Evidence from Establishment Data", *Journal of Development studies*, Vol.36, No.1, pp. 53-73.

Smarszynska, Beata, K. 2002. "Does Foreign Direct Investment Increase the productivity of Domestic firms? In search of Spillover Effects through Backward Linkages", World Bank research, policy paper 2923.

Swedish Trade Council (STC). 2005. "An analysis of the Life Science Industry in India: Identification of Business and Co-operation possibilities Between India and Sweden". Swedish Trade Council, New Delhi

Taymaz, Erol and Lenger, Aykut. 2004. "Multinational Corporations as a Vehicle for productivity Spillovers in Turkey, Danish Research Unit for Industrial Dynamics". (DRUID), Working paper No. 04-09

United Nations Economic Commission for Europe (UN-ECE). 2001. "The Environment for FDI spillovers in the transition economies", Working paper, Geneva,

United Nations Conference of Trade and Development (UNCTAD). 2001. "World Investment Report-Creating linkages 2001". United Nations New York and Geneva

United Nations Conference of Trade and Development (UNCTAD). 2002. "World Investment report 2002". United Nations New York and Geneva

United Nations Conference of Trade and Development (UNCTAD). 2003. *Foreign Direct Investment and performance requirements: New Evidence from selected countries*. United Nations Geneva

Sources of data:

PROWESS database, Centre for Monitoring Indian Economy

Interviews:

Ahuja, Seema, 2005-11-10, Senior Manager Corporate communication, Ranbaxy

Bansal, Vipin, 2005-10-28, CEO, Vee Excel Drugs & Pharmaceuticals (P) Ltd.

Bhujle, Satish S., 2005-12-06, Economist, Organisation of Pharmaceutical Producers in India (OPPI)

Chandavarkar, Anjali, 2005-12-19, PR & Communications, AstraZeneca Pharma India Ltd.

Desai, Mira, 2005-12-06, Corporate communication, Sun Pharmaceutical Industries Ltd.

D' Souza, Michelle, 2005-12-20, Corporate communications, Pfizer Ltd.

Gulati, Rajiv, 2005-11-10, Chairman and Managing Director, Eli Lilly and Company (India) Pvt. Ltd.

Mehendale, Mangesh, 2005-12-08, Senior Manager, Wockhardt Ltd.

Paresh, Johri, 2005-11-09, Deputy Secretary, Department of Chemicals & Petrochemicals, Government of India

Pandey, Dr. R.N., 2005-11-09, Director, Department of Industrial Policy and Promotion, Government of India

Pathak, Suresh 2005-10-27, Chief Executive Officer, Get Well Life Science

Sanglikar, N.Y., 2005-12-06, Senior General Manager Corporate communication, GlaxoSmithKline Pharmaceuticals Ltd

Sathye, Vijay B., 2005-12-08, Vice President-Investor Relations and M&A, Nicholas Piramal India Ltd.

Shahani, Ranjit, 2005-12-09, Managing Director, Novartis India Ltd.

Yogeswara, Rao, Dr. D., 2005-10-14. Head of Department, Council of Scientific and Industrial Research.

I. The major firms in India, net sales, in 1996, 2000, 2004

Domestic firms	Net sale (Rs. Crores)		Foreign firms		Net sale (Rs. Crores)	
	1996	2000	2004	1996	2000	2004
Ranbaxy Laboratories Ltd.	926,1	1784,7	4 162,8	GlaxoSmithKline Pharmaceuticals Ltd.	834,27	816,9 1137,4
Cipla Ltd.	336,8	704,7	1920,5	Aventis Pharma Ltd.	324,95	479,79 671,1
Dr.Reddy's Ltd.	195,1	436,0	1758,3	Novartis India Ltd.	494,06	793,09 512,0
Nicholas Piramal India Ltd.	155,7	411,1	1261,3	Pfizer Ltd.	205,16	275,39 507,6
Aurobindo Pharma Ltd.	113,2	695,2	1253,7	Merck Ltd.	175,13	276,67 364,2
Wockhardt Ltd.	n.a	841,7	729,4	AstraZeneca Pharma India Ltd.	56,51	94,19 176,9

Source: CMIE- Prowess database (2005)

Net fixed assets in 1996, 2000, 2004

Domestic firms	Net fixed assets (Rs. Crores)		Foreign firms		Net fixed assets (Rs. Crores)	
	1996	2000	2004	1996	2000	2004
Ranbaxy Laboratories Ltd.	367,55	631,9	738,68	GlaxoSmithKline Pharmaceuticals Ltd.	86,03	90,07 92,79
Cipla Ltd.	94,41	161,75	603,57	Aventis Pharma Ltd.	163,36	174,45 155,59
Dr.Reddy's Ltd.	78,3	189,49	524,58	Novartis India Ltd.	89,95	92,51 26,19
Nicholas Piramal India Ltd.	185,89	186,92	372,68	Pfizer Ltd.	33,34	35,03 61,1
Aurobindo Pharma Ltd.	1,47	133,89	584,94	Merck Ltd.	42,38	65,34 56,07
Wockhardt Ltd.	Na	556,22	351,9	AstraZeneca Pharma India Ltd.	19,12	21,45 26,17

Source: CMIE- Prowess database (2005)

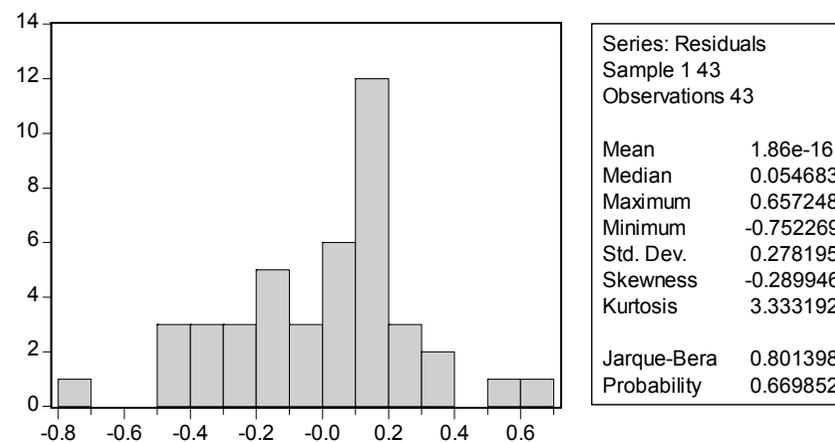
II. Ramsey Reset test for model specification

F-statistic	0.117892	Prob. F(2,35)	0.889144
Log likelihood ratio	0.288705	Prob. Chi-Square(2)	0.865583

III. White Heteroskedasticity test

F-statistic	0.863084	Prob. F(10,32)	0.575190
Obs*R-squared	9.134099	Prob. Chi-Square(10)	0.519426

IV. Jarque Bera test for normality



V. Estimation results from using total assets and sales as F_sector coefficient

Variable	Coefficient	Std. Error	t-Statistic	Prob.
F_FIRM	0.001907	0.220348	2.046225	0.0512
F_SEC	0.016333	0.322056	1.158671	0.7882
R-squared	0.827120	Prob(F-statistic)	0.000000	
Variable	Coefficient	Std. Error	t-Statistic	Prob.
F_FIRM	0.002007	0.002368	2.252401	0.0630
F_SEC	0.001589	0.072448	0.568941	0.9893
R-squared	0.792330	Prob(F-statistic)	0.000000	

RIS Discussion Papers

Available at http://www.ris.org.in/risdiscussion_papers.html

- DP#112-2006 *Regional Cooperation for Asian Energy Security* by Vipul Tuli
- DP#111-2006 *Demographic Complementarities and Outsourcing: Implications and Challenges for India* by Mukul G. Asher and Amarendu Nandy
- DP#110-2006 *Reinventing UNCTAD: Some Proposals for the UNCTAD Mid-term Review* by Muchkund Dubey
- DP#109-2006 *Trade Facilitation Priorities in India and Commitments at WTO: An Overview of Current Trends* by Sachin Chaturvedi
- DP#108-2006 *Towards Comprehensive Economic Co-operation between India and Central Asian Republics* by Dr. Ramgopal Agarwala
- DP#107-2006 *Monetary and Financial Cooperation in Asia: Emerging Trends and Prospects* by Ramkishan S. Rajan
- DP#106-2006 *Japan and an Asian Economic Community* by Masanori Kondo
- DP#105-2005 *India-Vietnam Trade: Current Relations and Prospects* by Rajesh Mehta
- DP#104-2005 *Trade in IBSA Economic Cooperation: The Role of Transportation Linkages* by Prabir De
- DP#103-2005 *Trade and Environment in the WTO: Negotiating Options for Developing Countries* by Sanjay Kumar and Nupur Chowdhury
- DP#102-2005 *Prospects for Environmental Trade under the Regional Process in South Asia: Evidence from SAPTA and Proposals for SAFTA* by S. K. Mohanty and Sachin Chaturvedi
- DP#101-2005 *Emergence of China and India in the new Millennium: Will it facilitate Market Access for LDCs and Developing Countries?* by S. K. Mohanty and Sachin Chaturvedi
- DP#100-2005 *Towards a Broader Asian Community: Agenda for the East Asia Summit* by Nagesh Kumar
- DP#99-2005 *Biosafety Protocol, International Trade and Agricultural Biotechnology: Policy Inferences for India* by Sachin Chaturvedi and Lian Chawii
- DP#98-2005 *The WTO Negotiations on Industrial Tariffs: What is at Stake for Developing Countries?* by Yilmaz Akyüz
- DP#97-2005 *Non-tariff Barriers Affecting India's Exports* by Rajesh Mehta
- DP#96-2005 *Advancing the ASEAN-India Partnership in the New Millennium* by Ong Keng Yong

- DP#95-2005 *The Search for Regional Architecture: The Role of ASEAN as Strange Attractor* by Djisman S. Simanjuntak
- DP#94-2005 *India-Central Asia Economic Relations: A Report of RIS/CII Seminar*
- DP#93-2005 *Asian Energy Outlook to 2020: Trends, Patterns and Imperatives of Regional Cooperation* by Kokichi Ito, Li Zhidong and Ryoichi Komiyama
- DP#92-2005 *Regional Trade and Investment Architecture in Asia-Pacific: Emerging Trends and Imperatives* by Tiziana Bonapace
- DP#91-2005 *India-East Asia Integration: A Win-Win for Asia* by Mukul G. Asher and Rahul Sen
- DP#90-2005 *Strategic Relevance of Asian Economic Integration* by Eric Teo Chu Cheow
- DP#89-2005 *China's Role in the Asian Economic Unification Process* by Yao Chao Cheng
- DP#88-2005 *Strategic Approach to Strengthening the International Competitiveness in Knowledge Based Industries: Electronics Industry* by K. J. Joseph
- DP#87-2004 *Regional Cooperation for Poverty Alleviation and Food Security in South Asia* by Sachin Chaturvedi
- DP#86-2004 *Towards a Free Trade Area in South Asia: Charting A Feasible Course for Trade Liberalisation with Reference to India's Role* by Indra Nath Mukherji
- DP#85-2004 *Industrial Restructuring and Export Competitiveness of the Textiles and Clothing Sector in SAARC in the Context of MFA Phase-Out* by Ram Upendra Das
- DP#84-2004 *India's Export by Countries and Commodities: On the Estimation of a Forecasting Model Using Panel Data* by Rajesh Mehta and Parul Mathur
- DP#83-2004 *Strategic Approach to Strengthening the International Competitiveness in Knowledge Based Industries: Indian Chemical Industry* by Vijay Kumar Kaul
- DP#82-2004 *Strategic approach to Strengthening the International Competitiveness in Knowledge Based Industries: The Case of Indian Automotive Industry* by Neelam Singh
- DP#81-2004 *Strategic approach to Strengthening the International Competitiveness in Knowledge Based Industries: Non-electrical Machinery Industry* by M. Padma Suresh
- DP#80-2004 *Strategic approach to Strengthening the International Competitiveness in Knowledge Based Industries: The Indian Pharmaceutical industry* by Aradhna Aggarwal
- DP#79-2004 *Complementarities and Potentials of Intra-regional Transfers of Investments, Technology and Skills in Asia* by Saikat Sinha Roy
- DP#78-2004 *Towards Formation of Close Economic Cooperation among Asian Countries* by S K Mohanty, Sanjib Pohit and Saikat Sinha Roy
- DP#77-2004 *Transaction Costs as Barriers to Economic Integration in Asia: An Empirical Exploration* by Prabir De.
- DP#76-2004 *Transforming Digital Divide into Digital Dividend: The Role of South-South Cooperation in ICTs* by K J Joseph.
- DP#75-2004 *Transport Cooperation in BIMST-EC: Issues and Way Forward* by Prabir De.
- DP#74-2004 *WTO Market Access Negotiations and Indian Small Scale Industry* by Rajesh Mehta and Pooja Agarwal.
- DP#73-2004 *ASEAN-India Economic Relations: Current Status and Future Prospects* by Rahul Sen, Mukul G. Asher and Ramkishan S. Rajan.
- DP#72-2004 *National Innovation Systems and India's IT Capability: Are there any lessons for ASEAN Newcomers?* by Nagesh Kumar and K J Joseph.
- DP#71-2004 *Monetary Cooperation in South Asia: Potential and Prospects* by Sweta Chaman Saxena and Mirza Allim Baig
- DP# 70-2004 *India-ASEAN Cooperation in Information and Communication Technologies: Issues and Prospects* by K.J. Joseph and Govindan Parayil
- DP# 69-2004 *Issue Related to India's Energy Trading with Central Asian Countries* by Barnali Nag.
- DP# 68-2004 *Biotechnology in South Asia: Issues, Concerns and Opportunities* by Sachin Chaturvedi.
- DP# 67-2004 *Environment Issues in Free Trade Agreements in Asia and the Post-Cancun Challenges: Issues and Policy Options* by Sachin Chaturvedi
- DP# 66-2003 *How Do Infrastructure Facilities Affect Regional Income? An Investigation with South Asian Countries* by Prabir De.
- DP# 65-2003 *Liberalization, Foreign Direct Investment Flows and Economic Development: The Indian Experience in the 1990s* by Nagesh Kumar.
- DP# 64-2003 *India's Monetary Integration with East Asia: A Feasibility Study* by Sweta Chaman Saxena.
- DP# 63-2003 *Rise of Service Sector Outward Foreign Direct Investment from India: Trends, Patterns, and Determinants* by Jaya Prakash Pradhan