# FDI AND TECHNOLOGY SPILLOVERS: A STUDY OF INDIAN MANUFACTURING INDUSTRIES

# FDI and Technology Spillovers: A Study of Indian Manufacturing Industries

*Dissertation submitted in partial fulfillment of the requirements for the Degree of* ***Master of Philosophy*** *in* ***Applied Economics*** *of the Jawaharlal Nehru University*

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I hereby affirm that the work for this dissertation, ***FDI and Technology Spillovers: A Study of Indian Manufacturing Industries,*** being submitted as part of the requirements of the MPhil Programme in Applied Economics of the Jawaharlal Nehru University, was carried out entirely by myself. I also affirm that it was not part of any other programme of study and has not been submitted to any other University for award of any Degree.

Sanjaya Kumar Malik

June 2010 **Sanjaya Kumar Malik**

Certified that this study is the bona fide work of Sanjaya Kumar Malik, carried out under our supervision at the Centre for Development Studies.

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*To*

*My beloved parents, sisters, brother, and*

*late sister-in-law (Sanjulate Malik)*

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ABSTRACT OF THE DISSERTATION

# FDI AND TECHNOLOGY SPILLOVERS: A STUDY OF INDIAN MANUFACTURING INDUSTRIES

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Foreign Direct Investment (FDI) is an important channel facilitating international technology diffusion. Countries around the globe are attracting multinational enterprises (MNEs) for FDI with an optimism to access technology spillovers from them. India, after pursuing inward-looking import substitution policy for decades, liberalized its economy in 1991. Since then, it has liberalized its policy towards FDI considerably which has brought in a substantial amount of FDI during 1990s and 2000s. Increasing inflow of FDI has generated a renewed interest among researchers and academia to assess the impact of FDI on Indian economy. Despite, the studies assessing the effect of FDI and technology spillovers being an important component, the analysis is, however, limited to horizontal technology spillovers. There is hardly any study examining how technology spillovers occur via vertical linkages (backward and forward) generated by multinational firms. This study makes an endeavor to examine the technology spillovers via vertical linkages from FDI.

Using the longitudinal data on manufacturing firms (from PROWESS database of CMIE) for the period from 2000-01 to 2007-08, the study notices that there are productivity improvements among domestic firms through technology spillovers from FDI. Semi-parametric method of Levinsohn-Petrin (2003) has been employed in the study to avoid the endogeneity bias in the estimation of productivity. The study confirms that there are positive and significant technology spillovers via backward linkages created by foreign firms and no significant technology spillovers in the same industry. It also asserts that firms in high technology industries benefit more from technology spillovers compared to others. Considering the heterogeneity of foreign firms, the study observes that minority-owned foreign firms are generating more spillover-benefits to the domestic firms compared to majority-owned foreign firms. It is however seen further that domestic firms belonging to high technology industries benefit more from the spillovers stemming from the majority-owned foreign firms.

**Key words: FDI, Technology Spillovers**

**JEL Classification:** F23

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# ABBREVIATIONS

**AC**: Absorptive Capacity

**ASI**: Annual Survey of Industry

**BPM5**: Balance of Payment Manual Fifth Edition

**BW**: Backward FDI

**CMIE**: Centre for Monitoring Indian Economy

**CSO**: Central Statistical Organisation

**DTAA**: Double Taxation Avoidance Agreement

**EPZ**: Export Processing Zone

**FDI**: Foreign Direct Investment

**FERA**: Foreign Exchange Regulation Act

**FIB**: Foreign Investment Board

**FIPB**: Foreign Investment Promotion Board

**FW**: Forward FDI

**GDP**: Gross Domestic Product

**GFA**: Gross Fixed Asset

**GFCF**: Gross Fixed Capital Formation

**HHI**: Herfindahl Index

**HZ**: Horizontal FDI

**IMF**: International Monetary Fund

**IPR**: Intellectual Property Right

**LP**: Levinsohn and Petrin

**MIGA**: Multilateral Investment Guarantee Agency

**MNEs**: Multi-National Enterprises

**NEC**: Not Elsewhere Classified

**NIC**: National Industrial Classification

**NIP**: The New Industrial Policy

**NRI**: Non-Resident Indian

**OCB**: Overseas Corporate Bodies

**OECD**: Organisation for Economic Co-operation and Development

**OGL**: Open General License

**OLS**: Ordinary Least Square

**R&D**: Research and Development

**RBI**: Reserve Bank of India

**RDS**: R&D Intensity

**SIA**: Secretariat for Industrial Assistance

**TFP**: Total Factor Productivity

**TFPG**: Total Factor Productivity Growth

**TMS**: Technology Import Intensity

**TRIM**: Trade Related Investment Measures

**UNCTAD**: The United Nations Conference on Trade and Development

**WIR**: World Investment Report

**XNS**: Export Intensity

# CHAPTER ONE

# INTRODUCTION

Foreign Direct Investment (FDI) is generally undertaken by Multi-National Enterprises (MNEs) and has long been considered as an important channel for international diffusion of technology (Moran, 1998 and 2005; Markusen, 2002; Keller, 2004). MNEs own, produce, and control most of world's advanced production technologies and are responsible for a major part of the world's research and development (R&D) efforts (Caves, 1982). These technologies has the nature of public good, resulting leakages to host countries through the realization of external economies or spillovers, known as technology spillovers or externalities (Blomstrom, 1992; Blomstrom and Kokko, 1998).

Optimism about the technology spillovers is in fact an important reason, inter alia, contributed to wide-ranging changes in national policies on FDI since 1990s[1] (Blomstrom, Kokko and Zejan, 1992; Blomstrom and Kokko, 2003). India liberalized its industrial and external sector in 1991 and since then it has been trying to attract FDI through its liberal policy favoring MNEs. This has resulted in a massive inflow of FDI to different sectors of Indian economy generating renewed interest among the academia and policy makers on the effects of FDI on growth and development of the Indian economy. Despite studies assessing the effect of FDI, and technology spillovers being the major component, the analysis is, however, limited to technology spillovers in the same industry. There is hardly any study examining the technology spillovers from foreign firms operating in downstream and upstream industries in India.

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[1] The United Nations Conference on Trade and Development's (UNCTAD) report on "Changes in national regulations of FDI" says that from 1991 through 2002, over 1,551 (95 per cent) out of the 1, 641 changes were introduced by 165 countries in their FDI law which were in the direction of creating more favorable environment for FDI in both developed and developing countries (UNCTAD 2003, Table 1.8)

In above context, the focus of present study is to examine technology spillovers from foreign firms operating in upstream and downstream industries in India. Further, the study seeks to answer another pertinent question as to how do the characteristics of domestic and foreign firms mediate the technology spillovers to domestic firms.[2]

This chapter is organized as follows. Section 1.1 presents the underlying theory of technology spillovers from FDI, where the concept of technology spillovers from FDI, the potential channels and the mediating factors facilitating technology spillovers are discussed. Section 1.2 and 1.3 respectively review the selected international as well as Indian empirical literature on technology spillovers from FDI. Section 1.4 discusses the issues emerging from the review of literature and the major research objectives to be analyzed in this study. Section 1.5 discusses about data and methodology of the study. Final section outlines the chapter scheme of the dissertation.

## 1.1 Technology Spillovers from FDI: Theory

Generally, technology spillovers occur when the production activities of firms affect the productivity of other firms in the same industry or other related industries. These spillovers increase with the entry or presence of MNEs in the host country. The MNEs usually possess modern technology, which broadly includes product, process, and distribution technology, as well as management and marketing technologies. These technological advantages help foreign firms to compete with the existing local firms (host country firms), who have better knowledge regarding local markets, consumer preferences, business practices, and established distribution networks. However, these technological assets have the nature of public goods and often lead to positive externalities in the form of productivity gains to the firms in the host country, which are known as technology spillovers (Blomstrom and Kokko, 1998). In the literature, technology spillovers are broadly classified as horizontal

[2] Characteristics of foreign and domestic firms affect the technology spillovers in host the host country. See sections 1.1.6 and 1.1.7 for detail.

technology spillovers and vertical technology spillovers. Horizontal technology spillovers occur when domestic firms working in the same industry get benefits in forms of externalities from foreign firms' activities. Vertical spillovers, on the other hand, occur across industries where domestic firms benefit from technology spillovers from foreign firms through buyer-supplier relationship with them.

A large number of studies have discussed the potential channels through which the technology spillovers have taken place (see, among others, Blomstrom and Kokko, 1998; Saggi, 2002; Gorg and Greenaway, 2004; Smeets, 2008). They are demonstration effects, employment turnover, competition effects, market access effects and vertical linkages discussed below.

### 1.1.1 Demonstration Effects

When foreign firms introduce new product and process, the local firms in the host country adopt the product and process through imitation or reverse engineering which boosts up the productivity of the domestic firms (Saggi, 2002; Gorg and Greenaway, 2004). Before a new process and product innovation is widely spread in the market, host firms in the developing country have limited information about the costs and benefits of the innovation and may thus perceive the risk of investment as too high. When the host firms come into contact with existing users, e.g., MNE affiliates, information about technological innovations and new management techniques are diffused, the uncertainty regarding the pros and cons of the innovation is reduced which increases the likelihood of imitation or adaptation and thereby increases the productivity of domestic firms (Blomstrom and Kokko, 1998).

### 1.1.2 Employment Turnover

A second channel through which technology spillovers could occur is the labor turnover or employment turnover. Multinationals are more likely to use highly skilled labor compared to their local counterparts. They also build local human capital by providing education and on-the-job training to the local employees. When

these highly skilled employees leave foreign firms and join local firms they can apply the intangible assets gained while working with foreign firms, which increases the productivity of local firms in the host country (Fosfuri et al., 2001). Sometimes these skilled personnel are being hired away by domestic firms, which boost up the productivity of domestic firms. Workers while working with foreign firms, acquire skills, attitudes and ideas on the job through the exposure to modern organization forms and international quality standards. If these employees move to local firms they can take some of this tacit knowledge along with them, which enhances productivity throughout the economy (Barrios and Strobl, 2002; Meyer, 2004).

### 1.1.3 Competition Effects

Theoretical models argue that greater competition may induce MNEs to transfer more advanced and latest technology to their subsidiaries, and thereby enhances potential technology spillovers (See, Wang and Blomstrom, 1992; Glass and Saggi, 2002, for instance). In developing country, there are some industries having economies of scale, high capital requirements, intensive advertising, and technology, which act as entry barrier for new domestic firms. As a consequence, there arises high concentration and inefficiency owing to low level of competition. MNEs are normally endowed with high economies of scale, advanced technologies. Their entry into this highly concentrated industry is more likely to intensify the competition by reducing the concentration of firms. The domestic firms with the alley of fear of losing their market shares use the existing resources more efficiently or they go in search for new or advanced technology. If they succeed in this respect, then it will lead to an increase in the productivity of firms in the host economy. Greater competition reduces the X-inefficiency[3] and thereby increases the productivity in the host economy. Besides, competition may increase the speed of adaptation of

[3] When a firm produces the maximum output it can, given the resources it employs, such as labor and machinery, and the best technology available then it achieves technical efficiency. X-inefficiency occurs if technical efficiency is not being achieved due to lack of competition in the economy (Leibenstein, 1966).

technology, which boosts up the productivity of indigenous firms (Globerman, 1979).

### 1.1.4 Market Access Effects

Another indirect source of productivity gain is via market access effect. Host country's firms learn to access or penetrate the international markets from MNEs (Aitken et al., 1997; Barrios et al., 2004; Blomstrom and Kokko, 1998). To become successful exporters firms should not only be competent manufacturers but they need to be endowed with all information facilitating export such as managing the overseas marketing, establishing distributional networks, serving outputs, creating transport infrastructure, learning about consumer preferences regarding design, packaging, and product quality, and regulating management and so on in overseas markets. MNEs are generally armed with all such information required to penetrate the world markets. The host country firms, through contact with them or sometimes through collaboration with them, learn how to access the overseas markets. In some cases, host country firms simply by copying or imitating MNEs learn about export markets. The market access increases export of firms in the host country and, thereby, boosts up their productivity (Banga, 2004; Gorg and Greenaway, 2004; Blomstrom and Kokko, 2003).

Up until now we have discussed the channels, which only facilitate horizontal technology spillovers. There are, however, vertical linkages facilitating vertical technology spillovers from FDI.

### 1.1.5 Vertical Linkages

Vertical linkages embody all such complementarities created between MNE subsidiaries and local firms in the host country. The technology spillovers of MNEs to local firms through vertical linkages occur predominately amongst industries rather than within industry (Kugler, 2000). Vertical linkages can be further categorized into backward linkages and forward Linkages.

Backward linkages include all upstream relationships with local one-off suppliers, key suppliers or subcontractors (UNCTAD, 2001). Local suppliers gain more than the pecuniary benefits of selling their products to foreign affiliates. They also benefit from inter-firm exchange of technological and managerial knowledge (Giroud, 2007). Foreign affiliates are reluctant to compromise firm-specific assets with local counterparts, but they transfer technology to their suppliers of intermediates, as there are mutual benefits of it (Blalock and Gertler, 2005). Rodriguez-Clare (1996), points out that when foreign affiliates produce more complex goods and the transaction costs between foreign affiliates and their parent company are high, then there will be technology spillovers through linkage effects. Foreign affiliates transfer technology to their suppliers of intermediates in the host country, as they want their best quality inputs at lower prices. In an imperfectly competitive domestic intermediate industry, the linkage effect tends to reduce the average cost of production due to economies of scale, and it increases profits for intermediate good's producers, which, in turn, may induce the entry of firms into the intermediate goods producing sector. This entry lowers the prices of intermediates, which not only benefits foreign affiliates but also benefits the domestic firms operating in the upstream industries.

Forward linkages, on the other hand, include all the downstream relationship of foreign affiliates with its customers (sales) agent and distributors in the host economy. Foreign affiliates provide knowledge embodied in products, process, and technology to the domestic customers at the downstream industries which help domestic firms boost up their productivity (Rengnati and Sica, 2007; Blomstrom and Kokko, 1998). Domestic firms enhance their productivity with the access of new improved products and inputs offered by foreign affiliates (Driffield, Munday, and Roberts, 2002).

### 1.1.6 Characteristics of Host Country Firms

The so-called technology spillovers arising out of FDI, however, are not automatic or guaranteed rather they depend upon some mediating factors. It is plausible that firms in host country may differ in their ability to benefit from the presence of foreign-owned firms and their superior technology (Lipsey and Sjoholm, 2005). The mediating factors in the host country act as an essential condition for technology spillovers potential to materialize into actual technology spillovers. The absence or presence of these factors may crucially influence the observed productivity effect of technology spillovers and a study, which does not take them into account, may obtain biased results (Smeets, 2008). Mainly, there are three mediating factors (namely (i) Absorptive capacity, (ii) Intellectual Property Rights (IPRs), and (iii) Competition in host countries), which translate the potential FDI spillovers into actual FDI spillovers.

**Absorptive capacity** of firms in the host country influences the potential spillovers from foreign firms' presence. It is acquired by investment in research and development (R&D) and human capital, which provide the basis of fundamental knowledge or technology necessary to assimilate and exploit external knowledge. Thus, firms need some minimum absorptive capacity to be able to capture spillovers from foreign firms (Kokko et al., 1996; Glass and Saggi, 1998). Findlay (1978), Wang and Blomstrom (1992) and Jordan (2008), on the other hand, argue that technological backwardness should enhance technology spillovers, because the potential for improvement is large. However, some early contributors suggest that a complementary relation between backwardness and absorptive capacity is required to facilitate technology spillovers from FDI. Abramovitz (1986) argues, "A country's potential for rapid growth is strong not when it is backward without qualification, but rather when it is technologically backward but socially advanced." He conditions the benefits of backwardness on the presence of social capabilities, hinting at the importance of some form of absorptive capacity. Nonetheless,

literature has not reached at a consensus whether absorptive capacity or backwardness facilitate the technology spillovers from FDI.

*Competition* in the host economy influences technology spillovers arising from FDI. High competition forces foreign subsidiaries to bring in relatively new and sophisticated technologies from the parent company as they want to retain their market shares in the host country. The technology that is transferred to the subsidiaries due to its public good character might leak out to the domestic firms and thereby increases spillovers (Wang and Blomstrom, 1992; Glass and Saggi, 1998).

*Intellectual property rights* (IPRs) in the host country also influence the technology spillovers from FDI. Strong IPRs induces MNEs to transfer advanced and latest technologies to their subsidiaries and thereby spreads spillovers. Though strong IPRs make it difficult to access spillovers through imitation (Markusen, 2001) still there can be spillovers through vertical linkages between MNE affiliates and host country firms.

### 1.1.7 Characteristics of FDI

Technology spillovers emanating from foreign affiliates are not only dependent upon the host country characteristics but they are also conditional upon the characteristics of FDI. Most of studies on FDI spillovers presume that all the FDI are homogenous and equally important for host country. They argue that increase in quantity of foreign investment increases technology spillovers in host country but they fail to demonstrate how the technology spillovers are taking place due to presence of heterogeneous FDI. Different quality associated with FDI has, in fact, different impact on the local firms in host country (Pradhan, 2006). How the heterogeneous nature of FDI affects the productivity of domestic firms in host economy is discussed below.

*Ownership sharing of foreign affiliates* is supposed to influence the technology diffusion in host country. It is assumed that local participation with multinationals

reveals the MNEs' technology and thereby facilitates spillovers (Blomstrom and Sjoholm, 1999; and Dimelis and Lauri, 2002). Full or majority ownership of MNEs in affiliates facilitates more spillovers than that of MNEs with minority ownership. When there is a risk for foreign firms to loose their intangible assets to local firms, they may hesitate to invest or bring less advanced (older) technologies to the affiliates (Mansfield and Romeo, 1980). But if they have majority share of ownership they can have control over production and profits that will provide more incentive to transfer technology, management skills, and other intangible to their affiliates (Blomstrom and Sjoholm, 1999). Muller and Schnitzer (2006) document that majority ownership induces MNEs to transfer more technology to their subsidiaries and thereby increases spillovers in the host economy. However, technological sophistication of these firms may impede technology diffusion to domestic firms operating in the same industry or related industries.[4]

In contrast, affiliates with minority foreign ownership may lead to grater technology spillovers due to major local ownership in affiliates. Sometimes, the MNEs look for joint venture without any formal requirements because local partners are more likely to have better knowledge of local conditions regarding factor endowments and skill of employees[5] which affect the choice of technology brought in by multinationals and thereby facilitates spillovers in the host economy.

*Motive of FDI* also influences potential spillovers in the host country. So far as technology is concerned scholars have classified FDI into two groups such as technology-seeking and technology-exploiting. The technology-seeking FDI is usually motivated by a desire to source or seek external foreign technology (Dunning and Narula, 1996; Kuemmerle, 1999; Fosfuri and Motta, 1999; Le Bas and

[4] Due to lack of absorptive capacity domestic firms fail to decode the sophisticated technology embodied in the products displayed by foreign firms. Therefore, majority owned foreign firms might not cause spillovers to domestic firms in same industry. They may not generate vertical technology spillovers as well since they require more sophisticated inputs for their production, which are difficult for domestic firms to supply.

[5] See, Beamish (1988) Blomstrom and Zejan (1991) find that Swedish firms with relatively brief experience of foreign production are likely to choose minority venture when they go abroad.

Sierra, 2002). Firms engaging in technology-seeking FDI try to capture technology spillovers from firms in the host countries in which they invest. Knowledge spillovers are expected to flow from local firms to MNE instead of other way round. Technology-exploiting FDI[6] that engages in FDI to exploit a technological or other ownership advantages abroad, part of which may spill over to the host country due to its public good nature (Kuemmerle, 1999; Le Bas and Sierra, 2002). Technology-exploiting FDI has therefore more likely to generate spillovers than technology-seeking FDI.

*Nature of FDI* determines the technology spillovers to host country firms. FDI can be classified as horizontal, vertical, and export platform (Smeets, 2008). Horizontal FDI[7] is usually motivated by market-seeking incentives and it has less spillover potential compared to other two forms of FDI. In the short run, it tends to crowd out domestic investment through its firm-specific advantages, but through increased competition it generates spillovers in the long run. Vertical FDI[8] is generally efficiency or resource seeking. It causes technology spillovers in the host country via backward and forward linkages. Export-platform FDI is motivated by the desire to find an efficient location from where exports could be made, easily and profitably, to other countries. Given the motivation to exploit the locational advantages offered by the host country like low-cost labor, raw materials, components, parts, inter alia, for export activities, they have potential to generate strong links with local firms in upstream and downstream sectors in host country. This enhances the scope of knowledge diffusion, and spillovers in the host country (Pradhan, 2006).

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[6] Technology-exploiting FDI is generally occurs when there is high risk of technology leakage associated with other source of technology transfers (say, for example, licensing) to overseas.

[7] Horizontal FDI is an investment made by a multinational company in different nations. The investment is made for conducting the similar business operations as already operated by the company. For example, if a soft drink manufacturing company makes its plant outside its national borders then it is horizontal FDI

[8] Vertical FDI takes place when the multinational fragments the production process internationally, locating each stage of production in the country where it can be done at the least cost.

## 1.2 Empirical studies on Technology Spillovers from FDI

Empirically, it is difficult to measure technology spillovers since technology is an intangible asset. The empirical literature, however, focuses upon the simple means to approximate whether the presence of foreign firms affects the productivity or output of domestic firms. This is usually done in the framework of an economic analysis in which output or productivity (labour productivity/total factor productivity (TFP)) of host country firms is regressed on a number of covariates assumed to have an effect on regressor, one of which is the presence of foreign firms. If the estimate of coefficient on the foreign presence variable turns out to be positive and statistically significant, this is considered as an evidence of technology spillovers from MNEs to domestic firms.

There are a number of studies empirically examining spillovers from FDI to domestic firms in the host country. Some of them find positive technology spillovers, some other get negative technology spillovers whereas rest reveals mixed findings that depend upon certain variables. [9],[10] These findings can be attributed to the use of different methodologies and datasets.

Keeping the above things in mind, studies on FDI spillovers can be broadly classified into two groups namely cross sectional analysis, and panel analysis. The early studies on FDI spillovers are based on cross-sectional dataset of a single year. Studies by Caves (1974) for Australia, Globerman (1979) for Canada and Blomstrom and Persson (1983) for Mexico provide evidence of positive spillovers from FDI in manufacturing industries in these countries. Subsequent study on the Mexican manufacturing sector (Blomstrom and Wolff, 1994) also confirms positive spillovers

[9] See Gorg and Strobl (2001) and Gorg and Greenaway (2004) for survey of literature on FDI spillovers.

[10] It is also worth mentioning that many studies find statistically insignificant results (for instance, Braconier et al. 2001, on Sweden). Interestingly enough, Gorg and Strobl (2001) show that there is a 'publication bias' in this area (studies of productivity spillovers are more likely to become published if they report statistically significant effects). If this is the case, there are studies, which do not find statistically significant results that can't be found in academic journals.

**Table 1.1: Relevant Studies on Horizontal Technology Spillovers using cross-section data**

| No | Author(s) | Economies | Countries | Year(s) | Aggregation | Results |
|---|---|---|---|---|---|---|
| 1 | Caves (1974) | Developed | Australia | 1966 | Industry | + |
| 2 | Globerman (1979) | Developed | Canada | 1962 | Industry | + |
| 3 | Demelis and Louri (2002) | Developed | Greece | 1997 | Firms | ? + |
| 5 | Blomstrom & Persson (1983) | Developing | Mexico | 1970 | Industry | + |
| 6 | Blomstrom (1986) | Developing | Mexico | 1970/1975 | Industry | + |
| 7 | Blomstrom & Wolff (1994) | Developing | Mexico | 1970/1975 | Industry | + |
| 8 | Kokko (1994) | Developing | Mexico | 1970 | Industry | ? +(AC) |
| 9 | Kokko et al. (1996) | Developing | Uruguay | 1988 | Firms | ? +(AC) |
| 10 | Sjoholm (1999a) | Developing | Indonesia | 1980-1991 | Firms | + |
| 11 | Sjoholm (1999b) | Developing | Indonesia | 1980-1991 | Firms | + |
| 12 | Blomstrom & Sjoholm (1999) | Developing | Indonesia | 1991 | Firms | + |
| 13 | Chung and Lin (1999) | Developing | Taiwan | 1991 | Firms | + |
| 14 | Kokko, Tansini and Zejan (2001) | Developing | Uruguay | 1988 | Firms | ? +(AC) |

Note:
(i) Aggregation: Use of either *Industry* or *Firm* level data
(ii) Here, + denotes positive and statistically significant, - denotes negative and statistically significant, ? denotes mixed results or statistically insignificant.
(iii) ( ): conditional upon, AC: absorptive capacity

from FDI on the productivity of local firms. Kokko (1994) advanced the idea that spillovers depend on the complexity of the technology transferred by multinationals,

spillovers in industries where multinational use highly complex technologies (as proxied by either larger payments on patents or high capital intensity). Expanding on Kokko (1994), Kokko, Tansini and Zejan (1996, 2001) hypothesize that domestic firms can only benefit if the technology gap is not too wide so that domestic firms can absorb the knowledge spilled over from multinationals.

Supporting the pioneering studies, Sjoholm (1999a, 1999b) and Blomstrom and Sjoholm (1999) for Indonesia support the earlier finding on technology spillovers from the presence of foreign affiliates in the host country. For Greek manufacturing, Demelis and Louri (2002), employing quantlie regression, find positive and significant spillovers from the minority foreign ownership and they also find significant spillovers from majority-owned foreign firms only for high technology domestic firms. It is seen that the studies employing cross-section data affirm the occurrence of technology spillovers from FDI (See Table 1.1).

From the findings of cross-section analysis it can't be said that there is technology spillover from FDI, since cross-section data fails to identify the direction of causality between FDI and productivity improvement of domestic firms. Görg and Strobl (2001) and Aitken and Harrison (1999) argue that panel data analysis is more reliable technique to disentangle technology spillovers from FDI. This is because of two reasons. Firstly, panel data analysis allows a researcher to follow the development of domestic firms' productivity over a longer time period, rather than studying dataset for one year. Secondly, panel data allows the researcher to investigate in more detail whether spillovers take place after controlling for other factors affecting dependent variable (i.e., productivity or output). Cross-sectional data, in particular if they are aggregated at the industry level, fail to control for time-invariant differences in productivity across firms, which might be correlated with, but not caused by, foreign

presence[11]. Thus studies failing to control such time-invariant aspect of firms may not give true estimate of technology spillovers from FDI.

In 1990s, scholars have, however, started analyzing the technology spillovers from FDI employing panel data. Table 1.2 shows the findings of horizontal technology spillovers based on panel data. Haddad and Harrison (1993), for the first time used panel dataset to estimate technology spillovers in Morocco manufacturing sector during second half of 1980s. They claim that foreign presence does not bring about any productivity gain to domestic firms though it reduces the dispersion of productivity in manufacturing sectors. Aitken and Harrison (1999), using panel of more than 4,000 Venezuelan manufacturing plants between 1976 and 1989, identify two effects on domestic enterprises. First, increase in foreign equity participations are correlated with increase in productivity for small recipient plants, suggesting that these plants benefit from the productivity advantages of foreign owners. Second, increase in foreign ownership negatively affects the productivity of wholly domestically owned firms in the same industry. They attribute the first finding to the multinationals' tendency to locate in more productive sectors and to invest in more productive plants, and second findings to the 'market-steeling effect'[12] of the multinationals firms. Further, studies by Kinoshta (1999) for China, Djankov and Hoekman (2000) for Czech Republic, and konnings (2000) for Bulgaria, Romania, and Poland cast doubt on the existence of horizontal spillovers from FDI. These researchers have either failed to find a significant positive effect or showed the evidence of negative spillovers.

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[11] For example, if productivity in the electronics sector is higher than, say, the food sector, multinationals may be attracted into the former. In a cross section, one would find a positive and statistically significant relationship between the level of foreign investment and productivity, consistent with spillovers, even though foreign investment did not cause high levels of productivity but rather was attracted by them (Gorg and Greenaway, 2004).

[12] When foreign firms enter the same industry, they may take market share away from local firms forcing them to spread the fixed costs over a smaller production scale which increases the local firms' average costs, resulting in a lower observed productivity. This is called market-steeling effect.

Sinani et al. (2004) estimate the impact of technology transfer from FDI on the growth of sales of domestic firms in Estonia between 1994 and 1999. They find positive spillovers of transfer of technology from FDI. Supporting Sinani et al. (2004), studies from developed economies such as Xiaming et al. (2000), Haskel et al. (2002), Keller and Yeaple (2003), and Driffield and Love (2007) affirm the plausibility of technology spillovers in same industry.

**Table 1.2: Relevant Studies on Horizontal Technology Spillovers using panel data**

| No | Author(s) | Economies | Countries | Year(s) | Aggregation | Results |
|---|---|---|---|---|---|---|
| 1 | Haddad & Harrison (1993) | Developing | Morocco | 1985-1989 | Firms | - |
| 2 | Aitken & Harrison (1999) | Developing | Venezuela | 1976-1989 | Firms | - |
| 3 | Kinoshita (1999) | Developing | China | 1990-1992 | Firms | ? |
| 4 | Blalock & Gertler (2009) | Developing | Indonesia | 1988-1996 | Firms | ? +(R&D) |
| 5 | Girma et al. (2001) | Developed | UK | 1991-1996 | Firms | ? + (AC) |
| 6 | Liu et al. (2000) | Developed | UK | 1991-1995 | Firms | + |
| 7 | Girma and Wakelin (2001) | Developed | UK | 1980-1992 | Firms | ? |
| 8 | Girma and Wakelin (2002) | Developed | UK | 1988-1992 | Firms | ? |
| 9 | Haskel et al. (2002) | Developed | UK | 1973-1992 | Firms | + |
| 10 | Girma (2002) | Developed | UK | 1989-1999 | Firms | ? +(AC) |
| 11 | Girma and Gorg (2002) | Developed | UK | 1980-1992 | Firms | ? +(AC) |
| 12 | Barrios et al. (2004) | Developed | Greece, Ireland and Spain | 1993-1997 | Firms | ? +(AC) |
| 13 | Barrios and Strobl (2002) | Developed | Spain | 1990-1994 | Firms | ? +(AC) |

| | | | | | | |
|---|---|---|---|---|---|---|
| 14 | Castellani and Zanfei (2001) | Developed | France, Italy and Spain | 1992-1997 | Firms | + for Italy, - for Spain,? for Frances |
| 15 | Keller and Yeaple (2003) | Developed | US | 1987-1996 | Firms | + |
| 16 | Gorg and Strobl (2003) | Developed | Ireland | 1973-1996 | Firms | ? +(AC) |
| 17 | Driffield and Love (2007) | Developed | UK | 1987 | Firms | + |
| 18 | Djankov and Hoekman (2000) | Transition | Czech Republic | 1992-1996 | Firms | - |
| 19 | Kinoshita (2000) | Transition | Czech Republic | 1995-1998 | Firms | ? +(R&D) |
| 20 | Konnings (2000) | Transition | Bulgaria, Poland and Romania | 1993-1997 | Firms | - |
| 21 | Damijan et al. (2003) | Transition | Bulgaria, Czech Republic, Estonia, Hungary, Poland, Romania, Slovakia and Slovenia | 1994-1998 | Firms | ? or -, + only for Romania |
| 22 | Sinani et al. (2004) | Transition | Estonia | 1994-1999 | Firms | + |

Notes:

(i) Aggregation: Use of either Industry or Firm level data

(ii) Here, + denotes positive and statistically significant, - denotes negative and statistically significant, ? denotes mixed results or statistically insignificant.

(iii) ( ): conditional upon, AC: absorptive capacity, R&D: research and development

Meanwhile, Girma et al (2001), Girma (2002), and Girma and Gorg (2002), among others, argue in favor of conditional technology spillovers.[13] They assert that technology spillovers in the same industry are conditional upon certain variables such as absorptive capacity, and Research and Development (R&D) expenditure of the firms. Using the panel data of UK manufacturing, they first don't find any technology spillovers from the presence of foreign firms and when they control for firm's absorptive capacity they obtain spillover benefits to domestic firms.

Similarly, Barrios and Strobl (2002) for Spain and Gorg and Strobl (2003) for Irish reveal technology spillovers from FDI are conditional upon the absorptive capacity of the firms. That means firms should have minimum absorptive capacity to avail technological externality from foreign firms.

Corroborating conditional technology spillovers from FDI, Kinoshita (2000) for Czech firms and Damijan et al (2000) for Romania (only among a number of Central and Eastern European transition economies) find positive spillovers only those industries, which are R&D intensive in host countries. Recently Blalock and Gertler (2009), using a panel dataset on Indonesia manufacturing from 1988 to 1996, find that firms with investment in R&D and firms with educated employees can codify the positive externalities coming from the presence of multinational firms.

From the panel data studies on horizontal technology spillovers, it can be said that results are far away from convergence rather they have arrived at mixed conclusions on the occurrence of horizontal technology spillovers in host country. Of the studies on developed economies, some studies show positive horizontal technology spillovers from FDI, others get positive spillovers only after controlling for absorptive capacity. Studies in developing economies, on the other hand, don't show any significant technology spillovers from foreign firms to firms in the same industry.

[13] Kokko (1994) and Kokko et al (1996), however, using cross sectional data, emphasize upon the conditional technology spillovers from FDI.

However, studies by Schoors and Van der Tol (2002), Javorcik (2004), and Blalock and Gertler (2005), inter-alia, are skeptical about the occurrence of horizontal technology spillovers from FDI. Indeed, it is hard to believe that such spillovers are likely in developing countries since the absorptive capacity of firms in developing countries is very low to internalize the spillovers emanating from FDI. Moreover, if both domestic and foreign firms compete in the same industry, then the latter has the tendency to prevent the technology leakage to the former. This can be accomplished through the protection of IPRs, paying higher wages to prevent employment turnovers, or operating only in countries or industries where the host country firms have lower imitating capacity to absorb the spillovers. Several studies, viz., Aitken et al (1996) and Girma et al (2001) suggest that foreign firms pay higher wages than domestic enterprises and foreign firms, in fact instigate a "brain drain" as they lure the most capable managers away from domestic firms. MNEs are also sensitive to the strength of IPRs protection in the host countries (Javorcik, 2004). So far as competition is concerned, foreign firms may specialize in the upper market segment or produce for exports, while domestic firms may focus on the local market only (Blalock and Gertler, 2008). Intra-industry, therefore, may not be the right place to search for technology spillovers form FDI.

Studies are more affirmative regarding the occurrence of technology spillovers via vertical linkages[14], i.e., vertical technology spillovers (See Tale 1.3). Schoors and Van der Tol (2002) argue in favor of vertical technology spillovers from FDI. Using two years data 1997 and 1998 for Hungarian manufacturing firms they find positive spillovers on labor productivity in the same sector. They assert that technology spillovers across industries are more important than those within an industry.[15] Studies by Javorcik (2004) and Blalock and Gertler (2005), for Lithuania and

[14] For a theoretical justification of spillovers through backward linkages, see Rodriguez-Clare (1996), Markusen and Venables (1999), and Lin and Saggi (2004). For case studies, see Moran (2001).

[15] Kugler (2000), however, first finds intersectoral technology spillovers from FDI in Colombia. However, he does not distinguish between different channels through which such spillovers may be occurring (backward versus forward linkages)

Indonesia respectively confirm the occurrence of technology spillovers via backward linkages only and they don't find any significant horizontal technology spillovers form the presence of foreign affiliates in the country.

**Table 1.3: Relevant Studies on Vertical Technology Spillovers**

| Author(s) | Countries | Year(s) | Data | Aggregation | Results | | |
|---|---|---|---|---|---|---|---|
| | | | | | HZ | BW | FW |
| Kuglar (2000) | Colombia | 1974-1998 | Panel | Firms | ? | + | ? |
| Schoors and Van der Tol (2002) | Hungary | 1997-1998 | Panel | Firms | + | + | - |
| Javorcik (2004) | Lithuania | 1996-2000 | Panel | Firms | ? | + | na |
| Blalock and Gertler (2005) | Indonesia | 1988-1996 | Panel | Firms | ? | + | na |
| Tomohara and Yokota (2006) | Thailand | 1999-2001 | Panel | Firms | + | + | ? |
| Kuglar (2006) | Colombia | 1974-1998 | Panel | Firms | + | + | na |
| Marcin (2007) | Poland | 1996-2003 | Panel | Firms | + | + | ? |
| Reganati and Sica (2007) | Italy | 1997-2002 | Panel | Firms | ? | + | na |
| Blalock and Gertler (2009) | Indonesia | 1988-1996 | Panel | Firms | ? | + | na |
| Liu (2008) | China | 1995-1999 | Panel | Firms | + | + | + |

Notes:

(i) HZ= horizontal technology spillovers, BW=technology spillovers via backward linkages, and FW= technology spillovers via forward linkages

(ii) na denotes for not applicable

(iii) Kugler (2000) do not distinguish backward and forward spillovers.

In a study of Italian manufacturing firms for the period of 1997-2002, Reganati and Sica (2007) demonstrate positive externalities from the presence of foreign firms in downstream industries and show no significant gains to domestic firms in same industry. Tomohara and Yokota (2006) for Thailand manufacturing firms, however, show both technology spillovers form foreign firms in same industry and downstream industries.

In balance, it can be said that the studies of vertical technology spillovers are evincing the occurrence of technology spillovers from foreign firms operating in downstream industries.

## 1.3 Technology Spillovers From FDI in India

Economic reforms in 1990s have brought in a substantial amount of FDI to India, which have induced the scholars and academia to study the effects of FDI on Indian economy. Besides assessing direct effects of FDI, there are studies examining the indirect effects of FDI, especially the effect of technology spillovers. In India, the early study on technology spillovers begins with the work of Lall (1980) on Indian automobile industry (truck manufacturing industry), which documents how the 'complementary activities' generate spillovers through backward linkages. Lall notes that MNEs may contribute to raise the productivity and efficiency in other firms in the host economy.[16] In his empirical study, he examines two Indian truck manufacturers (one MNE and one joint venture) and finds significant backward linkages and productivity gain to domestic manufacturers.

A study by Kathuria (1998), which employs the technique of stochastic production frontier and panel data literature in order to test the spillovers from the presence of foreign firms in the pre-1991 period (1975-1988), finds the existence of spillovers from FDI. This study also finds that spillovers from FDI are not uniform for all firms. Only scientific firms who have R&D capabilities can absorb spillovers from the presence of foreign firms. But for non-scientific firms who have low R&D intensity can't be much benefited from FDI because of inward oriented policy adopted during that period. Again, Kathuria (2002) intends to test how the domestic firms in India are benefited from the huge FDI inflows immediately after the pursuance of open

[16] MNEs— help prospective suppliers (domestic as well as foreign) to set up production facilities; provide technical assistance or information to raise quality of suppliers' products or to facilitate innovations; provide or assist in purchasing of raw materials and intermediates; provide training and help in management and organization; and assist suppliers to diversify by finding additional customers.

economic policy in 1990s. Employing the same technique of stochastic production frontier analysis for the period 1989-90 to 1996-97, he shows that only scientific non-FDI firms have benefited from liberalization and with respect to spillovers, only those domestic firms, which invest in R&D to decode the spilled knowledge, could benefit.

In line with the finding of Kathuria, Rajesh (2000) finds the plausibility of spillovers from FDI for India. However, he asserts that there exist spillovers on technical efficiency of domestic firms in manufacturing industries if there is lower technology gap between domestic firms and foreign firms.

Siddharthan and Lal (2004) advocate the estimation of separate firm level cross-section equations for each year to analyze the possible changes in the value of spillover coefficient over time. Their findings reveal the presence of significant spillover effects from FDI. During the initial years of liberalization, the spillover effects were modest, but increased sharply later on. Moreover, domestic firms having higher labour productivity and lower productivity gaps with MNE were able to enjoy higher spillovers, while those having larger productivity gaps with MNE could not benefit much.

Banga (2004) studies how the nationality of foreign firms affects the productivity of Indian manufacturing industries. She has studied firm-level data for the period for 1993-94 to 1999-2000 for three industries— automobiles, electrical, and chemicals. Using 'time-variant firm-specific' technical efficiency approach, and data envelopment analysis to estimate the production frontier, she finds that firms affiliated with Japanese investment has a significant impact on the productivity growth of domestic firms, while the impact of US affiliates is not found to be significant. However, she has not substantiated why there is no productivity spillover from US FDI when they are highly capital and technology intensive in nature.

**Table 1.4 Studies on Technology Spillovers from FDI in Indian manufacturing industries**

| Author(s) | Year(s) | Dependent variable | Measurement of Foreign Presence | Data & Methodology | t-statistics for foreign share |
|---|---|---|---|---|---|
| Kathuria (1998) | 1975-1988 | Change in productivity Growth | Share of sales of foreign firms in industry | Panel & Stochastic Frontier analysis | +*** |
| Rajesh (2000) | 1991-1997 | Technical efficiency of firm | Share of foreign firms' output in industry | Panel & Stochastic Frontier analysis | +*** |
| Kathuria (2002) | 1989- 1996 | Annual productivity change | Share of sales of foreign firms in industry | Panel & Stochastic Frontier analysis | +*** |
| Siddharthan and Lal (2004) | 1993-2000. | Value added per unit of labor cost | Value added per unit of labor cost of foreign firms[17] | Panel & OLS regression per year | +*** |
| Banga (2004) | 1993-1999 | TFPG | Foreign country's share of equity in firms | Panel & Time-variant firm specific technical efficiency approach | +*** |
| Bergman (2006) | 2004 | Output | Foreign ownership in industry[18] | Cross Section & OLS method | ? |
| Sasidharan (2006) | 1994-2002 | Output | Share of foreign firms' output in industry | Panel & OLS method | ? |
| Bhattacharya, Chen, and Pradeep (2008) | 1994-2006 | Output | Share of foreign firms' capital in industry | Panel & OLS method | +*** |

*** = Significant at 1 per cent level, + = positive, - = negative, and ? =not statistically significant

In the meantime, Sasidharan (2006) studying both horizontal as well as vertical technology spillovers, does not show any significant spillovers from foreign firms in same industry and in downstream industries. However, his study does not include

[17] Foreign presence is measured as the industry averages of value added divided by the wages and salaries bill of the MNE affiliates

[18] It is defined as foreign equity participation averaged over all firms in the industry, weighted by each firms in industrial employment.

how the foreign firms in upstream industries benefit domestic firms in India. In the same vein, Bergman (2006) for cross-section data evinces no evidence of horizontal spillovers from FDI. Nonetheless, Bhattacharya, Chen and Pradeep (2008) analyze spillovers from FDI, R&D, and exporting activities on productivity both for foreign and domestic manufacturing firms. Their findings indicate that foreign presence has a significant spillovers effect on productivity of the manufacturing firms compared to alternative spillovers such as from R&D and export.

Despite the increasing skepticism about the occurrence of horizontal technology spillovers in developing countries, studies in India are concentrated in explaining only intra-industry technology spillovers (see Table 1.4).

## 1.4 Issues and Objectives

Discussing the studies of technology spillovers from FDI in India, it is apparent that there are studies examining technology spillovers and except Sasidharan (2006), all are restricted in inspecting horizontal technology spillovers. Generally it is unlikely to expect technology spillovers from horizontal FDI in a developing country like India since domestic firms in developing countries don't have the required absorptive capacity to internalize the technology externalities from horizontal FDI. However, technology spillovers via vertical linkages are more likely to occur compared to those from horizontal FDI. Thus, it is a pertinent issue to look into how the technology spillovers occur from vertical FDI.

The above-mentioned studies treat all foreign firms equally prone for generating technology spillovers on the domestic firms.[19] As the characteristics of foreign firms are not alike rather they are heterogeneous in nature, which in turn have heterogeneous impact on domestic firms. Two characteristics namely, technology content of foreign firms and ownership structure of foreign firms, among others, are assumed to have differential impact on domestic firms in the host country. Firstly,

[19] Kojima, K (1978, 1991) and Banga R. (2004) have analyzed how the nationality of foreign firms influences the productivity spillovers in host country.

foreign affiliates with higher technology content will have higher technology spillovers on domestic firms and vice-versa. The high technology intensive foreign affiliates have more technology to transfer or diffuse and spillovers to host country compared to foreign affiliates with low technology intensity. To the best of my knowledge, there is no study discussing this issue. Secondly, ownership share of foreign firms also affects the magnitude of technology transfer from MNEs to their subsidiaries and thereby influences the spillovers in the host country. The studies, however, have not taken into consideration how the ownership shares of foreign firms affect the degree of technology spillovers in the host economy.[20]

Like foreign firms, domestic firms are not endowed equally to decode the technology externalities from MNE affiliates. Domestic firms are heterogeneous in nature. Basically, domestic firms with high technology intensity are benefited more from FDI spillovers compared to those with low technology intensity. They are thus benefited heterogeneously. This aspect needs to be examined in the context of India.

On the basis of above discussed issues we intend to look into following research objectives for our study.

a) To examine the productivity effect of vertical and horizontal technology spillovers from FDI.
b) To examine how the technology content of domestic firms mediate the technology spillovers from FDI.
c) To examine how the ownership of foreign firms mediate the technology spillovers to domestic firms in the host country.

[20] Only studies Sophia and Louri (2002), Javorcik (2004), and Blomstrom and Sjoholm (1999) have attempted to test how the ownership shares of foreign affect magnitude of spillovers in host country.

## 1.5 Data and Methodology

The study employs firm level panel data of 21 manufacturing industries in National Industrial Classification, 1998 (NIC-1998) for the period 2000-01 to 2007-08[21], obtained from the Centre for Monitoring Indian Economy's (CMIE) electronic database PROWESS. In addition to PROWESS database, the study also employs the industry level information from Annual Survey of Industry (ASI) of India, and Central Statistical Organization (CSO) data for input-output transaction tables and price indices. To examine technology spillovers from FDI, the present study uses fixed effect panel model with full set of time dummies.[22]

## 1.6 Chapter Scheme

This study is organized into four chapters including the introductory chapter. Chapter two discusses how, since independence, India's policy towards FDI evolved in tune with changing requirements of country's development process. It also discusses the consequent impact of new economic policy initiated in 1991 upon the size, trend, and pattern of FDI inflows in India. It serves as a background to the later analysis of the study. Chapter three establishes the empirical strategy to examine the research objectives. First, it makes a formal comparison between foreign and domestic firms with regard to their performance based on key variables such as R&D intensity, export intensity, technology import intensity, and total factor productivity (TFP). Then, it examines how the TFP of domestic firms are affected by the technology spillovers from FDI. It also looks upon issue of how the characteristics of domestic and foreign firms mediate the technology spillovers in Indian manufacturing. Finally, chapter four presents summary and conclusion of the study. It also discusses the limitations of the study and issues for future research.

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[21] Owing to unavailability of firm's equity holding information prior to 2000-01, we have restricted to our analysis for the period 2000-01 to 2007-08 only.

[22] Detail analysis of data and methodology is explained in chapter 3.

CHAPTER TWO

# FOREIGN DIRECT INVESTMENT IN INDIA

## 2.1 Introduction

India pursued a dirigiste development pathway for decades after independence in which the role of FDI was restricted to fill saving-investment gap, technology gap, and balance of payments gap (Subrahmanian and Pillai, 1977 and 1979). It liberalized its policy towards FDI considerably in 1991, which has brought about a phenomenal increase in FDI inflows during 1990s and 2000s. Its share in world FDI inflows has increased radically from an insignificant 0.05 per cent in 1991 to 2.45 percent in 2008 (Major FDI Indicators, World Investment Report, 2009). Her share of FDI coming to developing economies has also increased to 6.69 per cent in 2008 from 0.19 per cent in 1991 (Major FDI Indicators, WIR, 2009). The post-liberalization period has been accompanied by a change in sectoral compositions, sources, and entry modes of FDI. This chapter provides a brief overview of India's changing policy towards FDI after independence and its impact on the trends and patterns of FDI inflows. This chapter is meant to serve as background understanding on FDI in India, which acts as an auxiliary chapter for subsequent discussion on technology spillovers from FDI.

Rest of the discussion is organized as follows: section 2.2 reviews the definition of FDI; section 2.3 analyses how, since independence, India's policy towards FDI evolved in accordance with the requirements of country's development process; section 2.4 discusses the trends and patterns of FDI along with its changing sectoral compositions, sources, and modes of entry; and the concluding section summarizes the major insights from this chapter.

## 2.2 Foreign Direct investment

FDI is the process whereby residents of one country (the home country) acquire ownership of assets for the purpose of controlling the production, distribution and other activities of a firm in another country (the host country) (RBI, 2002). The internationally accepted definition considers "foreign direct investment as a category of international investment that reflects the objective of obtaining a lasting interest by a resident entity in one country in an enterprise resident in another economy" (IMF-BPM5). This definition, to a large extent, is similar to the definition provided by UNCTAD and OECD. The lasting interest implies the existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence by the investor on the management of the enterprise. This lasting interest is evinced when a direct investor own 10 per cent of equity holding in a firm in host country.

Flows of FDI comprise capital provided (either directly or through other related enterprises) by a foreign direct investor to an FDI enterprise, or capital received from an FDI enterprise by a foreign direct investor. According to IMF-BPM5, FDI has three components, namely, equity capital, reinvested earnings and intra-company loans. They are re defined as follows:

- Equity capital is the foreign direct investor's purchase of share of an enterprise in a country other than its own.
- Reinvested earnings comprise the direct investors' share (in proportion to direct equity participation) of earnings not distributed as dividends by affiliates, or earnings not remitted to the direct investor. Such retained profits by affiliates are reinvested.
- Intra-company loans or intra-company debt transactions refer to short- or long-term borrowing and lending of funds between direct investors (parent enterprises) and affiliate enterprises.

## 2.3 Evolution of FDI policy after Independence

India's policy and outlook toward FDI cannot be discussed in isolation with its shifting of country's political economy situation since independence. Clearly, FDI policies have been devised in accordance with other requirements of the developmental process and it can be classified into four distinct phases. Broadly, during the first phase (from 1948 to 1967), the government had a receptive attitude towards FDI; during the second phase (from 1968 to 1979), the government had a more restrictive attitude towards FDI; during third phase (the 1980s), the government adopted a cautious deregulation of FDI; and during the fourth phase (liberalized era from 1991 onward) the government made a full liberalization of FDI (See, Kumar, 1994; Virmani, 2006a, for detail). The subsequent subsections discuss each phase with some details.

### First Phase (1948-1967)

Soon after independence, India embarked on a strategy of import substituting industrialization with a focus on development of local capability in heavy industries including machinery-manufacturing industries. Investment in heavy industries though enabled India to have ownership specific advantage even though it was poor in technology, skills and entrepreneurship. This induced policy makers to adopt a welcoming attitude towards FDI in order to make industrial sector technologically developed. Moreover, the foreign exchange crisis of 1957-58 led to further liberalization of government attitude towards FDI. FDI was sought in mutually advantageous terms though the majority local ownership was preferred. It must be noted that during this period there were no restriction on foreign investors in repatriating profits and dividends to their home countries.

**Second Phase (1968-1979)**

Investments in machinery fabrication facilities, human capital development, and scientific and technological infrastructure during the first phase resulted in the development of certain 'created assets' in the economy, which increased the locational advantage for further FDI inflows. However, locally available skills and capabilities were seeking some sort of infant industry protection as they were not able to compete with more established industrialized countries' sources. Moreover, liberalization of FDI during first phase resulted in increased outflows due to repatriation of foreign investors and that became a significant proportion of foreign exchange account of the country.

All these factors were responsible for adopting a more restrictive attitude towards FDI during the second phase. In 1968, a new agency called Foreign Investment Board (FIB) was created within the government to deal with all cases involving foreign investment or collaboration with up to 40 per cent foreign equity. Those with more than 40 per cent of foreign ownership were to be screened by cabinet committee. There was restriction on proposals of FDI without technology transfer. In addition, the government classified industries where FDI was not desirable in view of local capabilities. The permissible range on royalty payments and duration of technology transfer agreements with parent companies were also specified for different items. Couple of years later, in 1970, a new Patent Act was enacted which abolished product patents in foods, chemicals, and drugs and reduced the life of process patents from 16 to 7 years (14 years in other cases) (Kumar, 1998).

In 1973, the industrial policy was modified so as to integrate foreign collaboration with the technological and economic objective of self-reliance. Foreign Exchange Regulation Act (FERA) in 1973 stipulated foreign firms to have equity holding only up to 40 per cent and exemptions were applicable only for companies operating in high priorities or those producing goods and services predominantly for exports (Subrahmanian, 1978; Chandra, 1993). Establishing branch plants were usually

prohibited. Foreign subsidiaries were instructed to gradually reduce their equity holding to less than 40 per cent in the domestic capital market. The law disallowed the use of foreign brands but permitted hybrid domestic brands such as Hero-Honda (Nagaraj, 2003). The changing attitude of government towards foreign investment also brought down the average number of collaborations approved per year to all time low 242 and the average foreign collaboration with equity participation fell from 108 during the 1959-66 period to 39 during 1967-79 (Kumar, 1994). During this twelve-year period of 1967-1979 the total value of foreign capital approved by the Government amounted to around $0.6 billion and the net inflow (net of dividends and repatriation of capital) was negative (Lall and Mohammad, 1983).

**Third Phase (1980s)**

The industrial policy during restrictive phase (1968-1979) retarded the domestic technical capabilities of India as reflected in poor quality Indian goods and this resulted in loss of export opportunities of labor-intensive manufactured products—in contrast to many successful East Asian economies (Nagaraj, 2003). Besides, such a restrictive policy with respect to FDI is said to have encouraged 'rent seeking' by domestic partners on imported technology with little efforts to improve product quality, or undertaking innovation (Ahluwalia, 2002; Mani, 1992). At the end of 1970s and early 1980s, India failed to boost up the volume and proportion of her manufactured exports in the wake of second oil price shock that began to worry the policy makers (Joshi and Little, 1993). The policy makers realized that highly protected local market adversely affected the international competitiveness of Indian goods and more so because of growing technological obsolescence, inferior product quality, limited range, and high cost (Kumar, 1998 and 2003). Another obstructing factor for Indian manufacturing sector is the export markets in industrialized countries which were substantially dominated by Multinational Enterprises (MNEs) which brought down the exports of Indian manufacturing (Kumar, 1994).

However, the 1980s saw a considerable though not radical relaxation of the dirigiste trade and investment regime, with a relatively benign attitude towards foreign direct investments. The industrial policy statement of 1980 and 1982, for instance, announced liberalization of industrial licensing (approval) rule, a host of incentives and exemption of foreign equity restriction under FERA to 100 per cent export-oriented unit (Kumar, 2005). Four more Export Processing Zones (EPZ) were set up in addition to the two existing ones, namely those at Kandla in Gujarat and at Santacruz in Maharashtra to attract MNEs to set up export-oriented units. The trade policy gradually liberalized imports of raw material and capital goods by expanding the list of items on the Open General License (OGL). Liberalization of industrial and trade policies was accompanied by an increasingly receptive attitude towards FDI and foreign collaboration. These policies were more flexible as regards to foreign ownership and exceptions from general ceiling of 40 per cent on foreign equity (allowed on merits of individual investment proposals). The rules and procedures relating to the payments of royalties and lump sum technical fees were also relaxed and withholding taxes were reduced.

### Fourth Phase

The piece-meal reforms in 1980s resulted in an average of more than 5 per cent growth rate of GDP, which was much better than the so-called Hindu Rate of Growth over last four decades (Virmani, 2003). However, this growth rate was not sustainable as it was accompanied with persistent fiscal and trade deficit that were financed through unsustainable short-term and long-term external borrowings that intensified into a severe balance of payments crisis in 1991 (Joshi and Little, 1993; Virmani, 2006a). As a means to tackle the balance of payment crisis, the government of India was compelled to undertake necessary economic reforms in conformity with the Washington Consensus.[23] The New Industrial Policy (NIP) announced on 24 July

[23] The term **Washington Consensus** was initially coined in 1989 by John Williamson to describe a set of ten specific economic policy prescriptions that he considered should constitute the "standard" reform package promoted for crisis-wracked developing countries by Washington,

1991 departed from the earlier FDI policy regime that regarded foreign investment as gap-filling mechanism (e.g. saving gap, balance of payment gap and technology gap) (Subramanian and Pillai, 1977 and 1979). The NIP abolished the industrial approval system in all industries except in 18 strategic or environmentally sensitive industries. As there was a need for creating confidence among foreign investors, FDI policy reform formed an integral part of industrial reforms. The government of India, in order to facilitate the free inflows of FDI, made an automatic route of FDI through Reserve Bank of India (RBI). FDI up to 51 per cent (from 40 per cent) foreign equity was thus freed for historically defined list of 34 'priority' (intermediate and capital good) industries and international trading companies. But, the dividend balancing condition[24] was there in the NIP. However, this dividend balancing condition was removed within next few months except for consumer goods and finally this condition on consumer goods was removed in 2000-01. Technology import was also put under the automatic route subject to conditions on royalty (less than 5 per cent for domestic and <8 per cent for export) and lump-sum payment (<Rs 1 crore) (Virmani, 2003).

Furthermore, any FDI (which is not falling under automatic route) or technology import had to be approved by a newly created Foreign Investment Promotion Board (FIPB). The existing companies are also allowed to raise foreign equity levels to 51 per cent for proposed expansion in priority industries. 51 per cent foreign equity was also allowed for FDI in oil exploration, production, refining, and marketing and captive coal mining. NRIs and overseas corporate bodies (OCBs) were allowed 100 per cent equity in priority industries, which became automatic in 1997-98. India also signed the convention of the Multilateral Investment Guarantee Agency (MIGA) for protection of foreign investments. Disinvestments by foreign investors no longer required RBI permission. International firms were allowed to use their own

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D.C.-based institutions such as the International Monetary Fund (IMF), World Bank, and the US Treasury Department.

[24] Cumulative dividends remitted out of the country could not exceed total foreign FDI in that company.

trademarks. In 1996-97 the automatic approval list was expanded to 48 industries, with three mining-related activities allowed 50 per cent and 9 infrastructure activities allowed 74 per cent foreign equity. The latter was raised to 100 per cent two years later. A significant step has been taken in 1999-2000 with the introduction of a negative list approach where, except a small negative list, all other industries are placed under the automatic route for FDI/NRI/OCB investment. The negative list includes all the proposals requiring industrial licenses under the industries (Development and Regulation) Act, 1951; cases having foreign equity more than 24 per cent in equity capital of units manufacturing items reserved for small scale industries; proposals having previous venture/tie-up; proposals falling out side notified sectoral policy caps etc (Yadav, 2008). The international trade policy regime has also been considerably liberalized with lower tariffs on most types of importable and sharp pruning of negative list for imports. The rupee was made convertible first on trade and finally on current account.

## 2.4 Foreign Direct Investment in India since New Economic Policy

### 2.4.1 Trends and Patterns of FDI

The sea change in India's foreign investment policy in 1991 resulted in a substantial amount of FDI inflows to India during 1990s and 2000s. India's FDI inflows have increased phenomenally to US $35.168 billion in 2008-09, from a minimal US $97 million during reform year (See Table 2.1). However, the growth rate of FDI fluctuated both during 1990s and 2000s. As is seen clearly from Table 2.1 the annual growth rate of FDI inflows is 144 per cent of total FDI inflows in 1992-93, but it fell down to -30.78 per cent in 1998-99. Much of these fluctuations are attributable to the East Asian Crisis in 1997 that obstructed the free flows of FDI to East Asia. The FDI inflows, however, revived in early 2000s before it fell down to negative in 2002-03 and 2003-04. The reason for the declining trend could be attributed to a host of elements, the most important among them being the severe restriction imposed on India by USA on account of the nuclear test carried out by India at Pokhran in 1998, the slow down of the economy, the restriction imposed on FDI Inflows regarding

TRIM (Trade Related Investment Measures), the poor domestic industrial environment, and unfavorable external factors such as the financial crisis of the South East Asia (RBI Annual Report, 2003 and 2004). The growth rate of FDI inflows again recovered in 2004-06 and it reached the highest 154.73 per cent before it declines to 2.35 per cent in 2008-09 owing to the Global Financial crisis in 2007-08. In balance, though the FDI inflows are volatile throughout 1990s and 2000s, still the trend is increasing with mild fluctuation (See Figure 2.1).

**Table 2.1: Foreign Direct Investment Inflows in India**

| Year | US $ million | Growth Rate of FDI Inflows (%) |
|---|---|---|
| 1990-91 | 97 | - |
| 1991-92 | 129 | 32.99 |
| 1992-93 | 315 | 144.19 |
| 1993-94 | 586 | 86.03 |
| 1994-95 | 1314 | 124.23 |
| 1995-96 | 2144 | 63.17 |
| 1996-97 | 2821 | 31.58 |
| 1997-98 | 3557 | 26.09 |
| 1998-99 | 2462 | -30.78 |
| 1999-00 | 2155 | -12.47 |
| 2000-01 | 4029 | 86.96 |
| 2001-02 | 6130 | 52.15 |
| 2002-03 | 5035 | -17.86 |
| 2003-04 | 4322 | -14.16 |
| 2004-05 | 6051 | 40.00 |
| 2005-06 | 8961 | 48.09 |
| 2006-07 | 22826 | 154.73 |
| 2007-08 | 34362 | 50.54 |
| 2008-09 | 35168 | 2.35 |

Source: RBI Database

It is clear that FDI's share in GDP has increased from a minimal 0.03 per cent in 1990-91 to 3.27 percent in 2008-09 (Table 2.2). FDI inflows have also contributed increasingly to economy's capital formation. In 2008-09, it shares 9 per cent in GFCF as compared to very insignificant 0.13 per cent in 1990-91 (Table 2.2). Observing the rising share of FDI in Indian economy, it can he said that significance of FDI in the economy has been increasing over last two decades.

Figure 2.1

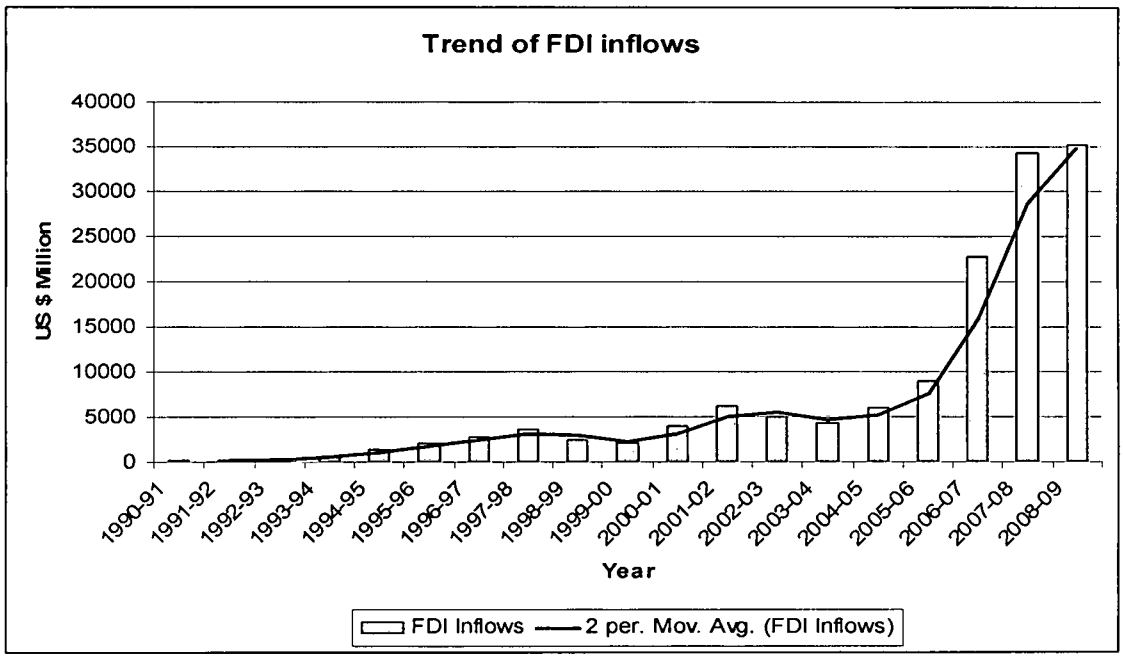


Table 2.2: Share of FDI Inflows in the Economy

| Year | % Share of FDI Inflows in GDP | % Share of FDI Inflows in GFCF |
|---|---|---|
| 1990-91 | 0.03 | 0.13 |
| 1991-92 | 0.05 | 0.22 |
| 1992-93 | 0.14 | 0.57 |
| 1993-94 | 0.23 | 0.99 |
| 1994-95 | 0.45 | 1.84 |
| 1995-96 | 0.66 | 2.46 |
| 1996-97 | 0.79 | 3.14 |
| 1997-98 | 0.94 | 3.76 |
| 1998-99 | 0.64 | 2.60 |
| 1999-00 | 0.52 | 2.05 |
| 2000-01 | 0.96 | 3.85 |
| 2001-02 | 1.39 | 5.43 |
| 2002-03 | 1.08 | 4.17 |
| 2003-04 | 0.78 | 2.89 |
| 2004-05 | 0.94 | 3.03 |
| 2005-06 | 1.21 | 3.57 |
| 2006-07 | 2.74 | 7.69 |
| 2007-08 | 3.20 | 8.61 |
| 2008-09 | 3.27 | 8.72 |

Note: GDP refers to Gross Domestic Product at Factor Cost, GFCF refers to Gross Fixed Capital Formation.

Source: own compilation using data from RBI Database

### 2.4.2 FDI Inflows into India through Different Routes of Approvals

There are four routes through which the FDI inflows into the Indian economy could be approved: namely, (i) Government approvals (Secretariat for Industrial Assistance (SIA) or the Foreign Investment Promotion Board (FIPB)); (ii) Reserve Bank of India (RBI) automatic approvals; (iii) Non Resident Indian (NRI) investments and (iv) Acquisition of shares. The SIA or the FIPB route of approval implies that it is not necessary to get the approval from the RBI for the inflows if it is more than 51% of its holdings. Instead, it is enough if permission is secured from the SIA or the FIPB. The FDI inflows could be approved either through the automatic route or through the government route.

Table 2.3 reveals that during 1990s a lion share of FDI inflows is through SIA/FIPB or the Government route and rest of FDI inflows are through RBI automatic route, NRI, and Acquisition of Share (only after 1994-95). During the first half of 1990s, one-third of the FDI is channelised through NRI but during the second half of 1990s its share has declined very sharply and reaches 4 per cent in 1999-2000. In 2000s, figure of FDI inflow has been inflated due to the inclusion of 'Reinvested earnings', 'Inter-company debt transactions of FDI entities', and Equity capital of unincorporated bodies'. Prior to 2000-01, FDI inflows consisted of only equity capital, which led to underestimation of FDI inflows in comparison to other East Asian countries (China, for instance). India has broadened its FDI estimation in 2001 by including Reinvested earnings, other capitals, and equity capital of unincorporated bodies.

**Table 2.3: FDI inflows into India classified according to different routes (US$ Million)**

| Year | a. SIA/FIPB | b. RBI | c. NRI | d | e | f | g | FDI Inflows |
|---|---|---|---|---|---|---|---|---|
| 1991-92 | **66 (51.16)** | – | **63 (48.84)** | – | – | – | – | **129** |
| 1992-93 | 222 (70.48) | 42 (13.33) | 51 (16.19) | – | – | – | – | 315 |
| 1993-94 | 280 (47.78) | 89 (15.19) | 217 (37.03) | – | – | – | – | 586 |
| 1994-95 | 701 (53.35) | 171 (13.01) | 442 (33.64) | – | – | – | – | 1314 |
| 1995-96 | 1249 (58.26) | 169 (7.88) | 715 (33.35) | 11 (0.51) | – | – | – | 2144 |
| 1996-97 | 1922 (68.13) | 135 (4.79) | 639 (22.65) | 125 (4.43) | – | – | – | 2821 |
| 1997-98 | 2754 (77.42) | 202 (5.68) | 241 (6.78) | 360 (10.12) | – | – | – | 3557 |
| 1998-99 | 1821 (73.96) | 179 (7.27) | 62 (2.52) | 400 (16.25) | – | – | – | 2462 |
| 1999-00 | 1410 (65.43) | 171 (7.94) | 84 (3.90) | 490 (22.74) | – | – | – | 2155 |
| 1990s | **10425 (67.33)** | **1158 (7.47)** | **2514 (16.23)** | **1386 (8.95)** | – | – | – | **15483 (100)** |
| 2000-01 | 1456 (36.14) | 454 (11.27) | 67 (1.66) | 362 (8.98) | 61 (1.51) | 1350 (33.51) | 279 (6.92) | 4029 |
| 2001-02 | 2221 (36.23) | 767 (12.51) | 35 (0.57) | 881 (14.37) | 191 (3.12) | 1645 (26.84) | 390 (6.36) | 6130 |
| 2002-03 | 919 (18.25) | 739 (14.68) | – | 916 (18.19) | 190 (3.77) | 1833 (36.41) | 438 (8.70) | 5035 |
| 2003-04 | 928 (21.47) | 534 (12.36) | – | 735 (17.01) | 32 (0.74) | 1460 (33.78) | 633 (14.65) | 4322 |
| 2004-05 | 1062 (17.55) | 1258 (20.79) | – | 930 (15.37) | 528 (8.73) | 1904 (31.47) | 369 (6.10) | 6051 |
| 2005-06 | 1126 (12.57) | 2233 (24.92) | – | 2181 (24.34) | 435 (4.85) | 2760 (30.80) | 226 (2.52) | 8961 |
| 2006-07 | 2156 (9.45) | 7151 (31.33) | – | 6278 (27.50) | 896 (3.93) | 5828 (25.53) | 517 (2.26) | 22826 |
| 2007-08 (P) | 2298 (6.60) | 17127 (49.17) | – | 5148 (14.78) | 2291 (6.58) | 7679 (22.04) | 292 (0.84) | 34835 |
| 2008-09 (P) | 4699 (13.36) | 17998 *(51.16)* | – | 4632 (13.17) | 666 (1.89) | 6428 (18.27) | 757 (2.15) | 35180 |
| 2000s | **16865 (13.24)** | **48261 (37.89)** | **102 (0.08)** | **22063 (17.32)** | **5290 (4.15)** | **30887 (24.25)** | **3901 (3.06)** | **127369 (100)** |

Note: FDI = a + b + c + d + e + f + g,
where d = Acquisition of shares , e = Equity capital of unincorporated bodies, f = Reinvested earnings & g = Other capital (inter company debt transactions of FDI entities)
Figures in parenthesis indicate percentage to total

Source: RBI Bulletins, 2002 & 2010

Inclusion of reinvested earnings and inter-company debt transaction of FDI entities brought down the share FDI inflows coming through SIA/FIPB route but FDI inflows as reinvested earning surged to one third of total FDI inflows. During the 2000s, FDI inflows via Government route declined sharply and reached at 13.36 per cent in 2008-09 while FDI inflow as reinvested earnings though declined but its share was more than those coming through Government route. In 2004-05 reinvested earnings accounts for 31.47 per cent of FDI followed by 20.79 per cent via RBI automatic route, 17.55 per cent via Government route, 15.37 per cent as acquisition of shares, 8.73 per cent as equity capital of unincorporated bodies, and 6 per cent as other capital. During the second half of 2000s, FDI inflows through RBI automatic route have increased while those through Government route have sharply declining. But reinvested earnings accounted for higher share though its share declines mildly in late 2000s. In 2008-09, more than 50 per cent of FDI (i.e., US $17998 million (51 per cent)) come through RBI automatic route, followed by US $6428 million (18.27 per cent) as reinvested earnings, US $ 4699 (13.36 per cent) million via government route and US $ 4632 million (13.17 per cent) through acquisition of shares (See Table 2.3).

### 2.4.3 Country-wise Distribution of FDI inflows coming to India

An analysis of the origin of the FDI inflows into India reveals that the new policy measures broadened their sources. There were more than 100 countries, which had contributed to the FDI inflows in the year 2004 compared to only 29 countries in 1991 (SIA Newsletter, Department of Industrial Policy & Promotion, India). In 1990, only six countries—the USA, the UK, Germany, Japan, Italy and France contributed more than two-thirds of the total FDI inflows into India (Economic Survey, 1998.). Table 2.4 shows that the actual FDI inflows received from the different countries during 1990s and 2000s.

It is evident that fourteen out of all investing countries contributed more than 90 per cent of total FDI (which is the sum of FDI inflows coming from all countries only). Furthermore, of all the countries, six countries (Mauritius, Singapore, U.S.A., U.K.

Germany, and Netherlands) have the lion share of total FDI (i.e., more than 70 per cent of total FDI inflows in India coming from these six countries) over the period from 1991 to 2008.

However, Mauritius has been the top investor in India since 1991. It is having 30.64 per cent of total cumulative FDI inflows during 1990s, which has increased significantly to 48.01 per cent during 2000s. In 2000, Mauritius has 35.39 per cent of total FDI inflows followed by U.S.A with 17.85 per cent, Netherlands with 5.42 per cent, Singapore with 4.97 per cent, Germany with 3.68 per cent, and U.K. with 2.7 per cent. But in 2008, the share of Mauritius in total FDI inflows increased to 50 per cent followed by Singapore with 13.18 per cent, U.S.A. with 6.3 per cent, U.K. with 5.86 per cent, Netherlands with 3.58 per cent, and Germany with 2.78 per cent. During both 1990s and 2000s the share of Mauritius in total FDI inflows is highest.

The main reason for the higher levels of investments from Mauritius is the fact that India has a Double Taxation Avoidance Agreement (DTAA) with Mauritius, under which, investors from Mauritius were protected from taxation in India. The DTAA has become the cause of increasing round-tripping[25] from Mauritius. It has also led to decline in share of FDI from USA as investors from USA are routing their investment to India via Mauritius in order to avail the benefit of reduced taxation.

[25] Round-tripping refers to the capital belonging to a country, which leaves the country & then is reinvested in the form of FDI. This facilitates many benefits mainly tax benefits, administrative supports, and easier access to financial services etc.

Table 2.4: Country wise break up for FDI Inflows received from 1991 to 2008

| Country | 1991-99 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2000-08 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mauritius | **30.64** | **35.39** | **47.80** | **45.23** | **27.64** | **31.77** | **51.04** | **47.33** | **53.68** | **50.00** | **48.01** |
| Singapore | 3.05 | 4.97 | 1.02 | 1.40 | 1.80 | 1.97 | 7.69 | 6.08 | 9.80 | 13.18 | 8.77 |
| U.S.A. | 20.53 | 17.85 | 10.54 | 8.43 | 20.35 | 20.51 | 11.23 | 7.07 | 6.11 | 6.30 | 8.46 |
| U.K. | 5.48 | 2.79 | 8.18 | 10.55 | 9.22 | 4.53 | 5.20 | 16.67 | 3.31 | 5.85 | 7.26 |
| Germany | 5.78 | 3.68 | 3.81 | 4.12 | 3.87 | 5.01 | 2.00 | 2.98 | 2.38 | 2.78 | 2.98 |
| Netherlands | 5.34 | 5.42 | 6.57 | 4.64 | 12.42 | 15.68 | 2.86 | 4.78 | 4.69 | 3.58 | 5.03 |
| Sub Total | **70.81** | **70.11** | **77.92** | **74.37** | **75.31** | **79.46** | **80.01** | **84.90** | **79.97** | **81.69** | **80.51** |
| | | | | | | | | | | | |
| Cyprus | 0.24 | 0.02 | 0.20 | 0.25 | 0.16 | 0.11 | 1.66 | 0.55 | 3.70 | 4.87 | 2.80 |
| France | 2.37 | 3.39 | 3.79 | 3.29 | 1.76 | 3.64 | 0.70 | 0.83 | 0.88 | 1.71 | 1.69 |
| Japan | 7.30 | 9.78 | 6.35 | 12.30 | 4.64 | 3.67 | 4.04 | 1.11 | 4.66 | 1.42 | 3.44 |
| Italy | 2.27 | 5.78 | 1.02 | 0.14 | 0.66 | 0.81 | 0.78 | 0.55 | 0.20 | 1.24 | 0.95 |
| U.A.E. | 0.09 | 0.03 | 0.66 | 0.37 | 0.88 | 0.93 | 1.14 | 2.34 | 1.49 | 1.04 | 1.23 |
| Switzerland | 1.95 | 1.86 | 1.13 | 1.56 | 4.59 | 2.16 | 2.00 | 0.67 | 1.52 | 0.52 | 1.15 |
| Korea (South) | 5.14 | 0.76 | 0.13 | 1.13 | 1.21 | 0.84 | 1.60 | 0.63 | 0.47 | 0.52 | 0.65 |
| Sweden | 1.22 | 2.52 | 2.86 | 0.54 | 2.25 | 2.37 | 0.75 | 0.06 | 0.58 | 0.33 | 0.73 |
| **Sub Total** | **20.58** | **24.14** | **16.14** | **19.58** | **16.14** | **14.54** | **12.67** | **6.73** | **13.49** | **11.65** | **12.63** |
| | | | | | | | | | | | |
| **Grand Total** | **91.39** | **94.25** | **94.07** | **93.95** | **91.45** | **94.00** | **92.68** | **91.63** | **93.46** | **93.33** | **93.15** |

Note: Value in 1991-99 & 2000-08 are the percentage of cumulative FDI from 1991 to 1999 & 2000 to 2008 respectively.
Moreover values are expressed as percentage of total FDI received from various countries.
Here year refers to calendar year (January to December).

Source: Own compilation using data from SIA NEWSLETTER, various issues

### 2.4.4 Sector Wise Distribution of FDI Inflows in India

Prior to economic reforms, FDI inflows were concentrated in manufacturing activities because of import substituting industrialization programme, which encouraged the tariff-jumping investments to capture the protected domestic market (Joshi and Little, 1993). The trend of FDI inflows changed towards tertiary sector (encompassing mainly the service activities) after 1991. Table 2.5 presents a break up of FDI inflows to different sectors or activities in India during the period 1991-2008.

**Table 2.5: Percentage Distribution of FDI in India**

| Year | Manufacturing Industries | Tertiary Sector | Power Sector | Mining Industry | Miscellaneous Industries | Total |
|---|---|---|---|---|---|---|
| 1991-1999 | 56.25 | 21.80 | 8.75 | - | 13.21 | 100.00 |
| 2000 | 45.09 | 10.59 | 4.80 | - | 39.52 | 100.00 |
| 2001 | 38.88 | 35.65 | 10.99 | - | 14.49 | 100.00 |
| 2002 | 54.84 | 18.35 | 19.27 | - | 7.53 | 100.00 |
| 2003 | 48.69 | 28.32 | 7.76 | - | 15.23 | 100.00 |
| 2004 | 64.50 | 21.31 | 4.83 | 0.33 | 9.04 | 100.00 |
| 2005 | 44.46 | 46.76 | 0.79 | 0.14 | 7.85 | 100.00 |
| 2006 | 19.32 | 69.19 | 1.79 | 0.03 | 9.67 | 100.00 |
| 2007 | 22.43 | 62.84 | 1.61 | 2.55 | 10.57 | 100.00 |
| 2008 | **28.87** | **54.51** | 4.11 | 0.17 | 12.34 | 100.00 |
| 2000-08 | 31.38 | 51.78 | 4.29 | 0.58 | 11.97 | 100.00 |
| 1991-2008 | 34.09 | 48.52 | 4.77 | 0.52 | 12.10 | 100.00 |

Note: value of in 1991-99 & 2000-08 are percentage of cumulative FDI.
Here year refers to calendar year (January to December)

Source: own compilation using data from SIA Newsletter, various issues.

During the 1990s FDI inflows were mainly concentrated in manufacturing industries as is visible from above table that 56.25 per cent of total cumulative FDI received by India is in manufacturing industries followed by tertiary sector attracting 21.8 per cent, miscellaneous industries attracting 13.21 per cent, and power sector attracting 8.75 per cent. The trend of FDI inflows has steadily turned towards the tertiary sector during the 2000s. FDI inflows to manufacturing industries has declined to less than 30 per cent (28.87 per cent, for instance) in 2008, instead it has been diverted to tertiary sectors (54.51 per cent of FDI inflows coming to tertiary sector in 2008). The reason unambiguously is the departure of Indian economy from inward looking

policy to market-oriented policy. Nevertheless, during the 1990s and first half of the 2000s FDI inflows were concentrated on manufacturing sectors as the cumulative figure of FDI inflows from 1991 to 2008 shows that 34 per cent of FDI inflows are into manufacturing industries.

## 2.5 Conclusion

In summing up of the chapter it can be said that government's policy toward FDI has evolved over time in tune with the changing requirements in the process of economic development in different periods. The drastic change in FDI policy in 1991 brought about a phenomenal change in the trends and patterns of FDI inflows received by India. But the FDI inflow is unsteady and fluctuating throughout the period from 1991 to 2008. Nevertheless, the post-liberalization period has been accompanied by a change in sectoral compositions, sources, and entry modes of FDI.

It is clear that prior to economic liberalization, much of the inflows of FDI were mainly to manufacturing sector. But the trend of FDI to manufacturing sector has changed during 2000s. However, during 1990s and first half of 2000s, manufacturing sector shares a major part in FDI inflows to India. This entails a question pertaining to the impact of FDI on growth and development of manufacturing sector. How do increasing inflows of FDI benefit manufacturing sector in India? How the productivity of domestic firms in manufacturing industries is affected from the FDI inflow?

CHAPTER THREE

# TECHNOLOGY SPILLOVERS IN INDIAN MANUFACTURING INDUSTRIES: AN EMPIRICAL ANALYSIS

## 3.1 Introduction

This chapter examines how the productivity of domestic firms is affected by the technology spillovers from foreign firms in India. The present study makes an endeavor to look into following issues. First, it examines the prevalence of vertical technology spillovers in Indian manufacturing firms; second, it explores how the characteristic of domestic firms, especially technology intensity, mediates the technology spillovers from FDI to domestic firms. Lastly, it probes how the degree of foreign investors' shares in affiliates or subsidiaries affects the technology spillovers to the domestic firms.

The chapter is organized as follows: section two explains the empirical framework for estimating technology spillovers from FDI; section three discusses the data and variables used for the analysis; section four makes a comparison between the performance of domestic and foreign firms on the basis of some key variables; section five estimates the productivity effect of technology spillovers from FDI on domestic manufacturing firms; and final section presents the concluding observations from the analysis.

## 3.2 Empirical Framework

The study intends to examine how foreign firms' presence in host country affects Total Factor Productivity (TFP) of domestic firms in Indian manufacturing industries. Caves (1978), Blomstrom (1992), and Blomstrom and Kokko (1998), among others, affirm that productivity of domestic firms is influenced by positive externality generated from production activities of multinational firms in host

country. R&D expenditure generally signals a firm's in-house technology content and its endeavor to be on the frontier technology. So it affects the productivity of the firm. Technology imports (both embodied and disembodied) also influences productivity of firms. In addition, the export of the firms affects this productivity. Increase in exports of firms leads to increase in economies of scales and thereby increases productivity. Moreover, entry of foreign firms following the economic liberalization are said to change the market structure of manufacturing firms in India. Change in market structure leads to change in allocation of existing resources and productivity of firms are affected by this change. Therefore, we use following regression model to examine the impact of FDI on productivity.

$$TFP_{ijt} = \beta_1 HZ_{jt} + \beta_2 BW_{jt} + \beta_3 FW_{jt} + \beta_4 HHI_{jt} + \beta_5 RDS_{ijt} + \beta_6 XNS_{ijt} + \beta_7 TMS_{ijt} \qquad (1)$$

Where $TFP_{ijt}$ is the total factor productivity of $i^{th}$ firm in industry j in year t. HZ, BW, and FW are horizontal FDI, Backward FDI, and Forward FDI respectively and they are variables to capture horizontal and vertical spillovers from foreign firms; HHI, RDS, XNS, and TMS refer to Herfindahl index of industry, R&D intensity of the firm, export intensity of the firm, and technology import intensity of firms respectively.

We are interested in the effect of technology spillovers from foreign firms on TFP of domestic firms. To proxy TFP we use firm-level residual from production function estimated at firm level. We estimate the TFP using output and all production inputs such as capital stock, labour input, raw materials and energy. It is well acknowledged that estimation of production function using Ordinary Least Squares (OLS) gives inconsistent and biased estimates of explanatory variables. There are likely to be a host of firm, industry, time, and region-specific influences that are unobservable to the econometrician but are known to the firm. These unobservable might influence the usage of production inputs and usage of inputs thus determined endogenously. Since OLS technique assumes production inputs are uncorrelated with omitted unobservable variables, it fails to address this endogeneity issues and

thereby results in inconsistent and unbiased estimates of production function, which is otherwise known as endogeneity bias.

Marshack and Andrews (1944), and Grilliches and Mairesse (1995), among others, have explored the potential correlation between input levels and firm-specific productivity shocks in estimating production function. Olley and Pakes (1996) have outlined a semi-parametric method to handle the simultaneity problem. They use investment as proxy to control the correlation between input levels and unobserved firm-specific productivity shocks in the estimation of production function. But this methodology is applicable if plants report non-zero investment. Unfortunately, many plants in developing countries do not report positive levels of investment. For our study, there are also zero investment values. So in order to apply this method to any study, sample of the study needs to be truncated if it has zero investment values in it. However, Levinsohn and Petrin (2003) propose an alternative method to estimate the production function. They, instead, use intermediate inputs such as electricity or energy to address the simultaneity problem.[26] The method allows the analysis to proceed without reducing the sample size. Another benefit of this method compared to the use of investment proxy is its applicability to non-convex adjustment costs. "If adjustment costs lead to kink points in the investment demand function, plants may not entirely respond to some productivity shocks, and correlation between the regressors and error can remain. If it is less costly to adjust the intermediate input, it may respond more fully to the entire productivity term" (Levinsohn and Petrin, 2003, p. 318).

We have used Levinsohn and Petrin (LP) methodology to estimate firm-level production function. The detail of the estimation is as follows. We assume a Cobb-Douglas production function:

[26] Another method is Blundell and Bond's (2000) GMM estimator. The method uses lagged inputs for the endogeneity problem but it is not applicable with short time series data. The method can't be employable to the present study owing to short time series data.

$$y_t = \beta_0 + \beta_k k_t + \beta_l l_t + \beta_m m_t + \beta_e e_t + \omega_t + \eta_t \qquad (2)$$

Where $y_t$, $k_t$, $l_t$, $m_t$, and $e_t$ are the logarithm[27] of output, capital stock, labour input, raw materials, and energy of firm respectively, $\omega_t$ denotes productivity of the firm and $\eta_t$ stands for measurement error in output, which is uncorrelated with input choices. Subscripts for firm and industry in the above equation are not used for notational convenience.

We take energy as proxy to take care of the endogeneity bias. LP assume that firm's intermediate inputs (say energy) demand function, $e_t = e_t(\omega_t, k_t)$ is monotonically increasing in productivity given its capital stock. This allows inversion of energy demand function as $\omega_t = \omega_t(e_t, k_t)$. Thus the unobservable productivity term $(\omega_t)$ depends solely on two observed inputs, $e_t$ and $k_t$. Rewriting equation (2) gives us:

$$y_t = \beta_l l_t + \beta_m m_t + \phi(k_t, e_t) + \eta_t$$

$$\text{Where, } \phi(k_t, e_t) = \beta_0 + \beta_k k_t + \beta_e e_t + \omega_t(k_t, e_t) \qquad (3)$$

Here the error term $(\eta_t)$ is not correlated with the inputs. The estimation of production function has been taken place at two stages. In the first stage, conditional moments $E(y_t \mid k_t, e_t)$, $E(m_t \mid k_t, e_t)$, and $E(l_t \mid k_t, e_t)$ are estimated. Conditional moment, say, $E(y_t \mid k_t, e_t)$, is approximated by a third order polynomial in k and e with full set of interactions. Conditional moments e.g., $E(m_t \mid k_t, e_t)$, and $E(l_t \mid k_t, e_t)$ are also approximated in the same way. Next we consider the following equation

$$y_t - E(y_t \mid k_t, e_t) = \beta_l (l_t - E(l_t \mid k_t, e_t)) + \beta_m (m_t - E(m_t \mid k_t, e_t)) \qquad (4)$$

No-intercept OLS, is then used on this equation to estimate parameters, $\hat{\beta}_l$ and $\hat{\beta}_m$. In the second stage, LP assume that productivity is governed by a first-order

[27] Here logarithm means logarithm to the base 10.

Markov process, $\omega_t = E(\omega_t \mid \omega_{t-1}) + \xi_t$, where $\xi_t$ is an innovation to productivity. Now compute $\phi_t + \eta_t = y_t - \hat{\beta}_l l_t - \hat{\beta}_m m_t$ and find the estimate $\hat{\phi}_t(.)$ from the regression of $\phi_t + \eta_t$ on 3rd order polynomial of $e_t$ and $k_t$ with full sets of interaction terms. For the candidate value of $\beta_k$ and $\beta_e$ as $\beta_k^*$ and $\beta_e^*$ respectively (which we can get from OLS regression of (2)), followings can be computed.

$$\omega_t \pm \eta_t = y_t - \hat{\beta}_l l_t - \hat{\beta}_m m_t - \beta_k^* k_t - \beta_e^* e_t$$

$$\omega_{t-1} \pm \eta_{t-1} = \hat{\phi}_{t-1} - \beta_k^* k_{t-1} + \beta_e^* e_{t-1}$$

$E(\omega_t \mid \omega_{t-1})$ can be estimated by regressing of "$\omega_t \pm \eta_t$" on fourth order polynomial in "$\omega_{t-1} \pm \eta_{t-1}$". Given $\hat{\beta}_l, \hat{\beta}_m, \beta_k^*, \beta_e^*$ and $E(\omega_t \mid \omega_{t-1})$, we can write the residual of the production function as

$$\xi_t \pm \eta_t \left(\beta_k^*, \beta_e^*\right) = y_t - \hat{\beta}_l l_t - \hat{\beta}_m m_t - \beta_k^* k_t - \beta_e^* e_t - E(\omega_t \mid \omega_{t-1})$$

For the estimation of coefficients in the second stage, we use two moment conditions to identify $\beta_e$ and $\beta_k$. First moment condition identifies $\beta_k$ by assuming that capital stock does not respond to the innovation in productivity, i.e., $E(\eta_t + \xi_t \mid k_t) = 0$; second moment condition identifies $\beta_e$ by using the fact that last period's energy choice should be uncorrelated with innovation in productivity this period, i.e., $E(\eta_t + \xi_t \mid e_{t-1}) = E(\xi_t e_{t-1}) = 0$. Thus, we have only two population moment conditions given by the vector of expectations:

$$E[(\eta_t + \xi_t) Z_t]$$

Where $Z_t$ is the vector given by

$$Z_t = \{k_t, e_{t-1}\}$$

Finally, we get the estimates of ( $\beta_k$, $\beta_e$ ) by minimizing the GMM criterion function

$$Q(\beta^*) = \min \beta^* \sum_{h=1}^{2} \left\{ \sum_i \sum_t (\eta_{i,t} + \xi_{i,t}(\beta^*)) Z_{i,h,t} \right\}^2$$

where i indexes firms, h indexes two instruments and t indexes time.

However, the estimation requires several steps and taking care of variances and co-variances of estimates at each stage is quite tedious job, estimates have been bootstrapped to draw inference.[28] The bootstrap technique resamples the empirical distribution of the observed data to construct new "bootstrapped" samples. The value of the statistic is computed for each of these samples and the distribution of estimates so generated provides the bootstrap approximation to the sampling distribution of the statistics. Using the estimated coefficients of production function $\hat{\beta}_l, \hat{\beta}_m, \hat{\beta}_k$, and $\hat{\beta}_e$ [29] we have estimated the $LogTFP_{ijt}$ as

$$LogTFP_{ijt} = y_{ijt} - \hat{\beta}_l l_{ijt} - \hat{\beta}_m m_{ijt} - \hat{\beta}_k k_{ijt} - \hat{\beta}_e e_{ijt}$$

## 3.3 Data and Variable Construction

The basic database for the study is the firm level panel data of 21 manufacturing industries in National Industrial Classification, 1998 (NIC-1998) for the period 2000-01 to 2007-08[30], obtained from the Centre for Monitoring Indian Economy's (CMIE) electronic database PROWESS. The sample is selected for the present study by various steps. In the first step, all firms in the manufacturing sectors are selected; in the second step, firms not having equity holding information are dropped; in the third step, firms for which the key variables like sales, Gross Fixed Assets (GFA), salaries and wages, raw materials, and energy are available are selected. Firms not having continuous time series of at least three years have been dropped as capital

[28] See Horowitz (2001) for an overview of the bootstrap.

[29] See appendix A. 2 for estimates of coefficient of production inputs

[30] Owing to unavailability of firm's equity holding information prior to 2000-01, we have restricted to our analysis for the period 2000-01 to 2007-08 only.

stock estimation requires continuous times series. Finally, correcting for outliers we are restricted with 11506 observations on 1897 manufacturing firms.[31]

In addition to PROWESS database, we use the industry level information from Annual Survey of Industry (ASI) of India, and Central Statistical Organization (CSO) data for input-output transaction tables and price indices.

## Construction of Variables

All the variables in the production function are in 1993-94 prices, obtained by deflating values reported in current prices using appropriate price indices collected from "*Index Numbers of Wholesale Prices in India, base 1993-94 = 100*" published by the Economic Adviser Ministry of Commerce and Industry, Government of India. The specific details on the construction of each variable are given below.

*Output (Q):* The output series are obtained by deflating reported nominal value of output, which is the sum of sales and change in stock of finished/semi-finished goods of the firm. A more disaggregated level of industry price indices is used for deflating output.

*Raw materials (M):* It is obtained by deflating the reported cost of raw materials consumed using raw material price indices. Raw material price index for each industry (this is also at more disaggregated level) is constructed using weights obtained from Input-Output Transaction Table of India for 2003-04, published by the Central Statistical Organization (CSO) and appropriate price indices collected from *Index Numbers of Wholesale Prices in India, base 1993-94 =100.*

*Capital (C):* The database reports Gross Fixed Assets (GFA) of the firm in historical cost. Capital stock is constructed using perpetual inventory method by taking 2004-

[31] To correct outliers of the sample we follow Tukey (1977). Tukey's Exploratory Data Analysis includes a resistant rule for identifying possible outliers in univariate data. Using lower and upper quartles $Q_L$ and $Q_U$, it labels as "outside" any observations below $Q_L - 1.5\,(Q_U - Q_L)$ or above $Q_U + 1.5\,(Q_U - Q_L)$.

05 as the benchmark year. For this, we have converted the reported GFA of 2004-05 into replacement cost on the basis of a revaluation factor computed using the procedures given in Srivastava (1996) (See Appendix 1, for detail). We use gross fixed asset rather than the net fixed asset, as the construction of net fixed asset needs information on the economic rate of depreciation of assets, which is not available for the Indian manufacturing industry.

*Labour (L):* The PROWESS database provides information on wages and salaries of the firm and provides no information on the number of employees. Therefore, we need to use this information to arrive at the number of person engaged in each firm. Number of persons engaged in a firm is arrived at by dividing the salaries and wages at the firm level by the average wage rate of the industry (two-digit) to which firm belongs. To arrive at the average wage rate we make use of the Annual Survey of Industries (ASI) data on Total Emoluments as well as Total Persons Engaged for the relevant industry. At the time of this study, ASI data was available only up to 2005-06. We have extrapolated the values for the remaining years of our study.

*Energy (E):* The energy variable is constructed by deflating the reported energy cost[32] by an energy price index which is constructed using weights obtained from the Input-Output Transaction Table of India for 1993-94 and appropriate price indices from the Index Numbers of Wholesale Prices in India base 1993-94=100.

*Technology Import Intensity (TMS):* Technology import intensity controls for how the expenditure on technology imports influence the productivity of the domestic firms. Modern and advanced technologies are always priced at higher rate, higher expenditures on technology import show the firm's interest in improvement and hence there is increase in productivity of firms. Technology import intensity is measured as the ratio of firm's expenditure on technology import to its sales value in

[32] Energy cost is measured by the reported power and fuel.

a year. The technology import expenditure includes the expenditure on the import of capital goods and foreign exchange spending on royalty/technical know-how.[33]

*Export Intensity (XNS):* Firm's extent of interaction with the foreign buyers and foreign markets and the consequent learning from them is represented by its export intensity. It is defined as the ratio of firm's export to its sales value in a year.

*R&D Intensity (RDS)*: Firm's in-house endeavor to develop, absorb and reach at technology frontier is measured by its R&D intensity. This is defined as the ratio of firm's R&D expenditure to its sales value.

*Herfindahl Index (HHI)*: Herfindahl index is meant to capture the effect of competition in industry. It is the proxy for the level of industry concentration and it is the sum of the squared market shares of firms in a given industry. Symbolically, it is

$$HHI_j = \sum_i \left( \frac{S_i}{\sum S_i} \right)^2$$

where $S_i$ is the sale of firm $i^{th}$ firm and j stands for industry. Higher value of HHI indicates a more concentrated industry. A more concentrated industry implies lower competition, which creates inefficiency and thereby lowers productivity of firms in the industry.

There are some variables, namely, Horizontal FDI, Backward FDI, and Forward FDI that capture the technology spillovers from FDI. They are constructed as follows.

*Horizontal FDI (HZ):* It measures the share of output accounted by the foreign firms[34] in the total output of the industry. It is defined as

[33] Foreign exchange spending on royalty/technical know-how is the expenditure on the import of disembodied technology.

$$HZ_{jt} = \frac{\sum_{i=1}^{m} Y_{it}^{f}}{\sum_{i=1}^{n} Y_{it}}$$

where $Y_{it}$ is the output of firms i in year t and $Y_{it}^{f}$ are output of foreign firm i in same year. n stands for total number of firms in an industry consisting of both domestic and foreign firms and m denotes number of foreign firms in an industry.

*Backward FDI (BW):* Backward FDI is the share of total output of an industry that is sold to foreign firms in downstream industries. To construct this variable we follow Blalock and Gertler (2005). In contrast to horizontal FDI it is not straightforward to measure rather it is more complicated. Here, we would like to measure the share of firm's output sold to foreign-owned firms. Unfortunately, this information is not available in our dataset. So, we proxy the share of the firm's output sold to foreign firms by the share of an industry's output that is sold to foreign firms. Then, how to measure the share of an industry output sold to foreign firms in other industries? *"If we assume that a firm's share of an industry's use of a particular input is equal to its output share, then a measure of the share of an industry output sold to foreign firms is the sum of the output shares purchased by other industries multiplied by the share of foreign output in each purchasing industry"* (Blalock and Gertler, 2005).[35] Now formally we can express the Backward FDI for industry j at time t as follows.

$$BW_{jt} = \sum_{k \neq j} \alpha_{jk} HZ_{kt}$$

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[34] Firms having foreign equity greater than 10 per cent of total equity are classified as foreign firms or foreign owner firms, foreign affiliates.

[35] To illustrate the Backward FDI, let's consider there are 3 industries such as wheat flour milling, pasta production, and baking. Suppose that half of the wheat flour industry's output is purchased by the bakery industry and the other half is purchased by the pasta industry. Further, assume that the bakery industry does not have any foreign factories but that foreign factories produce half of the pasta industry output. The calculation of the Backward FDI for flour industry would be 0.25=0.5(0.0) + 0.5 (0.5).

Where, $\alpha_{jk}$ is the proportion of industry j's output supplied to industry k, which is taken from the 2003-04 *industry x industry* coefficient matrix[36] at two-digit level (NIC-1998). The formula shows that inputs supplied within the sector are not included, since the Horizontal FDI captures this effect. This variable states that higher presence of foreign firms in downstream industry generates higher backward linkages to firms in upstream or supplying industry in host country.

***Forward FDI (FW):*** Forward FDI measures the degree of forward linkages from foreign firms to domestic firms in downstream industries and it is defined as the proportion of an industry's intermediate consumption supplied by foreign-owned firms. Using the same assumption used for constructing backward FDI, we can approximate the share of an industry's intermediate consumption supplied by foreign firms as the sum of shares of intermediate input sourced from other industries multiplied by share of foreign firms' output in each supplying industry. Further, while measuring share of foreign firms' output in upstream or supplying industry, we have excluded goods produced by firms for export, since only intermediate sold in the domestic markets are relevant for construction of forward FDI. Thus the approximation for Forward FDI is

$$FW_{jt} = \sum_{w \neq j} \sigma_{wj} \left[ \frac{\sum_{i=1}^{m} \left( Y_{it}^{f} - X_{it}^{f} \right)}{\sum_{i=1}^{n} \left( Y_{it} - X_{it} \right)} \right]$$

where $\sigma_{wj}$ is the share of inputs purchased by industry j from industry w in total inputs sourced by industry j and superscript f stands for foreign firm and the second term of right side of equation computes the share of foreign firms' output in upstream or supplying industry. For the same reason as before, inputs purchased

[36] Industry-Industry Coefficient matrix is constructed using Input-Output Transaction Table of year 2003-04. See Appendix A.2 for detail.

within the sector are excluded. The value of the variable increases with increased in share of foreign firms' output in upstream industries.

As pointed out above, an important feature of this study is to see how the degree of foreign ownership in foreign firms affects the technology spillovers on domestic firms in host country. For this we have divided total foreign firms into majority-owned foreign firms and minority-owned foreign firms. Former is the firm with at least 50 per cent foreign equity participations and later is the firm with foreign equity participation above 10 per cent but below 50 per cent.[37] Accordingly, we have constructed six measures of foreign presence such as MajHZ, MinHZ, MajFW, MinFW, MajBW, and MinBW.

**MajHZ:** It is the share of output of majority-owned foreign firms in a given industry. Symbolically, it is as follow:

$$MajHZ_{jt} = \frac{\sum_{i=1}^{m}\left(Maj_{it} * Y_{it}^{f}\right)}{\sum_{i=1}^{n} Y_{it}}$$

Where the numerator is the total output of majority-owned foreign firms functioning in India in industry j and year t and denominator is the total output of the same industry in the same year. $Maj_{it}$ is a dummy variable that takes the value one for majority-owned foreign firms and zero for other firms. The value of the above variable expresses the proportion of total output of a given industry in a given year that is produced by majority-owned foreign firms.

**MajBW**: It is the share of output of an industry that is supplied to majority-owned foreign firms in downstream industry. Applying the same procedure used for backward FDI, majority-backward FDI is defined as follow:

[37] Similar approach has been used by Demelis and Louri (2002) for defining majority and minority-owned foreign firms.

$$MajBW_{jt} = \sum_{k \neq j} \alpha_{jk} MajHZ_{kt}$$

This variable shows that higher presence of majority-owned foreign firms in downstream industry generates higher backward linkages to firms in upstream or supplying industry.

**MajFW:** It is the proportion of output of an industry that is purchased from majority-owned foreign firms in upstream industry. Following the procedure applied for forward FDI, we are approximating the share of an industry's intermediate input supplied by majority-owned foreign firms as the sum of the shares of intermediate input bought from other industries multiplied by share of output of majority-owned foreign firms in each supplying industry. We have also excluded the goods produced by firms for export while measuring share of foreign firms' output in upstream or supplying industry, since only intermediate inputs sold in the domestic market are relevant for construction of majority-forward FDI. So, majority-Forward FDI is as

$$MajFW_{jt} = \sum_{w \neq j} \sigma_{wj} \left[ \frac{\sum_{i=1}^{m} \left( Maj_{it} * \left( Y_{it}^{f} - X_{it}^{f} \right) \right)}{\sum_{i=1}^{n} \left( Y_{it} - X_{it} \right)} \right]$$

where the second term in the right side of the equation is the share of output of a given industry produced by majority-owned foreign firms. The measures of foreign presence such as MinBW, MinFW, and MinHZ are constructed in an analogous manner.

## Classification of Industries

As outlined earlier, technology content of domestic firms are not homogenous. Firms in high technology industries are assumed to have more technological competency compared to firms in low technology industries. Hence, productivity effect of FDI

spillovers can vary across industries. Here needs to be a classification of industries on the basis of technology intensity in order to examine how the domestic firms with different technological capability are benefited from FDI spillovers. However, classification of industries on the basis of their technological intensity is quite a difficult job because no single criterion is available for this purpose and hence any classification involves some amount of arbitrariness. Therefore, the present study, while classifying manufacturing industries into high technology and low technology, follows the OECD classification, which uses R&D expenditure and output of 12 OECD countries to classify manufacturing industries (OECD, 2007). Following table gives the classification of Indian manufacturing industries.

**Table 3.1: Classification of Manufacturing Industries**

| NIC Code | **Low Technology Industries** |
|---|---|
| 15 | Food Product and Beverages |
| 16 | Tobacco Products |
| 17 | Textiles |
| 18 | Wearing Apparel; Dressing and Dyeing of Fur |
| 19 | Tanning and Dressing of Leather; Manufacture of Luggage, Handbags Saddlery, Harness and Footwear |
| 20 | Wood and of Products of Wood and Cork, Except Furniture; Manufacture of Articles of Straw and Plating Materials |
| 21 | Paper and Paper Products |
| 22 | Publishing, Printing and Reproduction of Recorded Media |
| 23 | Coke, Refined Petroleum Products and Nuclear Fuel |
| 25 | Rubber and Plastic Products |
| 26 | Other Non-Metallic Mineral Products |
| 27 | Basic Metals |
| 28 | Fabricated Metal Products, Except Machinery and Equipments |
| 36 | Furniture; Manufacturing N.E.C. |
| | **High Technology Industries** |
| 24 | Chemicals and Chemical, Products |
| 29 | Machinery and Equipment N.E.C. |
| 31 | Electrical Machinery and Apparatus N.E.C. |
| 32 | Manufacture of Radio, Television and Communication Equipment and Apparatus |
| 33 | Medical, Precision and Optical Instruments, Watches and Clocks |
| 34 | Motor Vehicles Travelers and Semi-Trailers |
| 35 | Other Transport Equipment |

## 3.4 Comparison between Foreign Firms and Domestic Firms

Before looking into the productivity effect of technology spillovers from FDI, this section makes a comparison of performance between foreign and domestic firms. Using the key variables of the sample, namely R&D intensity, export intensity, technology import intensity, and TFP, we have made a distinction between foreign and domestic firms in manufacturing industries.

**Table 3.2: Mean Value Comparison of R&D Intensity Between Foreign Firms &Domestic Firms**

| Year | Foreign Firms | Domestic Firms | Mean Difference |
|---|---|---|---|
| 2000-01 | 0.163<br>(0.033) | 0.002<br>(0.000) | 0.160***<br>(0 .015) |
| 2001-02 | 0.127<br>(0 .013) | 0.002<br>(0.000) | 0.125***<br>(0.006) |
| 2002-03 | 0.135<br>(0.013) | 0.002<br>(0.000) | 0.132***<br>(0.005) |
| 2003-04 | 0.135<br>(0.013) | 0.003<br>(0.000) | 0.131***<br>(0.005) |
| 2004-05 | 0.148<br>(0.013) | 0.003<br>(0.000) | 0.144***<br>(0.005) |
| 2005-06 | 0.154<br>(0.014) | 0.010<br>(0.006) | 0.143***<br>(0.017) |
| 2006-07 | 0.171<br>(0.014) | 0.004<br>(0.000) | 0.167***<br>(0.006) |
| 2007-08 | 0.148<br>(0.014) | 0.004<br>(0.000) | 0.144***<br>(0.006) |

Note: 1. Mean Difference= Mean (Foreign Firms) - Mean (Domestic Firms
2. Values in the parentheses are the Standard Error
3. ** and *** stand for value is significant at 5 per cent and 1 per cent respectively

*R&D Intensity:* It is observed that share of R&D expenditure in sales of the firms is very negligible in domestic firms in Indian manufacturing sector (See Table 3.2). As, it is evident that in all the years, foreign firms invest more than 12 per cent of their sales on R&D compared to domestic firm, which invests even less than 1 per cent of the sales. Foreign firms spend significant proportion of their sales on R&D compared

to domestic firms, as it is apparent that the mean difference of R&D intensity between foreign and domestic firms is statistically significant for all the years. It seems foreign firms are more R&D intensive in comparison to domestic firms.

**Table 3.3: Mean Value Comparison of Export Intensity Between Foreign Firms & Domestic Firms**

| Year | Foreign Firms | Domestic Firms | Mean Difference |
|---|---|---|---|
| 2000-01 | 0.011<br>(0.002) | 0.135<br>(0.007) | -0.124***<br>(0.016) |
| 2002-03 | 0.011<br>(0.001) | 0.147<br>(0.006) | -0.136***<br>(0.015) |
| 2003-04 | 0.014<br>(0.001) | 0.150<br>(0.006) | -0.136***<br>(0.015) |
| 2004-05 | 0.021<br>(0.004) | 0.157<br>(0.006) | -0.135***<br>(0.016) |
| 2005-06 | 0.027<br>(0.005) | 0.153<br>(0.006) | -0.126***<br>(0.016) |
| 2006-07 | 0.024<br>(0.003) | 0.168<br>(0.007) | -0.143***<br>(0.017) |
| 2007-08 | 0.018<br>(0.002) | 0.172<br>(0.007) | -0.154***<br>(0.016) |

Note: 1. Mean Difference= Mean (Foreign Firms) - Mean (Domestic Firms
2. Values in the parenthesis are the Standard Error
3. ** and *** stand for value is significant at 5 per cent and 1 per cent respectively

*Export Intensity:* It is apparent from our sample analysis that domestic firms are more export intensive than foreign firms in India. Export performance of domestic firms has been increasing over the years, as it is noticeable that domestic firms' average export intensity is 0.17 in 2007-08 compared to 0.13 in 2000-01. Foreign firms' export, on the other hand, is very negligible for all the year of study (See Table 3.3). This may be indicative of the fact that foreign-owned firms are domestic market seeking, focusing more on host country market rather than world markets.

*Technology Import Intensity:* In addition to R&D intensity and export intensity, technology import intensity is also important determinant of productivity growth of firms. Technology import upgrades the existing technology of firms and boosts up their productivity. It is broadly classified into embodied technology consisting of

capital goods and disembodied technology in the forms of blueprints and technical know-how. Comparing the technology import intensity of foreign and domestic firms it is apparent that foreign firms are spending more on technology importation compared to domestic firms (See Table 3.4). In the beginning of study period, mean technology import intensity of domestic firms is 0.08, while same is 0.10 for foreign firms. For all the years, the mean technology import intensity of domestic firms has, however, increased still it is below the average technology import intensity of foreign firms.

**Table 3.4: Mean Value Comparison of Technology Import Intensity Between Domestic Firms & Foreign Firms**

| Year | Foreign Firms | Domestic Firms | Mean Difference |
|---|---|---|---|
| 2000-01 | 0.100<br>(0.005) | 0.008<br>(0.000) | 0.092***<br>(0.003) |
| 2001-02 | 0.092<br>(0.005) | 0.007<br>(0.000) | 0.085***<br>(0.003) |
| 2002-03 | 0.085<br>(0.005) | 0.008<br>(0.001) | 0.077***<br>(0.004) |
| 2003-04 | 0.086<br>(0.005) | 0.007<br>(0.000) | 0.078***<br>(0.002) |
| 2004-05 | 0.086<br>(0.005) | 0.010<br>(0.001) | 0.075***<br>(0.003) |
| 2005-06 | 0.087<br>(0.005) | 0.016<br>(0.001) | 0.071***<br>(0.004) |
| 2006-07 | 0.090<br>(0.005) | 0.019<br>(0.001) | 0.070***<br>(0.004) |
| 2007-08 | 0.094<br>(0.006) | 0.017<br>(0.003) | 0.077***<br>(0.007) |

Note: 1. Mean Difference= Mean (Foreign Firms) - Mean (Domestic Firms
2. Values in the parenthesis are the Standard Error
3. ** and *** stand for value is significant at 5 per cent and 1 per cent respectively

*Total Factor Productivity (TFP):* It is seen above that both R&D expenditures and technology imports are predominantly higher for foreign firms, which may have enabled them to achieve higher productivity vis-à-vis their domestic counterparts. Table 3.5 shows that average TFP of foreign firms is higher than that of domestic firms for all the years. It is seen that both the productivity of foreign and domestic firms have increased over the study period. Average TFP of foreign firms in 2007-08

is 4.064, which has increased from 3.918 in 2000-01 while average TFP of domestic firms has also increased from 3.859 in 2000-01 to 3.987 in 2007-08. Although, the differences in mean TFP between foreign and domestic firms are statistically significant for all the year, still it is evident that productivity of domestic firms is increasing with the increase in productivity of foreign firm. This implies that domestic firms are catching up with foreign firms. This affirms that there might be some technology gains or spillovers from the presence of foreign firms to domestic firms.

**Table 3.5: Mean Value Comparison of TFP Between Foreign Firms and Domestic Firms**

| Year | Foreign Firms | Domestic Firms | Mean Difference |
|---|---|---|---|
| 2000-01 | 3.918<br>(0.024) | 3.859<br>(0.009) | 0.0591**<br>0.025 |
| 2001-02 | 3.876<br>(0.008) | 3.985<br>(0.021) | 0.108***<br>(0.022) |
| 2002-03 | 3.996<br>(0.020) | 3.892<br>(0.008) | 0.103***<br>(0.022) |
| 2003-04 | 4.001<br>(0.020) | 3.904<br>(0.008) | 0.096***<br>(0.022) |
| 2004-05 | 4.025<br>(0.020) | 3.921<br>(0.008) | 0.103***<br>(0.022) |
| 2005-06 | 4.026<br>(0.020) | 3.945<br>(0.008) | 0.081***<br>(0.022) |
| 2006-07 | 4.078<br>(0.020) | 3.992<br>(0.008) | 0.086***<br>(0.022) |
| 2007-08 | 4.064<br>(0.019) | 3.987<br>(0.009) | 0.076***<br>(0.021) |

Note: 1. Mean Difference= Mean (Foreign Firms) - Mean (Domestic Firms
2. Values in the parenthesis are the Standard Error
3. ** and *** stand for value is significant at 5 per cent and 1 per cent respectively

It is, now, obvious from the above analysis that foreign firms are diverting more of their income (total sales) for R&D and technology imports compared to the minimal amount that domestic firms divert for the same purpose. These increased spending on R&D and technology import might have resulted in deepening of technology content of foreign firms, as reflected in their TFP. Clearly, mean TFP of foreign firms

is significantly higher than domestic firms. Nonetheless, the domestic firms are catching up with the foreign firms.

## 3.5. Estimation of Technology Spillovers from FDI

The central focus of this chapter is to examine how the TFP of domestic firms are affected by the presence of foreign firms in Indian manufacturing industries. Following the studies of Aitken and Harrison (1999) and Blalock and Gertler (2005, 2009) our study also takes contemporaneous value of the variables to estimate technology spillovers from foreign investment. However, Kathuria (1998, 2002), and Javorcik (2004), among others, have used lagged and difference value of the variables respectively for estimating technology spillovers. For our purpose, we have used the following models.

*Model 1*

$$LogTFP_{ijt} = \beta_0 + \beta_1 BW_{jt} + \beta_2 FW_{jt} + \beta_3 HZ_{jt} + \beta_4 HHI_{jt} + \beta_5 RDS_{ijt} + \beta_6 XNS_{ijt} + \beta_7 TMS_{ijt} + \varepsilon_{ijt}$$

*Model 2*

$$LogTFP_{ijt} = \beta_0 + \beta_1 MajBW_{jt} + \beta_2 MinBW_{jt} + \beta_3 MajFW_{jt} + \beta_4 MinFW_{jt} + \beta_5 MajHZ_{jt} + \beta_6 MinHZ_{jt}$$
$$+ \beta_7 HHI_{jt} + \beta_8 RDS_{ijt} + \beta_9 XNS_{ijt} + \beta_{10} TMS_{ijt} + \varepsilon_{ijt}$$

As outlined earlier, the sample of the study covers 11,506 observations of 1897 manufacturing firms over the study period. Nearly, 16 per cent of total manufacturing firms have foreign investment during the study period 2000-01 to 2007-08. After classifying foreign firms on the basis of foreign ownership, we have found that of the total manufacturing firms 6 per cent are majority-owned foreign firms and 9 per cent are minority-owned foreign firms.

Table 3.6: Share of Foreign Presence in Manufacturing Industries, 2007-08

| Industries | Total Firms | Foreign Firms | Share of Foreign Firms |
|---|---|---|---|
| **Low Technology Industries** | | | |
| Food and Beverages (15) | 132 | 11 | 0.08 |
| Tobacco Products (16) | 8 | 2 | 0.25 |
| Textiles (17) | 156 | 10 | 0.06 |
| Wearing Apparel (18) | 14 | 3 | 0.21 |
| Leather (19) | 12 | 1 | 0.08 |
| Wood (20) | 10 | 1 | 0.10 |
| Paper (21) | 39 | 6 | 0.15 |
| Publishing (22) | 14 | 1 | 0.07 |
| Coke (23) | 15 | 3 | 0.20 |
| Rubber (25) | 109 | 15 | 0.14 |
| Other Non-Metallic (26) | 67 | 14 | 0.21 |
| Basic Metals (27) | 130 | 21 | 0.16 |
| Fabricated Metal (28) | 39 | 3 | 0.08 |
| Furniture (36) | 24 | 1 | 0.04 |
| **Sub Total (i)** | **769** | **92** | **0.12** |
| **High Technology Industries** | | | |
| Chemicals (24) | 333 | 52 | 0.16 |
| Machinery (29) | 107 | 29 | 0.27 |
| Electrical Machinery (31) | 60 | 13 | 0.22 |
| Radio, Television and Communication (32) | 34 | 8 | 0.24 |
| Medical (33) | 18 | 6 | 0.33 |
| Motor Vehicles (34) | 84 | 27 | 0.32 |
| Other Transport (35) | 10 | 1 | 0.10 |
| **Sub Total (ii)** | **646** | **136** | **0.21** |
| **Grand Total (i+ii)** | **1415** | **228** | **0.16** |

Note: Industries are the two-digit industries according to NIC-1998

Source: Own compilation using data from PROWESS, CMIE

Table 3.6 classifies domestic and foreign firms by industry for 2007-08. The presence of foreign firms is highest in Medical, Precision and Optical Instruments, Watches and Clocks industry with 33 per cent, followed by Motor Vehicles Travelers and Semi-Trailers industry with 32 per cent, Machinery and Equipment N.E.C. industry with 27 per cent, Tobacco Products industry with 25 per cent, and Manufacture of Radio, Television and Communication Equipment and Apparatus industry with 24 per cent. The lowest foreign presence is in Furniture; Manufacturing N.E.C. industry which has only 4 per cent. It is clear that during 2007-08, only 16 per cent firms have foreign investments. However, further segregation of manufacturing industries on the basis of technology shows that foreign firms are more in high technology

industries compared to their presence in low technology industries. From the sample statistics for the year 2007-08, it can be said that high technology industries attract more foreign investment compared to low technology industries.

Before going into estimation of above specified models, it is essential to know the behavior of the models' variables. The study has annexed the summary statistics of all the variables in the models (See Table A. 3 in Appendix). We also show two correlation matrices for both model 1 and 2 (See Table A. 4 & A. 5 in Appendix). For both the models, the correlation matrices are found not to be very problematic for running regressions. The only correlation coefficient between MinBW and MajBW is the highest among all the variables.

Further, we have restricted our sample to 9840 observations on 1640 domestic firms. Since we are interested in estimating technology spillovers from foreign firms towards domestic firms, our analysis considers only the later type of firms. The models have been estimated using a firm level fixed effect approach with full set of year dummies.[38] In fixed effects specification, heteroscedasticity and serial correlation are always the potential problem. The possible bias is larger the longer the time horizon. Since we have short time series and a large cross-section, it is appropriate to use cluster sample methods (Arellano, 1987; Wooldridge, 2003) to estimate the fixed effect models. Cluster sample methods are generalization of White's (1980) robust covariance matrices. The obtained robust variance matrix estimator is valid in the presence of heteroscedasticity and serial correlation provided that, as in our case, time period is small relative to the number of groups (Wooldridge, 2002, PP. 262-263, and 2003). The fixed effects panel estimation control for the unobserved heterogeneity among the firms in the sample.

[38] A Hausman test run on preliminary regressions clearly rejected random effect models in favor of fixed effect models.

## Estimations Results

We examine both the occurrence of vertical and horizontal technology spillovers from FDI in model 1. In model 2, we contrast between technology spillovers from minority-owned and majority-owned foreign firms. In both the models we also show how the domestic firms with different technology intensity are affected from FDI.

### (a) Horizontal and Vertical Technology Spillovers from FDI

Column (i) of the Table 3.7 shows the estimation of model 1 based on full sample of domestic firms. The estimate of coefficient of backward FDI is positive and statistically significant which suggests that TFP of domestic firms increases over 35 per cent due to one unit increase in output of foreign firms in downstream industries. This implies that the presence of foreign firms in downstream industries benefits domestic firms through linkages. In contrast, foreign firms in supplying industries and in same industry do not have any significant spillovers on the productivity of domestic firms, as the coefficients of FW and HZ are statistically insignificant at conventional level. All the firm-specific and time-variant control variables, namely R&D intensity, export intensity, technology import intensity, and industry specific control variable such as Herfindahl index don't also have any significant effect on domestic firms in India. This finding is similar to those found by Schoors van der Tol (2002), Javorcik (2004) and Blalock and Gertler (2005) who have affirmed the occurrence of vertical technology spillovers from FDI via backward linkages.

Table 3.7: Regression Results of Domestic Firms for period 2000-01 to 2007-08. Dependent Variable: LogTFP

| Independent Variables | All Firms (i) | Low Technology Firms (ii) | High Technology Firms (iii) |
|---|---|---|---|
| BW | 0.350*** | 0.571*** | 1.311* |
| | (0.125) | (0.123) | (0.705) |
| FW | 0.042 | -1.858** | -0.449** |
| | (0.105) | (0.780) | (0.151) |
| HZ | -0.095 | -0.083 | -0.024 |
| | (0.058) | (0.063) | (0.109) |
| HHI | 0.166 | -0.112 | -0.433 |
| | (0.211) | (0.250) | (0.424) |
| RDS | -0.003 | 0.002 | -0.480 |
| | (0.003) | (0.001) | (0.258) |
| XNS | 0.034 | 0.035 | -0.005 |
| | (0.030) | (0.037) | (0.050) |
| TMS | -0.092 | -0.165 | -0.011 |
| | (0.068) | (0.104) | (0.037) |
| Constant | 3.827*** | 3.894*** | 3.764*** |
| | (0.028) | (0.040) | (0.089) |
| Year Dummies | Yes | Yes | Yes |
| Firm Dummies | Yes | Yes | Yes |
| $R^2$ | 0.061 | 0.031 | 0.156 |
| F - Statistics | 18.46*** | 8.39*** | 21.11*** |
| Observations | 9840 | 5527 | 4313 |

Note: (1) Robust standard errors are in parentheses.
(2) *, **, and *** are significant at 10 per cent, 5 per cent, and 1 per cent respectively

**(b) Technology Spillovers & Characteristics of Host Country's Firms.**

To assess the influence of characteristics of domestic firms in terms of their technology content, the sample is divided into two subcategories viz., low technology intensive firms and high technology intensive firms[39]; and the results with respect to each are presented in column (ii) and (iii) of Table 3.7. In column (ii) we find that both coefficients of backward and forward FDI are statistically significant. The coefficient of backward FDI indicates that increase in share of output of foreign firms in downstream industries raises the TFP of domestic firms, where as

[39] Low technology and high technology firms are firms belonging to low technology and high technology industries respectively.

the coefficient of forward FDI shows the opposite results. That is, the increase in share of output of foreign firms in upstream industries brings down TFP of domestic firms. Though, there is technology spillovers through backward linkages from FDI, there is higher loss to domestic firms from foreign firms in supplying industries. This may be due to the fact that domestic firms in low technology industries have less absorptive capacity to exploit knowledge embodied in intermediate goods produced by foreign firms.

In column (iii) both the coefficients of backward and forward FDI are statistically significant at 10 per cent and 5 per cent level respectively. As per the coefficient of backward FDI domestic firms benefit from the presence of foreign firms in downstream industries. Similar to the finding of low technology firms, the coefficient of forward FDI unravels that productivity of high technology firms deteriorates with the presence of foreign firms in upstream industries. This implies that even domestic firms in high technology industries are less competent to internalize the embodied technology in intermediate goods purchased from foreign firms in supplying industries or upstream industries and thereby incur loss. However, positive spillovers from foreign firms in downstream industries are higher than the negative spillovers from foreign firms in upstream industries.

It can be said that foreign firms in downstream industries are sourcing more inputs from suppliers in high technology industries compared to suppliers in low technology industries, and thus increases the productivity of domestic firms in high technology industries in term of knowledge transfers and training to employees. We can, therefore, conclude that firms in high technology industries have more capability to absorb spillovers from FDI in comparison to those in low technology industries.

**(c) Technology Spillovers & Characteristic of FDI**

Table 3.8 depicts the results on the estimation of model 2 where we are examining how the characteristic of FDI, like, ownership of foreign firms affects the technology

spillovers to domestic firms. Column (i) of the table shows the result obtained from the use of full sample on domestic firms. Columns (ii)-(iii) present the results from sub-samples where whole sample has been segregated to two parts on the basis of technology intensity of industries.

**Table 3.8: Regression Results of Domestic Firms for period 2000-01 to 2007-08. Dependent Variable: LogTFP**

| Independent Variables | All Firms (i) | Low Technology Firms (ii) | High Technology Firms (iii) |
|---|---|---|---|
| MajBW | 0.528*** | 0.569*** | 1.048* |
| | (0.146) | (0.138) | (0.579) |
| MinBW | 0.542*** | 0.715*** | -0.084 |
| | (0.184) | (0.185) | (0.621) |
| MajFW | 0.096 | -0.393** | 8.164*** |
| | (0.190) | (0.191) | (1.419) |
| MinFW | -0.048*** | -0.041*** | 1.364 |
| | (0.014) | (0.014) | (1.430) |
| MajHZ | -0.114 | -0.013 | 0.171* |
| | (0.080) | (0.119) | (0.100) |
| MinHZ | -0.007 | 0.021 | 0.147 |
| | (0.068) | (0.061) | (0.167) |
| HHI | 0.080 | -0.145 | -0.350 |
| | (0.218) | (0.256) | (0.389) |
| RDS | -0.003 | 0.002 | -0.460* |
| | (0.003) | (0.001) | (0.255) |
| XNS | 0.033 | 0.037 | 0.001 |
| | (0.029) | (0.037) | (0.048) |
| TMS | -0.092 | -0.165 | -0.002 |
| | (0.068) | (0.105) | (0.035) |
| Constant | 3.806*** | 3.811*** | 3.649*** |
| | (0.030) | (0.032) | (0.097) |
| Year Dummies | Yes | Yes | Yes |
| Firm Dummies | Yes | Yes | Yes |
| $R^2$ | 0.064 | 0.034 | 0.166 |
| F - Statistics | 18.08*** | 8.81*** | 21.13*** |
| Observations | 9840 | 5527 | 4313 |

Note: (1) Robust standard errors are in parentheses.
(2) *, **, and *** are significant at 10 per cent, 5 per cent, and 1 per cent level respectively

The column (i) reveals that the coefficients on MajBW and MinBW are statistically significant, suggesting that productivity of domestic firms is positively correlated with the presence both majority and minority owned foreign firms in downstream industries. However, it is seen that domestic firms are getting more benefit from minority-owned foreign firms than majority-owned foreign firms. This implies that the minority-owned foreign firms might be sourcing or buying more intermediates input than majority-owned foreign firms. This is because local partners with majority equity holdings in foreign affiliates have the tendency to buy more intermediate inputs and thereby disseminating technology to their suppliers at upstream industries. Further, there are negative and significant technology spillovers from minority-owned foreign firms in supplying industries. It may be the case that minority-owned foreign affiliates are selling low quality inputs (as there are older technology transfers from parent company to minority-owned foreign affiliates) which reduces the productivity of domestic firms. Thus, there are negative spillovers to domestic firms who source inputs from foreign firms with minor equity holdings.

Column (ii) of the table 3.8 provides the same evidence that minority owned foreign firms have more spillovers than majority owned foreign firms. It also shows negative spillovers via forward linkages both from minority and majority-owned foreign firms. The possible explanation for this could be that firms in low technology industries are incompetent to decode the technology embodied in the inputs sourced from foreign firms. However, the positive spillover effect from backward FDI outweighs this negative spillovers effect from forward FDI.

Column (iii) confirms the significant productivity gains from majority-owned foreign firms and there is no significant spillover from minority-owned foreign firms. This implies domestic firms in high technology industries gain both from vertical and horizontal technology spillovers from majority-owned foreign firms. The possible explanation for this is as follows. There are two essential conditions underlying the transfer of technologies from MNE parent to subsidiaries in host

developing countries. First, MNE should have full or majority ownership in affiliates in order to avoid the technological leakages to host country (Mansfield and Romeo, 1980); second, characteristics of host firms, e.g., technological capabilities of firms which reduces cost of transferring technology to host countries (Behrman and Wallander, 1976; Chen, 1983; Dahlman et al., 1987; Kokko, 1990). Therefore, majority-owned foreign firms benefit only firms in high technology industries. Domestic firms in high technology industries are being more productive via vertical linkages with majority-owned foreign firms. As we know, high technology intensive firms have more capability to go in for reverse engineering of the products displayed by majority-owned foreign firms, which upgrades their technology and thereby increases productivity.

## 3.6 Concluding Observations

This chapter has examined the productivity effect of FDI spillovers in the Indian manufacturing industries. Departing from the earlier studies on Indian manufacturing sector, which are limited in explaining only horizontal technology spillovers from FDI, this study has stepped ahead to explain both vertical and horizontal productivity spillovers from FDI. We have also explained how the firms in high technology industries gain from the presence of foreign firms compared to those in low technology industries. Furthermore, this study also unravels how the FDI characteristics (for example, degree of foreign ownership in affiliates) mediate the productivity spillovers in the host country.

Supporting the earlier studies carried out by Schoors van der Tol (2002), Javorcik (2004), and Blalock and Gertler (2005), we have found the existence of spillovers from FDI via backward linkages. This means that there may be some technology transfers or knowledge assistance from foreign firms to suppliers of intermediates in upstream industries in host country. In addition, we have also ascertained that suppliers of intermediates in high technology industries are benefited more from the presence of foreign firms in downstream industries.

However, taking into account the FDI characteristics, it is seen that domestic firms in supplying industries benefit more from minority-owned foreign affiliates compared to majority-owned foreign affiliates. This asserts that firms with minority foreign equity holding source or buy more domestically produced inputs compared to firms with majority foreign share-holdings. Nevertheless, it is noticed that domestic firms in high technology industries can get more spillover benefits from majority-owned foreign firms in the host country. Two things such as majority foreign equity in affiliates and technology capability of firms in host developing country induces the transfer of technology form parent company to foreign affiliates in the host country. Therefore, domestic firms in high technology industries gain from technology spillovers from the presence of majority-owned firms.

# APPENDIX

## A.1. Measurement of capital

The mostly complicated task faced by researchers while estimating production function is the measurement of capital stock variable. For measuring the capital stock of the firm, we follow the methodology of Srivastava (1996), which revalues the capital stock given at historical cost to a base year. The detail of the methodology is discussed below.

The database provides information on gross fixed asset (GFA) and its various components and depreciation. Capital stocks of some firms are revalued and this revaluation portion is reported separately in the database. The difference between the current and lagged values of GFA gives the actual investment, which gets into the production process. Given the revalued capital stock at base year and actual investment we can apply the perpetual inventory method (PIM) to construct capital stock, which is as given below.

$$K_{t+1} = K_t + I_{t+1}$$

$$K_t = K_{t-1} + I_t$$

$$K_{t-2} = K_t - I_t - I_{t-1}$$

And so on.

Where $k_{t+s}$ and $I_{t+s}$ are the capital stock and the real investment respectively at time t+s. The application of PIM requires a base year capital stock $k_t$ that is valued at replacement cost. The reported GFA is measured in historical cost, therefore, we have to choose one base year and revalue that year's capital stock. We have taken 2004-05 as the base year for the estimation of capital stock. The rationale for taking

2004-05 as the base year is the availability of largest number of observations for this year

*Capital Stock at Replacement Cost in the base year*

Since we don't have a capital stock at replacement cost in the base year, the base year capital stock needs to be revalued so as to obtain its value at replacement cost. Given the available data, there is no perfect way of doing this and any method used is an approximation. The method that we have used is based on the following assumptions.

(1). No firm has any capital stock in the base year (2004-05) of a vintage earlier than 1985-86. The year 1985-86 itself is chosen because the life of machinery is assumed to be twenty years, as noted in the report of the Census of Machine Tools (1986) of the Central Machine Tool Institute Bangalore ('National Accounts Statistics: Sources and Methods' New Delhi: Central Statistical Organization, 1989). For firms incorporated before 1985-86 it is assumed that the earliest vintage capital in their capital mix dates back to the year of incorporation. Clearly, as stated by Srivastava (1996) the year of incorporation and the vintage of the oldest capital in the firm's asset mix may not coincide for some firms, but the assumption is made for want of a better alternative.

(2). The price of capital has changed at a constant rate, $\pi$

$$\pi = \frac{P_t}{P_{t-1}} - 1$$

from 1985-86 or from the date of incorporation of the firm (which ever is later) up to 2004-05 (base year). Values for $\pi$ were obtained by constructing capital formation price indices from the series for gross fixed capital formation in manufacturing obtained from various issues of the National Account Statistics of India. The

constant inflation rate $\pi$ is not firm specific but it varies with the year of incorporation, provided the firm was incorporated after 1985-86.

(3). Investment has increased at a constant rate for all firms and the rate of growth of investment (g) is

$$g = \frac{I_t}{I_{t-1}} - 1$$

Here the rate of growth of gross fixed capital formation in manufacturing at 1993-94 prices is assumed to apply to all firms. Again different average annual growth rates are obtained for firms established after 1985-86.

Making these assumptions the revaluation factor $\mathbf{R}^G$ for the base year gross fixed capital stock can be obtained as described below. The balance sheet value of assets in the base year is scaled up by the revaluation factor to obtain an estimate of the value of capital stock at replacement costs.

Replacement Cost of Capital = $\mathbf{R}^G$ x [Value of Capital Stock at Historic Cost]

The revaluation factors can be obtained as follows

*Revaluation Factor for Gross Fixed Assets* ($\mathbf{R}^G$)

Let us denote $\mathbf{GFA}_t^h$ and $\mathbf{GFA}_t^r$ as gross fixed asset at historical costs and replacement costs respectively and $\mathbf{I}_t$ is the real investment at time t. By definition and making the assumptions mentioned above.

$$\mathbf{GFA}_t^h = \mathbf{P}_t\mathbf{I}_t + \mathbf{P}_{t-1}\mathbf{I}_{t-1} + \mathbf{P}_{t-2}\mathbf{I}_{t-2} + \ldots\ldots$$

$$= \mathbf{P}_t\mathbf{I}_t\left(\frac{(1+g)(1+\pi)}{(1+g)(1+\pi)-1}\right)$$

And

$$GFA_t^r = P_t I_t + P_{t-1} I_{t-1} + P_{t-2} I_{t-2} + .....$$

$$= P_t I_t \left( \frac{(1+g)}{g} \right)$$

Defining $R^G$

$$R^G = \frac{GFA_t^r}{GFA_t^h}$$

Then $$R^G = \frac{(1+g)(1+\pi)-1}{g(1+\pi)}$$

If it is assumed more realistically that the capital stock does not dates back infinitely, but the capital stock of the earliest vintage is t period old, then we can derive the revaluation factor as follows.

$$R^G = \frac{[(1+g)^{t+1}-1](1+\pi)^t[(1+g)(1+\pi)-1]}{g\{[(1+g)(1+\pi)]^{t+1}-1\}}$$

We have used GFA thus obtained, after deflating it with the wholesale price index for machinery and machine tools with base 1993-94=100, in the estimation of frontier production function.

Finally, in this study we have used gross fixed asset of the firm rather than net fixed asset. For estimating the net fixed asset of the firm we need information on accounting and economic rate of depreciation. Reliable data on accounting and economic rate of depreciation are not available in India. Further, Dennison (1967) argues that the correct measure of capital stock falls some where between gross and net stock of capital, advocating the use of a weighted average of the two with higher weight for the gross asset as the true value is expected to be closer to it.

**Table A.1: Revaluation Factor**

| Year | Revaluation Factor |
|---|---|
| 1985-86 | 3.5371 |
| 1986-87 | 3.8484 |
| 1987-88 | 7.0414 |
| 1988-89 | 2.0410 |
| 1989-90 | 2.8860 |
| 1990-91 | 4.0128 |
| 1991-92 | 4.1988 |
| 1992-93 | 3.8235 |
| 1993-94 | 3.5937 |
| 1994-95 | 3.3348 |
| 1995-96 | 1.6943 |
| 1996-97 | 3.0616 |
| 1997-98 | 2.9396 |
| 1998-99 | 3.0707 |
| 1999-00 | 3.1802 |
| 2000-01 | 2.5002 |
| 2001-02 | 2.3141 |
| 2002-03 | 1.5394 |
| 2003-04 | 1.2606 |
| 2004-05 | 1 |

## A.2 Methodology for Industry x Industry Coefficient Matrix

For our studies we need to construct an *industry* × *industry* coefficient matrix using the Input-output transaction Table of India of year 2003-04, published by the Central Statistical Organization (CSO). The Input-output transaction Table consists of two matrices: absorption matrix (commodity-industry) and make matrix (industry-commodity). The former records the values of purchases of commodities by industries and the later records the value of commodities produced by industries. There are two basic assumptions, which combine both information in the make and absorption matrices to estimate a 'pure' table of *industry* × *industry* or *commodity* × *commodity* (Input-Output Tables and Analysis, 1973). They are generally referred to as the commodity technology and industry technology assumptions. The former assumes that a commodity has the same input structure in whichever industry it is produced. The industry technology assumption, on the other hand, assumes that all

commodities produced by an industry are produced with same input structure and thus commodities will have different input structures depending on the industry in which they are produced.

The following gives briefly the methodology in mathematical terms for constructing 'pure' tables. The basic data available from industry input and output tabulations satisfy the following relationships:

Input relations: $$q_j = \sum_K X_{jk} + f_j \qquad (1)$$

Output relations: $$q_j = \sum_i M_{ij} \qquad (2)$$

$$g_i = \sum_j M_{ij} \qquad (3)$$

Where

$q_j$ = total output of j-th commodity group

$g_i$ = total output (of all products and by-products) of the i-th industry group

$f_j$ = final demand of the j-th commodity

$X_{jk}$ = output of j-th commodity used as input in the k-th sector (industry group)

$M_{ij}$ = output of j-th commodity produced by the i-th industry group

The above symbols without subscript refer to the corresponding vectors.

We can put all the mathematical expression of the input-output relationships explained above into a simplified accounting framework (see following Table).

| | Commodity | Industries | Final Demand | Total |
|---|---|---|---|---|
| **Commodity** | | $X$ | $f$ | $q$ |
| **Industries** | $M$ | | | $g$ |
| **Primary inputs** | | $y'$ | | |
| **Total** | $q'$ | $g'$ | | |

Note: y denotes the column vector of $y_j$ and $y_j$ denotes the value of primary inputs (factor incomes) in the j-th industry. The superscript prime (') is used to denote the transpose.

Source: Central Statistical Organization (CSO) Report/Publication, India

Given the industry technology assumption, *industry* × *industry* coefficient matrix can be constructed using the above accounting data. Symbolically, it is defined as follow.

$$E = DB$$

Where E is the *industry* × *industry* coefficient matrix, **D** is the Market share matrix, the columns of which show proportions in which various industries produce the total output of a particular commodity. Symbolically, it is as $\mathbf{D = M\,(q)^{-1}}$, and B is the *commodity* × *industry* coefficient matrix, defined as $\mathbf{B = X\,(g)^{-1}}$.[40] For constructing *industry* × *industry* coefficient matrix we first have to aggregate the input-output transaction table for manufacturing sector to two-digit level. Then we construct the *industry* × *industry* coefficient matrix using the make and absorption matrices.

[40] Here q is the diagonal matrix with diagonal elements as the elements of vector q and similarly g is the diagonal matrix with diagonal elements as the elements of vector g.

**Table A.2: Production Function Estimation for TFP, Dependent variable: Output**

| Independent Variables | Observed Coefficients | Bootstrap Standard Error |
|---|---|---|
| Capital | 0.050*** | 0.015 |
| Labour | 0.263*** | 0.011 |
| Raw materials | 0.628*** | 0.015 |
| Energy | 0.089*** | 0.011 |

Note:
(i) Production Function estimated using Levinson-Petrin (2003) Methodology
(ii) *** denotes significant at 1 per cent level

**Table A.3: Summary Statistics**

| | Full Sample | | Domestic Firm | |
|---|---|---|---|---|
| Variables | Mean | Standard Deviation | Mean | Standard Deviation |
| Log TFP | 3.936 | 0.308 | 3.923 | 0.304 |
| RDS | 0.026 | 0.137 | 0.004 | 0.086 |
| XNS | 0.132 | 0.226 | 0.153 | 0.240 |
| TMS | 0.023 | 0.066 | 0.011 | 0.055 |
| BW | 0.108 | 0.102 | 0.110 | 0.103 |
| FW | 0.045 | 0.037 | 0.043 | 0.037 |
| HZ | 0.205 | 0.133 | 0.199 | 0.131 |
| HHI | 0.062 | 0.072 | 0.073 | 0.073 |
| MajBW | 0.053 | 0.050 | 0.054 | 0.051 |
| MinBW | 0.052 | 0.054 | 0.053 | 0.055 |
| MajFW | 0.022 | 0.022 | 0.022 | 0.022 |
| MinFW | 0.028 | 0.150 | 0.026 | 0.144 |
| MajHZ | 0.127 | 0.109 | 0.122 | 0.107 |
| MinHZ | 0.077 | 0.074 | 0.076 | 0.072 |
| Observations | 11506 | | 9840 | |

Source: Own calculations

**Table A.4: Correlation Matrix of Variables in Model 1**

| | Log TFP | BW | FW | HZ | HHI | RDS | XNS | TMS |
|---|---|---|---|---|---|---|---|---|
| Log TFP | 1 | | | | | | | |
| BW | 0.1141* | 1 | | | | | | |
| FW | 0.0810* | -0.2123* | 1 | | | | | |
| HZ | 0.0771* | 0.0002 | 0.2621* | 1 | | | | |
| HHI | 0.0079 | -0.1953* | 0.1143* | 0.1238* | 1 | | | |
| RDS | 0.0064 | -0.0041 | -0.0041 | 0.0103 | -0.0104 | 1 | | |
| XNS | -0.0183 | -0.0135 | -0.0363* | -0.0437* | -0.0056 | 0.0456* | 1 | |
| TMS | 0.0244 | -0.0480* | 0.0198 | -0.0351 | 0.0006 | 0.0016 | 0.0834* | 1 |

Note: * stands for 1 per cent level of significance

Source: Constructed using Data from PROWESS, CMIE

Table A.5: Correlation Matrix of Variables in Model 2

| | Log TFP | MaJBW | MinBW | MajFW | MinFW | MajHZ | MinHZ | HHI | RDS | XNS | TMS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Log TFP | 1 | | | | | | | | | | |
| MaJBW | 0.0967* | 1 | | | | | | | | | |
| MinBW | 0.0890* | 0.8680* | 1 | | | | | | | | |
| MajFW | -0.0245 | -0.3289* | -0.3053* | 1 | | | | | | | |
| MinFW | 0.0380* | -0.0929* | -0.0787* | 0.0118 | 1 | | | | | | |
| MajHZ | 0.0702* | -0.0557* | -0.0218 | -0.0722* | -0.0388* | 1 | | | | | |
| MinHZ | 0.0350* | -0.0623* | -0.0465* | -0.0090 | 0.0647* | 0.0188 | 1 | | | | |
| HHI | 0.0079 | -0.2357* | -0.1400* | 0.1715* | 0.0242 | -0.0540* | 0.3036* | 1 | | | |
| RDS | 0.0064 | -0.0026 | -0.0040 | -0.0102 | -0.0038 | 0.0150 | -0.0036 | -0.0104 | 1 | | |
| XNS | -0.0183 | 0.0121 | -0.0235 | -0.0126 | -0.0355* | 0.0104 | -0.0944* | -0.0056 | 0.0456* | 1 | |
| TMS | 0.0244 | -0.0433* | -0.0461* | 0.0401* | 0.0062 | -0.0399* | -0.0040 | 0.0006 | 0.0016 | 0.0834* | 1 |

Note: * stands for 1 per cent level of significance

Source: Constructed using Data from PROWESS, CMIE

Table A.6: Industrial Classification

| NIC CODE | Industry Classification | IOTT Sector No. (2003-04) |
|---|---|---|
| 15 | Food Product and Beverages | 38-44 |
| 16 | Tobacco Products | 45 |
| 17 | Textiles | 46-51 |
| 18 | Wearing Apparel; Dressing and Dyeing of Fur | 52-54 |
| 19 | Tanning and Dressing of Leather; Manufacture of Luggage, Handbags Saddlery, Harness and Footwear | 59-60 |
| 20 | Wood and of Products of Wood and Cork, Except Furniture; Manufacture of Articles of Straw and Plating Materials | 56 |
| 21 | Paper and Paper Products | 57 |
| 22 | Publishing, Printing and Reproduction of Recorded Media | 58 |
| 23 | Coke, Refined Petroleum Products and Nuclear Fuel | 63-64 |
| 24 | Chemicals and Chemical, Products | 65-73 |
| 25 | Rubber and Plastic Products | 61-62 |
| 26 | Other Non-Metallic Mineral Products | 74-76 |
| 27 | Basic Metals | 77-80 |
| 28 | Fabricated Metal Products, Except Machinery and Equipments | 81-82 |
| 29 | Machinery and Equipment N.E.C. | 83-87 |
| 31 | Electrical Machinery and Apparatus N.E.C. | 88-91, 93 |
| 32 | Manufacture of Radio, Television and Communication Equipment and Apparatus | 92, 94 |
| 33 | Medical, Precision and Optical Instruments, Watches and Clocks | 101-102 |
| 34 | Motor Vehicles Travelers and Semi-Trailers | 97 |
| 35 | Other Transport Equipment | 95-96, 98-100, 104 |
| 36 | Furniture; Manufacturing N.E.C. | 55, 103, 105 |

# CHAPTER FOUR

# CONCLUSION

FDI serves as an important channel for technological diffusion across countries. Many countries across the world are wooing MNEs with an expectation of benefiting from technological spillovers. For a long time India followed the self-reliant strategy for its development and the role of FDI was restricted to fill saving-investment gap, technology gap and balance of payment gap. Since the liberalization of the economy in 1991 India has made phenomenal changes in its policy relating to the foreign investment, which has brought in substantial inflow of FDI. In this context the present study examined the following three research questions: (i) how the productivity of domestic firms is affected by vertical and horizontal technology spillovers from FDI, (ii) how does the technology content of domestic firms facilitate the technology spillovers from FDI, and (iii) how does the different degree of foreign ownership in the affiliate mediate the technology spillovers to the domestic firms. For evaluating the effect of FDI, especially, the technology spillovers, our study employed the panel of 9840 observations on 1640 domestic manufacturing firms for the period 2000-01 to 2007-08. Since we are interested in the technology spillovers from foreign firms to domestic firms, the study has taken latter type of firms into analysis.

## 4.1. Summary of the Findings

The analysis reveals that there are no technology spillovers in the same industry where both foreign and domestic firms are present. This might be due to restriction over technology leakages from foreign firms to domestic firms in the same industry. Nonetheless, there are evidences for technology spillovers to domestic firms from the foreign firms in downstream industries. This finding indicates that there might be some sort of technology transfers from foreign firms in the downstream

industries to domestic firms in the upstream industries. The study does not find any significant effect of foreign firms on the domestic firms in the downstream industries. This finding goes in contrast to the findings of Kathuria (1998, 2002) and Siddharthan and Lal (2002) inter-alia, who have emphasized the prevalence of horizontal spillovers from the foreign firms in Indian manufacturing firms.

Taking into account the characteristic of the domestic firms, specifically the technology content of domestic firms, it is found that the domestic firms in high technology industries benefit more from foreign firms in downstream industries compared to firms in the low technology industries. This implies that foreign firms are sourcing much of their intermediate goods from high technology firms compared to that of low technology firms. The possible explanation for this is that compared to firms in low technology industries, firms in high technology industries are capable of supplying the stringent quality inputs and delivering in time scheduled by foreign firms which increases their productivity.

Further enquiry into the question how the characteristic of foreign firms, especially the ownership of foreign investors in affiliates, mediates the technology spillovers on domestic firms, it is noticed that there are technology spillovers via backward linkages from both minority and majority-owned foreign firms. Domestic firms in downstream industries are getting more benefits from the minority-owed foreign firms compared to that from the majority owned foreign firms. This finding can be attributed to the fact that domestic partners with majority share in foreign firms may have the tendency to buy intermediate products from the domestic suppliers in upstream industries. In addition, it is found that domestic firms in high technology industries are benefited from majority-owned foreign firms. It may be due to two reasons, first, foreign investors with majority share holding in affiliates have the incentives to import or bring more of new or advanced technology from their parent company, as they have control over the affiliates and second, firms in high technology industries have more competency over firms in low technology industries to decode the external gains from the foreign firms. Such findings contrast

sharply to the findings of Blomstrom and Sjoholm (1999) and Javorcik (2004), which indicate that degree of foreign-ownership affects neither the level of productivity, nor the extent of spillovers in Indonesia and Lithuania manufacturing respectively.

## 4.2. Limitations of the Study

First, for examining the vertical technology spillovers, the study has employed industry level proxy to measure the vertical linkages from foreign firms. But, it is unable to explain the exact mechanism through which such spillovers occur.

Second, the conventional ordinary least square (OLS) technique that we have applied to estimate the technology spillovers from FDI estimates the average relationship between explained variable and explanatory variables. Since productivity of domestic firms is not homogenous to each other, they have different competency to absorb the externalities stemming from foreign firms. The OLS estimates how the productivity of domestic firms on an average is affected from the activity of foreign firms and therefore fails to test the technology spillovers on heterogeneous firms.

Third, the study used contemporaneous variables for estimating technology spillovers from foreign firms. There are some variables such as R&D intensity, technology intensity, and export intensity, which have effect on productivity of firms after some year, say for instance one year. But these contemporaneous variables do not have significant impact on productivity of firms. The lagged value of these variables may have significant impact upon the productivity of domestic firms. Besides, we have also taken contemporaneous value of variables measuring the presence of foreign firms in our analysis, however we have not taken the lagged value of these variables, which may have some influence on productivity of domestic firms.

## 4.3. Future research

From the present study we draw the following research issues, which needs further enquiry. Domestic firms do not have the equal capability to internalize the knowledge spilled over from foreign firms. Highly productive firms have better potential to be benefited from spillovers compared to lower productive firms. Most of the studies have measured how FDI on an average affects the productivity of domestic firms in host country; but they fail to explain how each group of firms with different productivity level are affected from the presence of foreign-owned firms in the host country. Therefore, we need to explore how the heterogeneity in productivity affects the domestic firms' to absorb spillovers from FDI.

It is presumed that foreign firms irrespective of their heterogeneous characteristic have spillovers on firms in host country. In terms of technology intensity foreign firms differ substantially - some firms are more technology intensive, and some are less technology intensive. Therefore, it is expected that they will have heterogeneous effects on productivity of host domestic firms. A study of spillovers encompassing technology heterogeneity of foreign firms needs to be done.

Meanwhile, service sector has a dominating importance in developed as well as developing countries. On an average, service sector accounts for about 72 per cent of GDP in developed countries and 52 per cent in developing countries (Ramasamy and Yeung, 2010). The increasing importance of service sector in economies has resulted in a diversion of FDI inflow from manufacturing to service sector. For example, in 1990, the share of service in global FDI stock increased to half from a quarter in 1970 and it has further increased to nearly two-third in 2005 (UNCTAD, 2007). Despite the increased supply of FDI into service sector, over last decade, literature on the effect of FDI tends to focus only on FDI in manufacturing sector. There is barely any study focusing upon how the increasing service FDI affects the productivity of domestic firms in host country.

In addition to technology spillovers, there are also spillovers on labor market from the presence of foreign firms in host country, i.e., wage spillovers from foreign firms. Multinational firms dominate the labor market in host country through setting higher wage level compared to the wage offered by domestic firms. This has a consequent impact on the wage level of domestic firms. Thus, there is need to study how the wage level of domestic workers is influenced by the presence of foreign firms. There is further need to examine how the domestic firms with different skill level are affected by the increasing presence of foreign firms in the host country.

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