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PRODUCTIVITY SPILLOVERS IN INDIAN MANUFACTURING FIRMS

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Abstract. Indian economic reform since early 1990s aims at improving productivity and competitiveness of major industries. The paper examines spillovers from foreign direct investment (FDI), research and development (R&D) and exporting activities on productivity both for foreign and domestic manufacturing firms. The data is obtained from the PROWESS database provided by the Centre for Monitoring Indian Economy (CMIE). Balanced panel of over 1,000 manufacturing firms in India between 1994 and 2006 are considered for our empirical analysis. Findings indicate that foreign presence has a significant spillover effect on the productivity of the Indian manufacturing firms compared to the alternative spillovers such as from R&D and export initiatives.

Keywords: Productivity, Spillovers, Indian manufacturing, FDI.

JEL Classification: F21, O47, O53

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1. Introduction

Since the 1980s, FDI has been a dominant form of technology transfer from developed to developing countries.[i] This view is based on the notion that multinational enterprises and their affiliates are an important source of international capital and technology. Foreign owned firms bring with them technical know-how, equipment, management, marketing and other skills (Lall, 1997; Keller, 2004). Productivity spillovers from FDI may occur at least via three major channels: (i) due to the movement of highly trained and skilled staff from foreign firms to domestic firms; (ii) due to the so-called 'demonstration effects' arising from arm's length relationships between foreign and domestic firms, which enables the latter to learn and adopt superior production technologies managerial and organizational skills; and (iii) due to the 'competition effects' from foreign firms, which may force rival domestic firms to upgrade production techniques in order to remain competitive and productive (Blomstrom and Kokko, 1997).

One of the earliest empirical studies of productivity spillovers from FDI to host countries is Caves (1974). Using two-digit level data for 22 Australian industries over the period of 1962 and 1966, he concludes that the presence of relatively high subsidiary shares are associated with higher levels of productivity in competing domestic firms. Globerman (1979), applying a similar approach to data on the Canadian manufacturing sector, concludes that differences in labor productivity levels are associated with spillover efficiency benefits associated with FDI. There have been several studies focusing on developing countries, including Blomström and Persson (1983), who examine the relationship between foreign investment and spillover efficiency in the Mexican manufacturing industry using four-digit industry level data for 1970. The empirical evidence from their study confirms the findings from the developed world viz, that there are efficiency spillovers from foreign-owned to domestically-owned plants. Flores *et al.* (2000) examine the impact of foreign direct investment on the productivity of domestic firms in Portugal at the two-digit level. They find a positive relationship between domestic firms' productivity and foreign presence only when there are differences in technology between the foreign and domestic producers and also these spillovers mostly occur within modern sectors. Recently, Wei and Liu (2006) assessed the productivity spillovers from

R&D, exports and the very presence of foreign direct investment in China's manufacturing sector, based on a panel of more than 10,000 indigenous and foreign-invested firms for 1998-2001. Their findings indicate that there are positive inter-industry productivity spillovers from R&D and exports, and positive intra and inter-industry productivity spillovers from foreign presence to indigenous Chinese firms within regions.

The empirical evidence on the effect of FDI is, however, mixed.[ii] Some studies, such as, Globerman (1979), Blomstrom and Wolf (1994), Caves (1996), and Djankov and Hoekman (2000), find that FDI has a positive or weak positive effect on productivity levels. On the other hand, there are other studies, viz, Haddad and Harrison (1993), Kokko (1994), Kokko et al, (1996), and Aitken and Harrison (1999), establishing that foreign firms have negative effects on the productivity performance of domestically owned firms. But these studies together establish the fact that the effect of FDI is industry-firm-host economy specific. Liu (2008) has used large panel of Chinese manufacturing firms and found that an increase in FDI at the four-digit industry level lowers the short-term productivity level but raises the long-term rate of growth in productivity of domestic firms. Her findings establish that spillovers through backward and forward linkages between industries at the two-digit level have similar effects on the productivity of domestic firms, and backward linkages seem to be statistically the most important channel through which spillovers occur.

The principal aim of this paper is to examine the effects of knowledge spillovers viz, FDI, R&D and export activities on productivity in case of Indian manufacturing sector. An obvious question appears here why did we select India?

India is a member of the G8+5 , a group of leaders consisting of Presidents and Prime Ministers from the G8 nations (Canada, France, Germany, Italy, Japan, Russia, United Kingdom and the United States), plus the leaders from five emerging developing countries (Brazil, China, India, Mexico and South Africa). India is also a newly industrialized countries (NlCs). During the early nineties following severe economic crisis, several liberalization measures were undertaken. Improvement in X-efficiency, access to imported technology; international knowledge spillovers and scale gain have been the direct effect of liberalization and have spillover effects on productivity. Deregulation of industries and introduction of various policies in attracting foreign direct investment are

part of economic reform in early 1990s. Since then India has become one of the major destinations of MNEs and is one of the highest recipients of FDI in the Asian region. At present, up to 100% of FDI is allowed in most sectors except for a reserved list of small scale industries and strategic sectors.

For the Indian economy, Kathuria (2000, 2001), Goldar *et. al*. (2003) and Siddharthan and Lal (2003) have studied the impact of FDI on total factor productivity growth, technical efficiency and labor productivity, respectively. Kathuria (2001) indicates that there are positive spillovers from the presence of foreign owned firms on total factor productivity growth of Indian firms, but the nature and type of spillovers vary depending upon the industries to which the firms belong and also on the R&D capabilities of the firms. Banga (2001) analyses the spillover effects of Japanese and U.S. FDI on the total factor productivity growth of the Indian firms. Her findings establish the presence of Japanese equity within an industry has a positive spillover effect while the market share of Japanese firms is negatively associated with the productivity growth of the Indian firms. The net spillover effect at the industry level is found to be positive, however the spillover effects from the U.S. based FDIs are not significant. The effect of foreign ownership on the technical efficiency of firms is found to be positive and significant in a study by Goldar *et. al.* (2003). Siddharthan and Lal (2003) find significant spillover effects from foreign firms on the labor productivity of Indian firms. Using firm-level data from the Indian manufacturing, Sasidharan and Ramanathan (2007) examine empirically the spillover effects from the entry of foreign firms. They have taken into account both the horizontal and vertical spillover effects of FDI. Their findings are similar to the recent findings related to negative horizontal and vertical spillover effects of FDI in case of some transition economies using panel data set. (Yudeva *et al*. 2003;for Russia; Merlevede and Schoors, 2005 for Romania).

Besides FDI, R&D and exporting activities are considered as sources of knowledge spillovers. R&D is usually treated as an important device for economic growth. R&D has long been seen as an important source of knowledge generation and productivity improvement. R&D not only directly affects the productivity of the firm that conducts R&D, but may also produce spillover effects that increase other firms' productivity. R&D

increases productivity by providing new products and processes or upgrading existing products and processes that enhance profits or reduce costs. The proportion of national resources spent on R&D has declined steadily in 1990s. Until recent time, India has followed 'techno-nationalism' or 'techno-protectionism' in R&D activities i.e., bulk of R&D activities are conducted by national enterprises, leaving private sector insignificant in engaging R&D activities.[iii] In presence of reform since 1991, the MNEs may reveal a lower R&D activity compared to local firms, presumably on account of their captive access to the laboratories of their parents and associated companies. On the other hand, local firms are engaged in their R&D activity towards absorption of imported knowledge and in providing a backup to their outward expansion.

Following endogenous growth theory, that international trade is an important channel in facilitating technology creation, transfer and diffusion. Buyers want low cost, better quality products from main suppliers. Participating in export markets allows firms to have access to international best practices and learning and opportunities to enhance productivity growth. Expanding exports may also raise productivity by encouraging the development of new technologies. In case of Indian manufacturing exports, key drivers in recent years were engineering goods viz, metal and instruments, transport equipment, electronic goods and iron and steel due to increase in external demand particularly in East Asia, China and non-traditional markets such as Latin America and Africa.[iv] Entry of new firms and increasing presence of MNEs during liberalisation has acted as a catalyst of exporting success for domestic firms.

The rest of the paper is organized as follows. The next section describes the FDI regimes in case of India. , In Section 3, we narrate FDI scenario in Indian manufacturing. Section 4 describes the model framework. Data source, descriptions of variables and estimations are presented in Section 5. The final section summarizes major findings and indicates possible policy implications of our findings.

2. Presence of FDI in India: Different Phases

Compared to most industrializing economies, India followed a fairly restrictive foreign investment policy until 1991 – relying more on bilateral and multilateral loans with long

maturities. Inward foreign direct investment was perceived essentially as a means of acquiring industrial technology that was unavailable through licensing agreements and capital goods imports. However, foreign investment was permitted in designated industries, subject to varying conditions on setting up joint ventures with domestic partners, local content clauses, export obligations, promotion of local R & D and so on – broadly similar to those followed in many rapidly industrializing Asian economies.

The economic reform program initiated by the Indian government in 1991 aimed at rapid and substantial integration of the Indian economy with the global market in a harmonized manner. Accordingly, the industrial policy in the post-reform period mainly aimed at de-licensing, privatization, and FDI promotion, which was coupled with trade liberalization in the manufacturing sector. To attract FDI, the policy regime was liberalized considerably. The first step in this direction was the granting of automatic approval, or exemption from case by case approval, for equity investment of up to 51 per cent and foreign technology agreements in identified high priority industries. Gradually, FDI has been permitted in almost all industries. Not only have restrictions on foreign equity investments been reduced, several incentives to encourage FDI in the manufacturing sector have also been undertaken e.g., tax incentives, tax holidays. Also, India has signed a number of bilateral investment treaties (BITs) to protect the interests of foreign partners in ensuring the appropriate treatment and facilitating their business operations in India.

Kumar (1994) categorizes FDI policy in India into three distinct phases. The first phase (i.e., 1948-1967) was characterized by gradual liberalisation. Even though the policy makers were aware of the importance of foreign capital, it was felt that foreign investment needed to be regulated to safeguard national interests. However, until 1956, there was no regulation of foreign capital. The industrial policy resolution passed in 1956 was based on the notion of a socialistic society. The resolution emphasized the reservation of certain industries for the public sector. The foreign exchange crisis in 1958-59 forced the centre to rethink its stand on foreign capital. The government tried to offer concessions in the form of tax incentives to foreign investors, resulting in many MNCs starting to show an interest in investing in India.

The Restrictive Phase (viz., 1968-1979) is marked by the regulation of foreign capital and streamlining of procedures in the approval of foreign collaborations. During

this period, a Foreign Investment Promotion Board was set up to monitor the approval of foreign collaborations, especially those exceeding 40% of equity. Three new enactments passed during this phase clearly underline the apathy of the policy makers to foreign capital. The Monopolistic and Restrictive Trade Practice Act (MRTP) of 1969 required the scrutiny by the MRTP commission of all projects involving capacity expansion of large firms. The Indian Patents Act of 1970 was an attempt to remove the monopolistic advantages enjoyed by the multinational corporations. The act was passed with the intention of helping domestic firms to grow.

The Third Phase (viz., 1980-1990) witnessed the easing of regulations on foreign capital. Until the early 1980s, the Indian economy was characterized by industrial licensing and controls along with import and exchange rate restrictions. This prevented competition and increased inefficiency in Indian Industries (Ahluwalia, 1991). The industrial policy resolutions of 1980 and 1982 announced certain liberal policy rules such as the delicensing of selected industries and the exemption from foreign equity restriction of fully export-oriented units. Along with the adoption of liberal trade policies, government also took certain measures to allow the import of capital goods and technology. The significant consequence of the policy changes during this period is the shift in the stock of FDI from plantations, minerals and petroleum to the manufacturing sector.[v]

Relaxation of controls over FDI constituted a significant plank of the wide ranging economic reforms introduced in 1991. The three main elements of reform were the abolition of the licensing requirements governing domestic investment, reduction in tariffs on imports and relaxation of controls over FDI. The principal changes in the foreign investment regime included automatic approval of FDI up to 51 % of equity ownership by foreign firms in a group of 34 technology intensive industries, a case by case consideration of applications for foreign equity ownership up to 75 % in nine sectors, mostly relating to infrastructure, and the streamlining of procedures pertaining to the approval of investment applications in general.

The year 1991 marks a new growth phase of FDI in India with inflows reaching an all time high. Following the Industrial Policy (1991)[vi], a large number of foreign companies from different parts of the world rushed into India. In addition to thousands of

foreign collaborations in India, as many as 145 foreign companies registered in the country between 1991 and 2000. Companies like General Motors, Ford Motors and IBM that had divested holdings in India during the 1950s and 1970s re-entered in this period. A large number of Asian companies such as Daewoo Motors, Hyundai Motors and LG Electronics from South Korea, Matshushita Television and Honda Motors from Japan invested in India during this period.

The total number of foreign collaborations increased from 976 in 1991 to 2,144 in 2000. Similarly, FDI increased from Rs.5156 million to Rs.3,73,722 million during the same period. In US dollar term, FDI inflows increased from US$237 million to US$5335 million between 1990 and 2004.[vii] It is also observed that there has been a significant shift in the share of FDI between countries. For example, the share of FDI in India from the UK fell to almost 10% and the share of FDI from USA also decreased during this period. Interestingly the share of other countries including South Korea, Malaysia, Australia and those from Asia and the European Union[viii] increased to over 65% of total FDI during this period. Table 2 depicts the top ten countries investing in India.

In summary, the poor balance of payments position of India and pressure from the International Monetary Fund and the World Bank forced the Government to accelerate the pace of liberalization after 1991. While the shares of FDI from traditionally dominant countries like the U.K and the USA have fallen, the shares of FDI from other countries including those from Asia and the European Union have increased from 53% in 1991 to 86% in 2000.

Table 1 Sectors Attracting Highest FDI Inflows

(Amount in Rupees Crore and in US$ in million in parentheses)

Ranks	Sector	2003-04	2004-05	2005-06	2006-07 (April – Sep)	Cumulative Inflows (from Aug 1991 to Sep 2006)	Share of Inflows (in per cent)
1	Electrical Equipments (including computer	2,449 (532)	3,281 (721)	6,499 (1451)	3,601 (778)	27,311 (6,272)	17.54

	software and electronics)						
2	Services Sector (financial and non-financial)	1,235 (269)	2,106 (469)	2,565 (581)	6,955 (1,509)	19,759 (4,600)	12.69
3	Telecommunications (radio paging, cellular mobile, basic telephone services)	532 (116)	588 (129)	3,023 (680)	3,835 (405)	16,172 (3,776)	10.39
4	Transportation Industry	1,417 (308)	815 (179)	983 (222)	1,187 (259)	14,502 (3,436)	9.31
5	Fuels (Power + Oil refinery)	521 (113)	759 (166)	416 (94)	632 (138)	11,608 (2,720)	7.45
6	Chemicals (other than fertilizers)	94 (20)	909 (198)	1,979 (447)	439 (95)	9.019 (2,238)	5.79
7	Food Processing Industries	511 (111)	174 (38)	183 (42)	150 (33)	4,852 (1,212)	3.12
8	Drugs and Pharmaceuticals	502 (109)	1,343 (292)	760 (172)	219 (48)	4,531 (1,055)	2.91
9	Metallurgical Industries	146 (32)	881 (192)	681 (153)	511 (111)	3,328 (766)	2.14
10	Cement and Gypsum Products	44 (10)	1 (0)	1,970 (452)	96 (21)	3,327 (768)	2.14

Source: FDI Data Cell, Ministry of Commerce

Table 1 clearly depicts the sectors attracting highest FDI inflows with respective ranks. The sector having highest inflows is the electrical equipments with 17.54 per cent followed by services and telecommunications sector with 12.69 and 10.39 per cent respectively. Metallurgical industries and Cement and Gypsum products received the lowest inflows with 2.14 per cent.

Table 2 Country-Wise FDI Inflows: 2000- 2008

(Amount in million)

S.No	Country	Amount of	FDI Inflows	% of total FDI inflows
		(In Rupees)	(In US$)	
1	Mauritius	1,037,850.34	24,002.57	45.49
2	USA	196,821.10	4,464.69	8.63
3	UK	188,279.71	4,304.25	8.25
4	Singapore	124,396.09	2,948.01	5.45
5	Netherlands	115,416.72	2,610.70	5.06
6	Japan	91,168.14	2,071.72	4.00
7	Germany	64,423.06	1,470.24	2.82
8	Cyprus	38,174.77	923.42	1.67
9	France	32,802.69	735.14	1.44
10	Switzerland	29,357.03	669.80	1.29

Source: Department of Industrial Policy & Promotion, Ministry of Commerce and Industry, India.

Table 2 depicts top 10 source countries for FDI inflows in Indian economy. Mauritius, USA and UK contributed 60 % of total FDI inflows between 2000 and 2008.

3. Foreign Investment in Indian Manufacturing

India is the fourth most attractive investment destination in the world after China, Central and Western Europe in terms of prospects of alternative business locations according to a survey conducted by the Ernst and Young in June 2008. Following the AT Kearney FDI confidence index, India continues to be in the second most preferred destination for attracting global FDI inflows since 2005.

India's vast domestic market and availability of low-cost workers with advanced technical skills has been instrumental in attracting the increasing number of multinationals that are establishing their manufacturing bases in the country. The sheer size of the Indian market has obvious appeal. The rapid growth of the Indian economy is likely to make India the fifth largest consumer market in the world by 2025 from twelfth in 2005, as reported in a study by the McKinsey Global Institute.

After the IT boom, a 'manufacturing take-off' is well underway in the Indian economy, spurred on by the increasing presence of multinationals, scaling up of operations by domestic companies and an expanding domestic market. India's manufacturing base, which is the fourth-largest among emerging economies, is among the fastest growing and has seen more investment as a proportion of gross domestic product than any country except China. Consequently, manufacturers from across the world are transforming India as a manufacturing power house, with technical and language skills in process, product, and capital engineering.

The sector has been averaging 9 per cent growth over the last four years (2004-08), with a record 12.3 per cent in 2006-07. Manufacturing output is USD 450 billion, contributes 79 % of FDI, 27 % of GDP and 53 % of Indian exports. The sector is expected to grow at 12 % to 14 % over the next decade.[ix]

Leading Japanese, Korean, European and American companies have set up their manufacturing base in India. Amongst them, Cummins is using India its manufacturing hub for a newly developed line of generator sets; Samsung plans to make its manufacturing plant in Chennai its global hub; Ford is making India its manufacturing hub for engine manufacturing; Suzuki and Hyundai have chosen India as their manufacturing and export

hub for small cars. Also, all the top five telecom manufacturers have set up manufacturing facilities in India.

4. Model Framework

The paper analyses the productivity spillovers from foreign direct investment in Indian manufacturing industries. We closely follow the methodology used by Wei and Liu (2006). The difference is that they have estimated spillover effects for industries, regions and among industries within a region respectively in case of Chinese manufacturing. In absence of data to capture geographical scale of productivity spillovers in case of Indian manufacturing, our research examines the effects of spillovers (from foreign investment, R&D and export activities) on firm productivity.

The common approach followed in the empirical literature of spillovers is to estimate a Cobb-Douglas production function:

$$Y_{it} = A_{it}K^{\alpha}_{it}L^{\beta}_{it}e^{\varepsilon it} \qquad (1)$$

where Y, K and L are output, physical capital and labor respectively; ε is an error term that reflects the effects of omitted variables, measurement errors and other disturbances; and subscripts *i* and *t* represent the firm and time period considered for our analysis. A is total factor productivity (TFP), which is a function of a firm's own R&D and export activities and is dependent upon other firms' R&D, exports and the presence of FDI. Hence, we can write the expression for A_{it} as follows:

$$A_{it} = f(RD_{it}, EX_{it}, RDSP_{it}, EXSP_{it}, FDISP_{it}) \qquad (2)$$

where RD and EX are the firm's own R&D and export activities, respectively. RDSP represents knowledge spillovers due to other firms' R&D activities. EXSP represents knowledge spillovers due to other firms export activities and FDISP is knowledge spillovers originating from foreign owned firms. The functional form of A_{it} is unknown, and we define this as follows:

$$\log(A_{it}) = \mu_1 RD_{it} + \mu_2 Ex_{it} + \mu_3 RDSP_{it} + \mu_4 EXSP_{it} + \mu_5 FDISP \qquad (3)$$

where the coefficients μ capture the contributions of the R&D, export and FDI spillover variables to TFP.

One important econometric issue is the possibility of endogeneity. Foreign firms, R&D and export-intensive firms could be more productive compared to the domestic firms due to greater access to technology, capital; human resources and knowledge from foreign market. To consider possible endogeneity problem, we incorporate lagged variables as instruments. Given that there is always a lag between knowledge spillovers and productivity gains, we include R&D, exports and FDI spillovers variables with a lag of one year into the estimations. Considering logarithmic version of Equation (1) after substitution of A_{it} from Equation (3) we get:

$$\log(Y_{it}) = \alpha \log(K_{it}) + \beta \log(L_{it}) + \mu_1 RD_{it-1} + \mu_2 Ex_{it-1} + \mu_3 RDSP_{it-1} + \mu_4 EXSP_{it-1} + \mu_5 FDISP_{it-1} + \varepsilon_{it} \quad (4)$$

Variables are defined in Equation (1) and (2).

5. Data, Variables and Estimations of the Model

5.1 Data, Variables and Estimation Techniques

The data for the study is obtained from the PROWESS[x] database provided by the Centre for Monitoring Indian Economy (CMIE), a private company in India. The data is primarily drawn from the information in the firms' annual reports. Since our data is pertaining to the manufacturing industries, we obtain data regarding output, capital, R&D and exports. The data covers the period from 1994 to 2006.[xi]

Table 3 depicts the classification of domestic and foreign firms by industry for 2006. The presence of foreign investment is highest in the Medical, Precision and Optical Instruments, Watches and Clocks industry with 57.1% followed by the Tobacco industry with 50%. The lowest foreign presence is in other transport equipment which has only 7.1%. From the Table it is also clear that during the year 2006, 27% of firms have foreign investments.

Table 3 Classification of Firms by Industry: 2006

NIC	Industry	Domestic	FDI	Total	% of FDI

15	Food	77	21	98	21.4
16	Tobacco	2	2	4	50.0
17	Textiles	91	17	108	15.7
18	Wearing Apparel	9	2	11	18.2
19	Leather	11	1	12	8.3
20	Wood	7	1	8	12.5
21	Paper	22	6	28	21.4
22	Publishing	8	1	9	11.1
23	Coke	9	5	14	35.7
24	Chemicals	165	77	242	31.8
25	Rubber	55	24	79	30.4
26	Other non-metallic	46	19	65	29.2
27	Basic Metals	64	24	88	27.3
28	Fabricated Metal	24	6	30	20.0
29	Machinery	50	38	88	43.2
30	Office Machinery	5	3	8	37.5
31	Electrical Machinery	34	18	52	34.6
32	Radio	23	12	35	34.3
33	Medical	6	8	14	57.1
34	Motor Vehicles	52	35	87	40.2
35	Other transport	13	1	14	7.1
36	Furniture	18	2	20	10.0
	Total	791	323	1114	27.14

% of FDI = FDI / Total * 100, FDI firms include with foreign equity of 10 percent or more.
Source: Based on authors calculations.

A summary statistics of the key variables and the correlation matrix of the variables are in Appendix Table A.2 and A.3 respectively. It is noticeable; the expenditure on R&D is very insignificant for our sample as shown in Table A2. Export intensity is almost similar both for domestic and foreign firms. Depreciation of Rupee and liberalization policy since 1990s has stimulated domestic firms to expand in global market. We estimate the equation (4) in logarithmic forms using the Fixed Effects (FE), Random Effects (RE) and Ordinary Least Squares (OLS) estimation techniques for all, foreign and domestic firms in our sample.

5.2 Discussions on Empirical Findings

Table 4

Determinants of Productivity Spillovers: 1994-2006

	FULL SAMPLE			*FDI FIRMS*			*DOMESTIC FIRMS*		
Variables	***4.1 OLS***	***4.2 FE***	***4.3 RE†***	***4.4 OLS***	***4.5 FE***	***4.6 RE†***	***4.7 OLS***	***4.8 FE***	***4.9 RE†***
Constant	*0.823* *(118.00)****	*0.601* *(53.80)****	*0.667* *(40.48)****	*0.867* *(53.45)****	*0.664* *(28.14)****	*0.775* *(19.73)****	*0.826* *(103.48)****	*0.580* *(46.10)****	*0.652* *(35.19)****
K	*-0.114* *(-17.11)****	*0.309* *(22.73)****	*0.191* *(16.70)****	*-0.080* *(-6.77)****	*0.262* *(9.47)****	*0.145* *(6.54)****	*-0.127* *(-15.76)****	*0.321* *(20.39)****	*0.205* *(15.26)****
L	*0.886* *(111.26)****	*0.379* *(29.95)****	*0.493* *(43.13)****	*0.871* *(58.09)****	*0.421* *(16.11)****	*0.540* *(23.81)****	*0.894* *(94.80)****	*0.365* *(24.97)****	*0.477* *(35.82)****
RD_{t-1}	*-0.077* *(-1.32)*	*-0.014* *(-0.42)*	*-0.009* *(-0.26)*	*-0.097* *(-1.15)*	*0.006* *(0.13)*	*0.005* *(0.11)*	*-0.079* *(-1.02)*	*-0.033* *(-0.70)*	*-0.023* *(-0.48)*
EX_{t-1}	*0.153* *(11.71)****	*0.019* *(2.34)***	*0.025* *(3.04)****	*0.173* *(5.97)****	*0.075* *(3.03)****	*0.073* *(3.02)****	*0.151* *(10.13)****	*0.016* *(1.73)**	*0.021* *(2.28)***
FDI_{t-1}	*-0.022* *(-1.05)*		*0.076* *(1.19)*	*-0.200* *(-7.43)****		*-0.141* *(-1.67)*	-	-	-
$RDSP_{t-1}$	*-1.008* *(-14.52)****	*-0.063* *(-1.24)*	*-0.086* *(-1.71)**	*-0.990* *(-7.08)****	*-0.274* *(-2.58)***	*-0.306* *(-2.94)****	*-1.078* *(-12.49)****	*-0.011* *(-0.19)*	*-0.037* *(-0.64)*
$EXSP_{t-1}$	*0.426* *(4.44)****	*-0.494* *(-1.84)**	*-0.104* *(-0.53)*	*0.701* *(4.24)****	*0.347* *(0.89)*	*0.380* *(1.40)*	*0.218* *(1.60)*	*-1.014* *(-2.83)***	*-0.403* *(-1.45)*
$FDISP_{t-1}$	*1.240* *(10.39)****	*1.215* *(10.39)****	*1.344* *(8.57)****	*1.058* *(8.86)****	*1.151* *(7.09)****	*1.286* *(8.58)****	-	-	-
Hausman Test	-	*1274.50*	-	-	*97.50*	-	-	*240.05*	-
R^2	*0.65*	*0.52*	*0.58*	*0.66*	*0.57*	*0.62*	*0.63*	*0.49*	*0.55*
Sample Size	***14482***			***4199***			***10283***		

Note: Values in parenthesis indicates t-ratio results; † Values in parenthesis indicates z-ratio results
*Significance at 10% level; **Significance at 5% level; and ***Significance at 1% level

Table 4 shows regression results for our full sample of firms, foreign firms and domestic firms in Indian manufacturing. Column 4.1, 4.2 and 4.3 include estimates based on the full sample (i.e., all firms); Column 4.4, 4.5 and 4.6 are based on foreign firms and Column 4.7, 4.8 and 4.9 are for domestic firms respectively. Even though we have presented the regression results for the OLS, FE and RE estimation techniques here, we consider the FE results for our discussion as it passes the Hausman test as indicated in Table 4.[xii]

5.2.1 Estimations for Full Sample

The K variable has strong positive influence on productivity. The effect of labor (L) is positive and statistically significant at 1 % level, which shows a higher share of labor to total factor productivity. The effect of R&D on firms' productivity is negative and insignificant. The reason for the negative R&D effect may be that R&D usually takes time and thus it should be the stock rather than the flow of R&D that is more important for firms' productivity. Moreover, a year of R&D expenditure is usually considered as a cost to the firm in that year and hence temporarily reduces the firms' productivity prospects. The effect of exports on firms' productivity is positive and significant at the 5% level. . This may result from more efficient use of resources, greater capacity utilization and gains of scale effects associated with large international markets.

Amongst spillover variables, the insignificant and negative coefficient on RDSP indicates that there is a negative but insignificant effect of R&D spillovers on productivity. EXSP has weak negative influence on productivity when we consider FE estimation technique. The FDI spillover is positive and strongly significant. The results indicate that FDI spillover has positive effects on firms' productivity. A 1% increase in FDI activities produces a 1.21% increase in all firms' manufacturing productivity. Our results of positive FDI spillovers are consistent with those of Wei and Liu (2006) for Chinese manufacturing.

5.2.2 Estimations for Foreign Owned and Domestic Firms

Both foreign owned and domestic firms registered statistically significant capital and labor coefficients as witnessed in column 4.4-4.6 and column 4.7-4.9 respectively in Table 4. For both sub-groups, the coefficients for capital and labor are positive and significant at the 1% level using FE estimation technique. This indicates that the effect of share of capital on total factor productivity is positive and proactive. Intuitively, a higher share of labor may imply a higher quality of labor employed (resulting in a higher wage rate) and suggests that higher labor quality improves production efficiency and thus raises productivity. For domestic firms, the effect of R&D on firms' productivity is negative and statistically insignificant, while for foreign firms coefficient is negative only for the OLS estimation but insignificant. Another tentative explanation is that a domestic firm's R&D may not be significant enough to enhance its own productivity. The effect of exports on firms' productivity is positive and significant at the 1% level for all three estimations.

Amongst spillover variables, the effect of R&D spillover is negative and significant at 1% level in case of foreign firms only; however for domestic firm this is negative and significant at 1% level only with OLS estimation. Exports have strong positive effects on productivity in case of foreign owned firm while for domestic firms positive influence on productivity is weaker. Export activities are strongly encouraged by the Indian government. This encouragement from the government made both foreign owned and domestic firms compete for exports of products, often at reduced prices. EXSP is negative and statistically significant in case of domestic firms. However, for FDI firms the coefficient of EXSP is positive but statistically insignificant. The FDI spillover is positive and strongly significant for the foreign owned firms. This could be due to the reason that foreign firms adopt most of their technologies from their parent companies in the home country and thus are sensitive to local spillovers.

6. Concluding Remarks and Policy Implications

This paper attempts to analyse the productivity spillover effects in presence of FDI in Indian manufacturing firms after controlling R&D and export activities. During the last decade there has been a substantial rise in trade and foreign ownerships in India. We confirm the existence of beneficial spillovers from FDI and negative spillovers from R&D

and exports. Our findings have some relevant implications in policy context in case of India. Major findings can be summarized as follows:

Firstly, there is strong evidence of positive productivity spillovers from FDI. This is because of the lower manufacturing cost and better FDI environment have been encouraging foreign firms to invest in India.[xiii]

Indian manufacturing industries so far do not seem to benefit significantly from R&D spillovers except for foreign owned firms. On the contrary, Wei and Liu (2006) found indigenous Chinese firms with positive R&D spillover effects on productivity. Given the liberal policy on technology imports, local firms in India are still less inclined to invest in uncertain risky in-house R&D activities. In improving productivity from R&D spillovers, the policy makers should focus on local technology generations, and provide more subsidies and tax concessions on product or process innovations in case of Indian manufacturing.

Finally, our findings indicate that there is negative productivity spillover from exports in both full sample and for domestic firms. However Chinese manufacturing has both negative and positive spillovers on productivity due to exporting. Indian export story is in stark contrast to the Chinese case, where FDI was predominantly export oriented. Multinationals acted as a catalyst to the local firms to enter. In India, FDI acted as a competitive spur for domestic exporters forcing them to innovate. MNEs aimed for the domestic market, allowing local firms to expand in export market.

In summary, our findings also have important implications for policy makers. From the findings, it is evident that the scope of R&D needs to be extended in improving productivity; and exporting activities has negative influence on productivity of domestic manufacturing firms. Fluctuation in Indian rupee and greater demand in domestic market have negative influence on export spillovers. Most prominently, liberalization of foreign investment has played a significant role in improving productivity and competitiveness in case of Indian manufacturing firms.

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Appendix – A.1

Variables and Measurements

Variable	Measures	Data Source
1. *Output*	PROWESS data contains information on value of total output by each firm belonging to a particular industry group. This was deflated using an industry-specific wholesale price index with base year as 1994 = 100.	PROWESS
2. *Capital*	Capital is derived from the PROWESS database provided by the Centre for Monitoring Indian Economy (CMIE) and is deflated according to the suitable deflators with base year as 1994 = 100.	PROWESS
3. *Labor*	The PROWESS database provides information on wages and salaries. No information on the number of employees is available. Therefore, we need to use this information to arrive at the man days of work for each firm. Man days at the firm level is arrived at by dividing the salaries and wages at the firm level by the average wage rate of the industry to which each firm belongs. To arrive at the average wage rate, we make use of the Annual Survey of Industries (ASI) data. ASI contains information on Total Emoluments (It includes Salaries, Wages, Provident Fund (PF) and Bonus) as well as Total Man days for relevant industry groups. At the time of this study, ASI data was available only till 2003-04. We have extrapolated the values for the remaining period of the study. (ie., from 2004-2006). The measurement of other variables is provided in the Appendix.	PROWESS
4. RD	R&D is calculated by the ratio of a firm's R&D expenditure out of total sales.	PROWESS
5. EX	(Exports) – The ratio of a firm's exports to its sales.	PROWESS
6. RDSP	(R&D Spillovers) – The ratio of intangible assets held by all other firms (the firm's own intangible assets are excluded) to fixed assets in an industry.	PROWESS
7. EXSP	(Exports Spillovers) – The ratio of exports by all other firms (the firm's own exports are excluded) to sales in an industry.	PROWESS
8. FDISP	(Foreign Direct Investment Spillovers) – The share of foreign-owned firms capital in total capital in an industry.	PROWESS

Table A2

Summary Statistics of the Variables

Variables	*All firms*		*FDI firms*		*Domestic firms*	
	Mean	*Std.Dev*	*Mean*	*Std.Dev*	*Mean*	*Std.Dev*
Y	1.070	0.797	1.266	0.749	0.992	0.803
K	1.014	0.921	1.202	0.865	0.939	0.935
L	0.373	0.807	0.579	0.735	0.291	0.819
RD	0.010	0.073	0.014	0.088	0.008	0.066
EX	0.144	0.307	0.147	0.241	0.142	0.330
RDSP	0.010	0.061	0.010	0.070	0.009	0.056
EXSP	0.005	0.045	0.008	0.060	0.005	0.036
FDISP	0.007	0.036	0.024	0.064	-	-

Source: Authors' computations are based on data sources described in the text.

Table A3

Correlation Matrix of the Variables (Full Sample)

	Y	**K**	**L**	**RD**	**EX**	**RDSP**	**EXSP**	**FDISP**
Y	1							
K	0.54	1						
L	0.77	0.73	1					
RD	0.02	0.05	0.04	1				
EX	-0.02	-0.08	-0.11	-0.02	1			
RDSP	0.01	0.002	0.09	-0.01	-0.01	1		
EXSP	0.01	-0.03	-0.01	-0.01	0.09	0.32	1	
FDISP	0.22	0.11	0.20	0.01	0.01	-0.002	0.09	1

Source: Authors' computations are based on data sources described in the text.

[i] We use FDI and multinational enterprises (MNEs) interchangeably. It includes any form of foreign involvement.
[ii] Gorg and Greeaway (2004) summarises the literature with many studies from the developed and developing countries.
[iii] Indian companies report R&D expenses if it is more than 1 percent of turnover
[iv] Reserve Bank of India (Annual Report, 2004-05)
[v] Sashidharan and Ramanathan (2007) provides the detail.
[vi] The Industrial Policy (1991) made several provisions to liberalize the flow of FDI into the country. This policy marked the beginning of many economic and fiscal reforms in India.
[vii] World Investment Report (various issues).
[viii] Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Switzerland, Sweden, Spain.
[ix] National Manufacturing Competitiveness Council, IMaCS analysis. IMaCS is ICRA Management Consulting Services Limited.
[x] The PROWESS database contains information from the balance sheets and income statements of listed companies in Mumbai Stock Exchange covering 70% of the economic activity in the organized industrial sector of India.
[xi] Although overall exit rates are very low, we use balanced panel of firms for the estimation purposes.
[xii] Signs and significance levels are similar for all three estimations for the full sample and for two sub-groups.
[xiii] Restrictive labor laws, red tape and constraints in infrastructure are still major barrier in increasing foreign investment in case of India.