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Foreign Investment and Productivity: A Study of Post-reform Indian Industry

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The paper uses firm level panel data for Indian industries in the post-reform period to study the direct and indirect productivity effects generated by foreign investment. It finds no evidence that foreign investment directly increased firm-level productivity, nor that R&D spending was more productive in firms or sectors with higher foreign investment. It however finds strong evidence that local firms benefited from foreign investment in their industries. These benefits are higher for larger firms and those that do more business domestically.

***Keywords**: Foreign Investment; Technology Spillover; Indian industries.*

***JEL Classification:** L60, C23, F23.*

INTRODUCTION

Recent years have seen significant increase in the flow of direct foreign investment (FDI) into developing economies (UNCTAD, 2001). Given its scale compared to host developing economies, FDI inflows are expected to have significant impact on the industrial structure of host countries. The literature on Transnational Corporations (TNCs) observes that certain assets owned by TNCs such as technology, marketing, management, and networks benefit developing economies through a process of spill-over (Caves, 1996, Dunning, 1981). Property rights on intangible assets being underdeveloped, they are partially public goods and firms can often use assets developed by other firms at a small cost. If local firms, through deliberate effort or spillover, obtain the superior practices of TNCs, it would improve industrial efficiency in host countries. If TNCs help faster diffusion of new technology (Teece, 1977; Gonclaves, 1986, Kokko, 1994), then it also leads to important industrial policy implications for the host country governments (Aitken and Harrison, 1999).

Though there are notable exceptions[1], a large part of the literature on the experience of industries in host countries is based on case studies whose qualitative methods usually present mixed evidence (eg. Mansfield and Romeo, 1980; Rhee and Belot, 1989). Availability of panel

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data across industries for some countries now makes it possible to use quantitative methods. The purpose of our paper is to examine issues related to foreign investment's contribution to productivity in Indian industries, which became more open to FDI following reforms in late eighties and particularly after 1991.

There are a number of studies on TNCs in India, eg, Basant and Fikkert (1996) and Kumar (1990). Our study focuses on the post-reform phase using firm level panel data across industries. During this period the Indian economy saw a series of reforms not only in foreign investment regime, but also in financial markets, monetary policy, trade and taxation, and the economy grew at an average annual rate of more than six per cent. The rapid change of the regulatory environment and significant inflow of foreign investment have raised an interest in the question of the contribution of foreign investment both among scholars and the public. The data set spans over 1989 to 1999 across eleven industries that received significant FDI in the post-reform period. The sample covers all firms in the organized sector of the respective industries giving 1132 data points with observations on inputs, sales, ownership structure and expenditures at each data point.

The study focuses on two issues. First, whether more foreign investment embodied in a firm results in higher productivity. Though the literature does not question the technological superiority of TNCs, it has been observed that their investment may not necessarily perform better than the locals' in the host environment (Wu, 2000). Our first objective is motivated by these observations. We examine the productivity effect of foreign investment at the firm level. We also explore if these effects are concentrated in particular firm or industry types. A related question examined is whether R&D spending is more productive in firms and industries with larger foreign investment.

Secondly, are there externality benefits from foreign investment in a given industry for other firms in that industry? This so-called spillover can occur irrespective of whether firms with higher foreign investment are currently more productive than others or not, since the process is based on the diffusion of knowledge and practices. The issue can be broken into two separate questions. The first is whether there is at all any positive externality. This externality can benefit not only local firms but also TNCs who might benefit from one another's existence. Secondly, are the benefits different as between TNCs and locals? There is a significant literature on the second question and evidence appears varied. Lichtenberg and van Pottelsberghe de la Potterie (1996) found that FDI flows did not result in positive spillovers among OECD countries during 1970–1990, while Hejazi and Safarian (1999) found significant R&D spillovers from US firms to other OECD countries during the same period. In a study across 69 developing countries Borensztein, Gregorio, and Lee (1998) using data on FDI flow from OECD countries concluded that FDI had a positive effect on per capita income growth only for countries that had reached a minimum human capital threshold. A paper by Xu (2000) corroborates this finding for spillover effects from US firms across forty countries. Studies on individual countries also provide mixed conclusions. Caves, (1974) for Australia, Globerman, (1979) for Canada and Blomstrom and Persson (1983) for Mexico found positive effects of the presence of TNCs on local productivity. But Haddad and Harrison (1993) for Morocco and Aitken and Harrison (1999) for Venezuela find no evidence of spillover onto local firms. The study of Liu, Siler, Wang and Wei (2000) of UK panel data shows evidence of positive spillovers of FDI. They also observe that: (1) the greater the technological capabilities of local firms, greater are the spillover benefits; and (2) that the spillover effects are on average negatively related to the technology gap between foreign and locally-owned firms. A recent study of Feinberg and Majumdar (2001) of India's pharmaceutical industry examines spillovers from R&D effort of foreign firms. They observe that only MNCs gained from each other's R&D spillovers.

In this paper, we adapt an augmented production function framework similar to Aitken and Harrison (1999). With firm level panel data for 11 industries, we explore (1) if productivity is higher for firms with larger foreign equity; (2) if there are industry and firm attributes that influence this effect; (3) if there are externality benefits of DFI in an industry for local firms in that industry; (4) if these benefits are concentrated in specific industry types; and (5) whether there are firm-level attributes that influence the ability of firms to avail of these benefits. The attributes we focus on are R&D, size of firms, vertical integration and international trade intensity[2]. The paper is organized as follows. Section 2 introduces the methodology of the work and explains the rationale of the exercises. Section 3 discusses the data, and presents the main results. Section 4 analyzes and interprets the results. A summary is presented in Section 5, where we also discuss possible extensions.

METHODOLOGY

Our maintained hypothesis is that the contribution of intangible assets introduced through foreign investment in a firm[3] is expected to show up in the firm's total factor productivity. Similarly if it creates externalities for other firms in that industry, then that too should show up in the factor productivity of the latter firms. Both these effects can be nested in a suitably augmented production function at the firm level. We augment the production function of a firm with foreign investment in it and a variable measuring foreign presence in the industry to which it belongs. Foreign investment in the firm and foreign presence in the industry are thus treated as virtual inputs. We have used a logarithmic form so that, suppressing firm and time identifiers, the production function is

$$q = a + \beta' \ \mathbf{(D)} + \gamma' .\mathbf{(i)} + g_1.FE + g_2.FP + e \qquad ...(1)$$

where q is the logarithm of output, **(i)** is a vector of the logarithm of production inputs, FE is the percentage of foreign equity holding in the firm and FP is a measure of foreign presence as explained below. The random term e is assumed to have a normal distribution with zero mean and fixed variance over the sample. **(D)** is a 10×1 vector of industry dummies for capturing industry-specific intercepts.

γ_1 is the effect of a firm's foreign equity holding on its productivity. To probe if the productivity enhancing effect of foreign investment is different across industries, equation (1) is extended using an interactive term:

$$q = a + \mathbf{(D)} + .\mathbf{(i)} + \gamma_1.FE + \gamma_2.FP + \gamma'_3 \ FE.\ \mathbf{(D)} + \varepsilon \qquad ...(2)$$

In equation (2), γ'_3 is a vector of coefficients that would indicate effects of firm-level foreign investment differentiated by industry.

γ_2 measures the effect of the presence of foreign investment in the industry to which a firm belongs. To further examine if firms with different foreign equity levels benefit from this effect differently, we add the interactive variable $FE*FP$ to equation (2):

$$q = \alpha + \beta'(\mathbf{D}) + \gamma'.(\mathbf{i}) + \gamma_1.FE + \gamma_2.FP + \gamma'_3.FE.(\mathbf{D}) + \gamma_4.FE*FP + \varepsilon \qquad \ldots(3)$$

If the interactive term *FE*FP* is significant, then the marginal effect of *FP*, $\frac{\partial q}{\partial FP}$, can be written as $\gamma_2 + \gamma_4.FE$. A positive γ_4 would imply that externality benefits of foreign investment in an industry is *larger* for firms with higher foreign equity, ie. foreign firms benefit more from one another's investment into the industry than do the locals. A negative value would imply that the spillover effect is larger for firms with more local ownership.

Later on in place of *FE*FP* in equation (3) a number of alternative interactive terms are used to explore if the ability to benefit from foreign investment externality depends on the nature of the industry or any firm-level attribute. These equations are:

Industry dummies.	$q = \alpha + \beta'(\mathbf{D}) + \gamma'.(\mathbf{i}) + \gamma_1.FE + \gamma_2.FP + \gamma'_3.FE*(\mathbf{D}) + \gamma_4.FP*(\mathbf{D}) + \varepsilon$	(4)
RD = R&D/sales.	$q = \alpha + \beta'(\mathbf{D}) + \gamma'.(\mathbf{i}) + \gamma_1.FE + \gamma_2.FP + \gamma'_3.FE*(\mathbf{D}) + \gamma_4.RD*FP + \varepsilon$	(5)
IM = import/sales.	$q = \alpha + \beta'(\mathbf{D}) + \gamma'.(\mathbf{i}) + \gamma_1.FE + \gamma_2.FP + \gamma'_3.FE*(\mathbf{D}) + \gamma_4.IM*FP + \varepsilon$	(6)
EX = export/sales.	$q = \alpha + \beta'(\mathbf{D}) + \gamma'.(\mathbf{i}) + \gamma_1.FE + \gamma_2.FP + \gamma'_3.FE*(\mathbf{D}) + \gamma_4.EX*FP + \varepsilon$	(7)
SZ measures firm size as defined below.	$q = \alpha + \beta'(\mathbf{D}) + \gamma'.(\mathbf{i}) + \gamma_1.FE + \gamma_2.FP + \gamma'_3.FE.(\mathbf{D}) + \gamma_4.SZ*FP + \varepsilon$	(8)
VI is a measure of vertical integration as defined below.	$q = \alpha + \beta'(\mathbf{D}) + \gamma'.(\mathbf{i}) + \gamma_1.FE + \gamma_2.FP + \gamma'_3.FE.(\mathbf{D}) + \gamma_4.VI*FP + \varepsilon$	(9)

Interactive variables tried out in equations (4) to (9) have been shown in the first column. The interpretation of the signs of the interactive terms is similar to that of *FE*FP* discussed above. If *X* is an interactive variable used in one of these equations and the term *FP*X* is significant, then $\frac{\partial q}{\partial FP}$ can be written as $\gamma_2 + \gamma_4.X$. If γ_4 is positive, it would mean that the impact of foreign investment externality is higher if the firm has a higher value of *X*.

We based our choice of interactive variables on either empirical literature or theoretical presupposition. R&D expenditure and the size of a firm have been often suggested to influence the ability of a firm to take advantage of available industry-level pool of knowledge and practices. Higher vertical integration of production and lower import intensity imply that a larger share of the firm's activity can potentially benefit from technology absorption. A higher export to sales ratio is expected to create pressure for remaining internationally competitive and motivate technology absorption.

While interpreting our empirical results, it will be useful to note that equations (1) and (2) are just restricted forms of equation (3). However, each of the equations (4) to (9) is designed to test a hypothesis that is *econometrically* unconnected to another. The maintained hypothesis and the true model *is* different for each equation. Besides these equations, a number of other equations have been estimated to take some of the queries to specific directions, and will be reported in the appropriate place.

DATA AND EMPIRICAL RESULTS

Data

Data are sourced from the publications of the Centre for Monitoring the Indian Economy. Industries are: air-conditioners, auto ancillaries, communication equipment, electronic process control, light commercial vehicles, motor cycles, motors and generators, passenger cars, refrigerators, tyres and tubes, and washing machines. Table 1 describes the sample. Most of the work has been done using the software STATA (StataCorp LP, USA).

Table 1
The Sample

Industry	*Identifying Dummy*	*Number of firms*	*Number of data points*
Airconditioners	D1	5	54
Auto Ancillaries	D2	24	264
CommunicationEquipment	D3	22	227
Electronic Process Control	D4	5	52
Light Commercial Vehicles	D5	6	72
Motor Cycles	D6	4	48
Motors and Generators	D7	6	66
Passenger Cars	D8	10	68
Refrigerators	D9	4	47
Tyres and Tubes	D10	19	197
Washing Machines		5	37

Variables

1. q = logarithm of value added. Value added figures have been normalized by the producer wholesale price index.
2. (**i**) = (log$K$, log$L$). K is measured by the value of plants and equipment and L is proxied by deflated values of wages and salary.
3. (**D**) industry dummies. Table 1 provides the industry identification of each dummy.
4. FE = percentage of foreign equity in a firm.
5. FP = a measure of foreign investment presence in the industry to which the firm belongs.

   We have used three alternative measures. The first is $\frac{\sum (FE)_i K_i}{\sum K_i}$ over all firms in the industry. $(FE)_i$, the share of foreign equity in the i-th firm. The second and the third measures of FP replace K with L and value added respectively. Note that there is no *a priori* theoretical reason to expect FE and FP to be strongly correlated.
6. RD = R&D expenditure of a firm as percentage of its total sales.
7. IM = import of intermediate and capital goods as percentage of sales.

8. *EX* = exports as percentage of sales.

9. *SZ* = firm's share of total industry sales as percentage, measuring size of the firm.

10. *VI* = value added as percentage of sales, measuring vertical integration.

All three measures of *FP* have sufficient sample variance and are not significantly correlated with other variables of the system[4]. The correlation (sub)matrix with the three measures of *FP* and the interactive variables used in the regressions is presented in Table 2.

However among the set of variables *FE**(**D**), *FE**D2 and *FE**D3 are highly correlated, and we can use only one of them. This stops us (see footnote 6) from making comments on the sectoral effects of *FE* for the auto ancillaries and the communication equipment sectors.

Table 2
The Correlation (sub-)Matrix

	FP_V	FP_K	FP_L	*FE*	*IM*	*EX*	*SZ*	*RD*	*VI*
FP_V	1.0000								
FP_K	0.8911	1.0000							
FP_L	0.8451	0.7973	1.0000						
FE	0.2277	0.2319	0.1752	1.0000					
IM	0.0422	0.0376	0.0227	0.1011	1.0000				
EX	0.0145	0.0126	0.0072	0.1027	0.9627	1.0000			
SZ	0.3044	0.3064	0.1588	0.1658	-0.0173	-0.0234	1.0000		
RD	-0.0008	0.0570	-0.0025	-0.0202	-0.0009	-0.0076	-0.0165	1.0000	
VI	0.0226	0.0448	0.0683	-0.0436	-0.0059	-0.0059	-0.0666	-0.0096	1.0000

The subscripts of *FP* refer to the measure used. *V* denotes value added; *K* plant and equipment and *L* wages and salaries.

EMPIRICAL RESULTS

We estimated 9 equations, each with three different measures of foreign presence and each equation has a large number of variables. To keep the presentation manageable, we report the estimated coefficients for only equations 1, 2 and 3 below. They appear in Table 3.

The qualitative results are however presented in full for all the equations and all variants of the measure for foreign presence. They appear in Table 4, where column 1 refers to the equation number in the same sequence as presented in section 2. Column 2 shows the right hand side variables in the regression equation. The third column states the adjusted R^2 in parenthesis and mentions the variables significant at 5 per cent level[5]. A (-) sign indicates the estimated (and significant) coefficient is negative; D_i indicates that some of the dummies are significant, positive or negative; and $X*D_i$, where *X* is any variable, indicates that some elements of *X**(**D**) are significant, positive or negative. In all other cases the coefficient is positive. For each estimated equation all three measures of *FP* are used. The fourth column states if the measure is based on plant and equipment, labor or value-added. The three sets of estimates produce similar qualitative conclusions for all but two equations (see equations 5 and 8, Table 4).

Table 3
Estimation Results for Equations 1, 2 and 3

	FP with Value-added			*FP with Plant and Machinery*			*FP with Salaries and Wages*		
variables	*Eq. (1)*	*Eq (2)*	*Eq (3)*	*Eq (1)*	*Eq (2)*	*Eq (3)*	*Eq (1)*	*Eq (2)*	*Eq (3)*
Constant	0.5	0.51	049	0.63	0.64	0.57	0.62	0.62	
	(5.6)*	(5.7)*	(5.4)*	(7.3)*	(7.6)*	(6.8)*	(5.3)*	(5.5)*	0.61(5.5)*
Log K	0.28	0.28	0.27	0.30	0.28	0.28	0.30	0.28	0.26
	(12.4)*	(11.3)*	(11)*	(12)*	(11.4)*	(11)*	(12)*	(11)*	(10)*
Log L	0.67	0.68	0.68	0.67	0.67	0.68	0.67	0.68	0.69
	(29)*	(29)*	(29)*	(29)*	(29)*	(29)*	(29)*	(29)*	(29)*
FE	0.005	0.001	0.003	0.0002	0.001	0.0048	0.0002	0.001	0.005
	(0.53)	(1.43)	(2.8)*	(0.57)	(1.6)**	(3.9)*	(0.58)	(1.55)**	(4.5)*
FP	-0.01	0.002	0.19	-0.34	-0.36	0.02	-0.18	-0.18	0.046
	(-0.06)	(0.014)	(1.0)	(1.67)**	(1.8)**	(1.0)	(1.0)	(1.0)	(0.25)
FE*FP			-0.01			-0.017			-0.013
			(2.49)*			(3.6)*			(4.5)*
D1	0.16	0.07	0.05	0.12	0.034	0.01	0.08	-0.006	-0.03
	(2.1)*	(0.94)	(0.7)	(1.8)**	(0.45)	(0.14)	(0.79)*	(0.06)	(0.3)
D2	0.27	0.39	0.38	0.23	0.35	0.32	0.21	0.33	0.29
	(4.2)*	(6.0)*	(5.8)*	(4.5)*	(6.4)*	(5.9)*	(2.9)*	(4.5)*	(3.9)*
D3	-0.21	-0.2	-0.21	-0.28	-0.27	-0.28	-0.29	-0.28	-0.3
	(3.2)*	(3.0)*	(3.3)*	(4.5)*	(4.5)*	(4.7)*	(3.1)*	(3.1)*	(3.6)*
D4	-0.07	-0.36	-0.43	-0.019	-0.3	-0.43	-0.08	-0.37	-0.4
	(1.2)	(8.2)*	(4.9)*	(0.28)	(3.4)*	(4.6)*	(1.51)**	(4.6)*	(5.6)*
D5	0.58	0.67	0.63	0.59	0.68	0.6	0.54	0.63	0.03
	(10)*	(8.2)*	(7.5)*	(10)*	(8.4)*	(7.3)*	(7.6)*	(7.0)*	(0.27)
D6	0.11	0.14	0.12	0.08	0.11	0.08	0.05	0.08	0.03
	(1.63)**	(1.17)	(0.96)	(1.3)	(0.94)	(0.65)	(0.59)	(0.63)	(0.27)
D7	0.10	-0.03	-0.056	0.06	-0.07	-0.1	0.01	-0.12	-0.14
	(1.47)	(0.45)	(0.72)	(1.0)	(1.0)	(1.3)	(0.15)	(1.1)	(1.3)
D8	0.37	0.42	0.38	0.37	0.42	0.37	0.31	0.37	0.3
	(6.29)*	(5.8)*	(5.0)*	(6.4)*	(5.9)*	(5.0)*	(4.0)*	(4.2)*	(3.5)*
D9	-0.07	-0.06	-0.09	-0.07	-0.06	-0.13	-0.13	-0.12	-0.17
	(1.14)	(0.97)	(1.3)	(1.2)	(0.97)	(2.0)*	(1.6)**	(1.49)	(2.0)*
D10	0.36	0.4	0.40	0.29	0.33	0.34	0.29	0.32	0.3
	(5.0)*	(5.6)*	(5.6)*	(4.6)*	(5.2)*	(5.3)*	(3.1)*	(3.7)*	(3.5)*
D1*FE		0.003	0.002		0.003	0.0031		0.0031	0.0008
		(1.94)*	(1.6)**		(1.9)*	(1.9)*		(1.9)*	(0.52))
D2*FE		-0.0056	-0.006		-0.005	-0.005		-0.005	-0.006
		(5.2)*	(5.6)*		(5.3)*	(5.0)*		(5.2)*	(5.6)*
D3*FE		dropped	dropped		dropped	dropped		dropped	dropped
D4*FE		0.008	0.01		0.008	0.01		0.008	0.01
		(4.4)*	(5.0)*		(4.3)*	(5.7)*		(4.3)*	(5.5)*
D5*FE		-0.003	-0.0024		-0.003	-0.001		-0.003	-0.002
		(1.67)**	(1.2)		(1.73)**	(0.55)		(1.72)**	(1.46)
D6*FE		-0.001	-0.001		-0.001	-0.0005		-0.001	-0.001
		(0.32)	(0.34)		(0.3)	(0.18)		(0.35)	(0.59)
D7*FE		0.003	0.003		0.003	0.003		0.003	0.001
		(3.1)*	(2.7)*		(3.0)*	(3.0)*		(3.0)*	(0.89)
D8*FE		-0.002	-0.001		-0.0021	-0.0005		-0.002	-0.002
		(1.43)	(0.79)		(1.57)**	(0.38)		(1.5)**	(1.6)**
D9*FE		-0.0005	-0.0003		-0.0006	-0.001		-0.0006	-0.001
		(0.39)	(0.3)		(0.49)	(1.1)		(0.47)	(1.0)
D10*FE		-0.002	-0.003		-0.002	-0.003		-0.002	-0.004
		(2.1)*	(3.1)*		(2.2)*	(3.3)*		(2.2)*	(3.6)*
Adjusted R^2	0.89	0.90	0.906	0.89	0.90	0.907	0.89	0.90	0.907

Figures in the brackets are *t*-values. *Significant at 0.01; **Significant at 0.05 levels
For the treatment of D3*FE, see footnote 6 in the text.

Table 4
Qualitative Summary of Empirical Results

Equation 1	α, (**D**) ,*K, L, FE, FP*	(0.8986) α, D_i, *K,L*	Plant
		(0.8997), α, D_i,*K, L*	Labour
		(0.8984); α, D_i,*K, L*	Value added
Equation 2	α, (**D**), *K, L, FE, FP, FE**(**D**)	(0.9061) α, D_i, *K, L, FE*Di*	Plant
		(0.9059), α, D_i,*K, L, FE*Di*	Labour
		(0.9077); α, D_i, *K, L,* $FE*D_i$	Value added
Equation 3	α, (**D**), *K, L, FE, FP, FE**(**D**), *FE*FP*	(0.9071) α, D_i,*K, L, FE*, (-)*FE*FP, FE*Di*	Plant
		(0.9076) α, D_i, *K, L, FE*, (-)*FE*FP,* $FE*D_i$	Labour
		(0.9082); α, D_i,*K, L, FE*, (-)*FE*FP,* $FE*D_i$	Value added
Equation 4	α, (**D**), *K, L, FE, FP, FE**(**D**), *FP**(**D**)	(0.9067) α, D_i, *K, L*, (-)*FP, FE*Di,* $FP*D_i$	Plant
		(0.9098); α, D_i,*K, L*, (-)*FP, FE*Di, ,* $FP*D_i$	Labour
		(0.9081); α, D_i, *K, L*, (-)*FP,* $FE*D_i$, $FP*D_i$	Value added
Equation 5	α, (**D**), *K, L, FE, FP, FE**(**D**), *FP*RD*	(0.9062) α, D_i, *K, L, FE*Di*	Plant
		(0.9061); α, D_i,*K, L*, (-)*FP*RD,* $FE*D_i$	Labour
		(0.9060); α, D_i, *K, L*, (-)*FP*RD,* $FE*D_i$	Value added
Equation 6	α, (**D**), *K, L, FE, FP, FE**(**D**), *FP*IM*	(0.9115) α, D_i,*K, L*, (-)*FP*IM,* $FE*D_i$	Plant
		(0.9113); α, D_i, *K, L*, (-)*FP*IM,* $FE*D_i$	Labour
		(0.9112); α, D_i,*K, L*, (-)*FP*IM,* $FE*D_i$	Value added
Equation 7	α, (**D**), *K, L, FE, FP, FE**(**D**), *FP*EX*	(0.9126); α, D_i,*K, L*, (-)*FP*EX,* $FE*D_i$	Plant
		(0.9128); α, D_i,*K, L*, (-)*FP*EX,* $FE*D_i$	Labour
		(0.9123); α, D_i,*K, L*, (-)*FP*EX,* $FE*D_i$	Value added
Equation 8	α, (**D**), *K, L, FE, FP, FE**(**D**), *FP*SZ*	(0.9063) α, D_i,*K, L*, (-)*FP, FP*SZ,* $FE*D_i$	Plant
		(0.9065); α, D_i,*K, L, FP*SZ,* $FE*D_i$	Labours
		(0.9061): α, D_i,*K, L, FP*SZ,* $FE*D_i$	Value added
Equation 9	α, (**D**), *K, L,FE, FP, FE**(**D**), *FP*VI*	(0.9060) α, D_i,*K, L,* $FE*D_i$	Plant
		(0.9058); α, D_i,*K, L,* $FE*D_i$	Labour
		(0.9057); α, D_i, *K, L,* $FE*D_i$	Value added

DISCUSSION

Foreign Investment In A Firm And Its Productivity

Estimates of equation (1) show that at the overall sample level there is no evidence that more foreign investment in a firm has led to higher productivity.

Equation (2) tries to examine if there are particular industries where these effects might be concentrated. In the estimate of equation (2) several industries[6] return significant coefficients for *FE**(**D**). They are of mixed sign which explains the absence of the effect at the overall sample level. Thus in some industries firms with more foreign investment are more productive while in some others the opposite is the case.

These results raise the following important question for FDI. Could the sectoral distribution of the effects revealed by equation (2) be a result of sector-level (rather than firm-level) foreign investment? Equation (3) is formulated to test for this possibility. In equation (3) the effect of *FE* because of the overall foreign investment in that industry is captured by *FE*FP* while the *FE**(**D**) terms capture the 'pure' sectoral effects. As the estimates show, there are pure sectoral effects in most industries where *FE**(**D**) is significant in equation (2). But there is also an effect of overall foreign investment in the sector. This effect is negative, implying that in industries with more foreign presence, firms with less foreign investment are more productive.

It is however possible that *FE* contributes to firm level productivity conditional on firm level attributes and thus the effect remains obscure at the overall sample level. Equations presented above are not designed to explore this possibility. We conducted a number of additional exercises using *FE*X* as an explanatory variable, where *X* is a firm attribute from the list of variables presented earlier. The best in-sample predictor equation of this family is a regression of *q* on {(**i**) (**D**), *IM, FE*IM*}, and it returns significant negative coefficients for *IM* and *FE*IM*. Thus among local firms, those who depend more on locally produced materials benefit more by emulating the practices of TNCs than those who are more import-intensive. We will report below that a similar observation holds for the productivity of industry-level investment, too.

A related question is whether foreign investment in a firm or in its industry renders its R&D spending more effective. The evidence from the estimate of equation (5) is that the contrary is true. The evidence was reinforced by two additional exercises not listed in Table 4. In regressions of *q* on {(**i**) (**D**), *RD, FE*RD*} and on {(**i**) (**D**), *RD, FP*RD*} the coefficients of *FE*RD* and *FP*RD* are significant and negative. Thus the sample provides evidence that R&D activity is more productive in firms with smaller foreign holding and industries with smaller foreign presence[7]. A plausible explanation of this finding is that firms with higher foreign investment undertake their more serious R&D expenditure at parent organizations abroad. Spending on R&D in the host country may be of minor nature, and thus less contributive to productivity than those of local firms. However this is a speculation and our study is not designed to probe into this possibility.

Foreign Investment In An Industry And Spillover Effects

Though equation (1) shows no evidence that an industry's *FP* generates productivity gains at the overall sample level, significant negative coefficient of *FE*FP* in equation (3) implies that firms with lower foreign investment (loosely speaking, locals) gain from foreign investment in their industry of origin. That is evidence of spillover of industry-level FDI to local firms. Equation (4) tries to break up the effect of *FP* across industries. The only industry where it is unambiguously concentrated is tyres and tubes, which has a large number of firms with relatively small foreign presence.

Are there firm level attributes that help local firms to access more of the spillover effect? Equation (5) shows that the firm's own R&D effort is not one of such attributes, and equation (8) shows that size of the firm matters. Equations (6) and (7) show that the effect is significantly correlated with the firm's imports and exports as a percentage of sales. But contrary to expectations, firms that buy more from and sell more to the domestic market enjoy more of the benefits of industry-level foreign investment. This is an interesting finding. We should add that equations (6) and (7) are the best in-sample predictors of *q* among all the equations estimated here. It is also noteworthy that equation (9) fails to return a significant coefficient for the level of vertical integration of the firm. Note that by definition:

$$VI = 1 - IM - \frac{Domestic\ purchase}{sales}$$

The significant coefficient of *IM* in (7) and the failure of *VI* to be a significant regressor in

(9) imply that the share of domestic inputs in a firm's sales matters. Findings from equations (6) and (7) can be summarized as an aphorism: firms that do more business at home get more benefit from foreign investment in their industry.

CONCLUSION

The paper uses Indian industrial data for her post-reform era to study the productivity effect of direct foreign investment by adopting an augmented production function approach**.** It finds no evidence that foreign investment is more productive than domestic investment for the sample as a whole. The sectoral scenario is mixed. There are sectors where firms with larger foreign investment have higher productivity, while the opposite is true for some others. The sectoral variation of this effect is partly (but not wholly) contributed by the total foreign investment in a sector. The higher is the total foreign investment in a sector, the more productive are firms with smaller foreign investment. Also, the productivity of R&D spending is higher for firms and industries with more domestic rather than foreign investment.

Regarding externalities, there is evidence of spillover to domestic firms. It is found that firms with higher local ownership derive more benefit from industry level foreign investment. Also larger firms are able to absorb the spillovers more effectively than smaller firms. Finally firms that do more domestic business, both buying inputs at home and selling in the domestic market, tend to derive more benefits from foreign investment in their industry. This finding is interesting and consistent with the following explanation. Outward-oriented local firms have a larger set of entities to learn and copy from: not only foreign companies working in India, but also firms and organizations they come into contact in course of overseas activities. However for those local firms who depend more on local inputs and sell more at home (inward oriented), the only source of learning is the multinational corporations doing business at home.

Several useful extensions of the present work are warranted. The first is to examine whether local firms in industries that operate in technologically dynamic clusters reap the externality benefits more effectively than in dispersed industries (Baptista 2000). For this exercise we would require additional information to identify firms in our sample by location. The second extension stems from the possibility of endogenous determination of foreign investment variables**.** Direct foreign investment through equity purchase can be influenced by the price of stocks which has a direct relation with the firm's productivity. Also, fully owned subsidiaries of TNCs who want to sell largely in the host country, may, arguably, choose a low productivity industry to avoid competition in the early days. These are speculative possibilities, but if they materialize, they would lead to negative correlation of productivity with *FE* and *FP*. To allow for this possibility, we need to formulate and test hypotheses about *change* of firm level productivity in relation to foreign investment. This exercise would require data to be used as time series, and the sample length of the present data set may not be considered very convincing. But it is a worthwhile project, and we hope to undertake the exercise in future.

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NOTES

1. *Inter alia*, Caves, 1974 (Australia); Blomstrom and Persson, 1983 (Mexico); Blomstrom,1986 (Mexico); Blomstrom and Wolff, 1989 (Mexico); Branstetter, L.G., 2000 (U.S); Aitken and Harrison, 1999. (Venezuela).
2. In the light of the study of Hejaji and Safarian (1999) firms in developing countries derive externalities both from FDI and international trade and incorporating only one of the elements may lead to overestimation of externalities.
3. Assets in this category are technology, managerial practice, patents, brand names, marketing networks, etc. There is a view that foreign investment tends to flow into knowledge-intensive industries where intangible assets are more significant and provide TNCs with relative advantage (Dunning, 1981, Caves, 1996).
4. Since firms with more foreign investment are expected to be more capital intensive, the measure of FP based on plant and equipment was expected to be higher than that based on labor. But the computed series do not display this property uniformly.
5. All references to the level of significance in the text are at 5 per cent or lower level.
6. *FE* D*2 and *FE*D*3 are too highly correlated in our data to be both used. We have dropped *FE*D* 3; the same estimates are obtained in all cases if *FE*D*2 is dropped. In view of this we should refrain from any comments on the sectoral impact of FE in these two sectors.
7. A regression of *q* on {(i) (D), *RD*, *FE*RD*, *FP*RD*} does better than both of these equations on F-test, and produces the same qualitative conclusion.