FDI, Firm Heterogeneity and Exports

An examination of evidence in India

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*Abstract***:** The paper analyses the effect of foreign direct investment on firm-level export performance across manufacturing sectors in India. FDI inflow in India during post reforms is expected to improve export competitiveness. Such improvements are found to vary across sectors with varying levels of FDI and hence MNE participation across sectors. Further, the evidence of inter-firm variations in export performance across sectors is indicative of the existence of factors specific to firms. In determination of export performance a firm specific model has been set up for econometric estimation. Panel data estimation results show that ownership along with import of technology (embodied and disembodied), in- house R &D, import of raw materials, and expenditure on marketing, advertising and distribution are the major determining factors of firm-level exports. Firm-level productivity and credit availability also play significant role in certain sectors. As FDI brings with it a huge base of tangible and intangible assets, it also results in positive externalities or spillovers through various channels of transmission. The results also show presence of export spillovers from foreign to domestic firms in some manufacturing sectors.

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1 Introduction

In a fast globalizing world, export competitiveness of a nation determines its long run economic performance (see Balassa, 1978; Frankel and Romer, 1999; Marin 1992). Export is considered to be one of the major growth variables as it leads to productivity growth (de Melo and Robinson, 1992; Tybout, 1992) by exploiting economies of scale, enlarging the size of the market and reducing technical inefficiencies. Foreign Direct Investment (FDI) is a major instrument that provides impetus in accelerating export performance in an economy. This is particularly true for emerging market economies like India as FDI brings in a bundle of intangible assets such as new technology and know-how, skill, wider and more efficient marketing and distribution networks, better managerial capabilities etc., which are relatively scarce in these economies but are indispensable for improvements in export performance. FDI is also beneficial for the host country since it can result in positive externalities or spillovers through various channels of transmission.[2]

Multinational Enterprises (MNEs) form the major channel through which FDI flows into emerging market economies.[3] MNEs access foreign markets with much more ease than their domestic counterparts in the host country and often use the host country as export platform. Again the MNEs, given their scale of operations and a wide array of intangible assets, are productive and also have the capability to overcome the huge sunk costs while entering export markets.[4] These specific advantages give the foreign firms an edge in the export market than the domestic firms. Further, host country domestic firms can learn from the export activities of foreign subsidiaries and affiliates through information externalities, demonstration and

[2] See Bergman (2006).
[3] MNEs are the main channels through which foreign direct investment flows into host countries, whereby these firms acquire a substantial controlling interest in a host country firm or sets up a subsidiary in a host country (Markusen, 2004).
[4] See Greenaway and Kneller (2007); Roberts and Tybout (1995), for details.

competition channels thereby resulting in export spillovers. This paper investigates into these various dimensions of firm-level export performance across manufacturing industries in India during post-reforms period. In particular, the paper empirically tests whether ownership determines firm-level export performance in India and in what way MNE export performance impacts on domestic firms. The focus is to understand whether inflows of FDI following economic reforms have provided the required trigger for an improvement in overall export performance of Indian manufacturing industries.

After maintaining restrictions in cross-border trade till the mid-1980s and selective approach towards foreign direct investment till late 1980s, policy reforms were introduced in India. This was part of an entire gamut of policy changes since the early 1980s with industrial delicensing to start with and followed by trade policy changes in 1985 and both carried forward in 1991 along with wide-ranging complementary changes in other policies, thus embarking upon a phase of openness in the economy. The reforms in foreign investment policy measures initiated in 1991 made India more open and proactive with a view not only to get better access to technology but also to build strategic alliances to penetrate the world market (Ahluwalia, 2008) and improve India's export competitiveness (see Kumar and Joseph, 2007).[5] The reforms provided equal incentives across sectors, the sectors responded differently to the stimuli resulting in varied export performance[6]. Such evidence is indicative of the continuing existence of various sector specific factors that determine performance across sectors. Further, within each sector, there are firm specific factors including firm ownership that determine export performance.

Apart from ownership firm heterogeneity is one such factor determining export performance. In any sector, firms widely differ in terms of size and productivity. Melitz (2003)

[5] See Nagaraj (2003) for a different view which suggests that there is little evidence to show that higher FDI inflows have led to faster output and export growth in India.
[6] See Sinha Roy (2009) for detailed account of varying export performance across sectors.

introduced firm heterogeneity in terms of productivity in a general equilibrium model of international trade. The initial trade theory models, which introduced within-industry heterogeneity, did not explain asymmetries across firms in terms of productivity or size. This is because the thrust was to explain large volumes of trade between countries with similar factor composition. These models have limitations as they assumed symmetry across firms within an industry in terms of technology, which indirectly implied similar productivity levels. Later empirical findings established that only a small fraction of firms export and the exporters are larger in size and are more productive than the non-exporters[7]. Melitz's theoretical model with heterogeneous firms explains these features of the empirics. Further, empirical literature by Roberts and Tybout (1997), Bernard and Jensen (2004), and Das, Roberts and Tybout (2005) suggests that there exist large sunk costs of exporting in developed and developing countries alike. These are fixed costs of exporting and are interpreted as distribution and marketing costs. Hence, heterogeneity also exists in terms of capability of bearing this sunk cost, which explains export performance of firms.

There is a rich body of literature analyzing the various dimensions of the effect of FDI on export performance and export spillovers. The export-enhancing role of FDI is well documented in the literature.[8] However, these studies focus on the foreign affiliates only. There are studies, analysing the export performance of the foreign firms vis-à-vis, the local firms, though there is no conclusive evidence on better export performance of MNEs over local enterprises. While some studies, for instance by Reidel (1975), Jenkins (1979) on Mexico, Kirim (1986) on Turkish pharmaceutical industry, find no significant difference between the export performance of

[7] See, for instance, Clerides, Lach and Tybout (1998), Bernard and Jensen (1999), Aw, Chung and Roberts(2000), Baldwin and Gu (2003)

[8] See for instance, Blake and Pain (1994) for UK, O'Sullivan (1993) and Barry and Bradley (1997) for Ireland, and Cabral (1995) for Portugal.

foreign controlled enterprises and their local counterparts, Cohen (1975), based on some export oriented firms in South Korea, Taiwan and Singapore, concludes that local firms' export performance outperformed that of foreign firms. For India, Aggarwal (2002) finds better export performance of MNE affiliates than their local counterparts. However, no strong evidence was found to suggest that India was attracting efficiency-seeking outward-oriented FDI. Further, Aggarwal (2002) shows that low-tech industries with high foreign ownership have better competitive advantage than high-tech ones. Earlier, Subrahmanian and Pillai (1979) and Kumar (1989) also arrived at similar results in case of Indian manufacturing sector. This is in line with other empirical works relating to India and other developing countries [Newfarmer and Marsh, (1981), quoted in Lall and Mohammad, (1983)]. Singh (1986), in a different analysis on export and import propensities and balance of trade for a sample of Indian pharmaceutical firms, finds that, compared to the local firms, the foreign firms have higher export intensity along with a much higher import intensity. Again, among the foreign firms, affiliates of relatively big MNEs seem to have lower balance of trade deficit, arising from lesser dependence on imported raw materials.

The MNEs endowed with specific advantages can bring indirect effects on the host country domestic firms through various channels of transmission. This spillover effect of MNEs might ultimately lead to productivity growth of the host economy as a whole [Caves (1972); Globerman(1979), Blomstorm and Persson (1983), Haddad and Harrison (1993). Aitken, Hanson and Harrison (1997), also looking into export spillovers for Mexican industries, tested whether spillovers associated with one firms' export activity reduce the cost of exporting for other firms. Evidence of spillovers was found in MNEs, but not from general export activity. There is no conclusive evidence on the export inducing presence of FDI in the host country. Greenaway,

Sousa and Wakelin (2004) confirm the presence of positive spillovers from MNEs on the decision of domestic firms to export as well as their export propensity in the UK. Bergman (2006) shows that despite high productivity for India's pharmaceutical firms with foreign ownership, the correlation between FDI and domestic firms' productivity turns out to be insignificant.

Any further research on the issue of FDI and export performance in an emerging country such as India thus has to investigate into both export performance of MNEs vis-à-vis their local counterparts at a further disaggregate level as well as spillover effects of MNEs on local firms with regards to export performance. This research work investigates into these various dimensions of firm-level export performance across manufacturing industries in India during post-reforms period. In doing so, the study controls for various factors that determine export performance of Indian manufacturing enterprises while highlighting on whether foreign ownership is important for export performance and whether the exporting activity of the MNEs has spillover effects on exporting behaviour of the domestic firms. This is where the study, in particular, contributes to the existing literature.

The paper is organized as follows. Section 2 provides some stylized facts on the overall export performance of the Indian manufacturing industries during 1991-2010. Section 3 discusses the analytical framework, the empirical model and method, and the database for analyzing the determinants and spillover effects of firm-level export performance. Section 4 presents the empirical results and discusses on the determinants of firm-level export performance and spillovers. Section 5 summarizes the major findings of the paper and puts forth the policy implications.

2 Export Intensity during Post-Reforms: *Some facts*

Earlier studies have shown that India's FDI inflows increased substantially since reforms in 1991, with wide-ranging changes in sectoral composition (Kumar, 2005). The shift has been from the primary to the secondary to the service sector. Within manufacturing, FDI stocks were the largest in chemicals industry during the mid-1990s. FDI stocks in food and beverages and the transport equipments industry became predominant in 2000.[9] Along with increase in FDI stocks, average firm-level export intensity across manufacturing sectors in India improved during post-reforms, especially after the year 2000. The average intensity for manufacturing, as is evident in Table 1, increased from 0.10 in 1990s to 0.15 in 2000s.

The sectors considered for the purpose are food and beverages, textiles, chemicals, metal and metal products, machinery and transport equipment industries, which account for about 70 per cent of India's merchandise exports. The choice of these industries also gives us the insight about post-reform export performance of low technology industries in comparison to the medium and high tech industries. This analysis is carried out using Prowess Database of the Centre for Monitoring Indian Economy (CMIE).

Table 1: Firm-level Average Export Intensity in India during Post-Reforms

Year	Food & beverages	Textiles	Chemical	Ferrous Metals	Non - Ferrous Metals	Electrical Machinery	Electronics	Non Electrical Machinery	Transport Equipments	All industries
1990s	**0.24**	**0.22**	**0.09**	**0.04**	**0.13**	**0.06**	**.007**	**0.07**	**0.10**	**0.10**
2000s	**0.28**	**0.29**	**0.18**	**0.04**	**0.26**	**0.07**	**0.01**	**0.12**	**0.11**	**0.15**

Source: Calculations based on CMIE, PROWESS database.

[9] See Chakraborty and Nunnenkamp (2008) for industry specific FDI stocks.

The average export intensity for food and beverages, textiles, chemicals, non-ferrous metals and non-electrical machinery industries as a whole, increased after 2000.[10] Average export intensity of chemicals and non ferrous metals doubled in the decade of 2000s over the decade of the 1990s. The average export intensity in chemicals increased from 0.07 in 1991 to 0.28 in 2010, with drugs and pharmaceutical industry accounting for the largest share along with a better performance than the sectoral average. It is important to mention here that foreign investments up to 100 per cent have been allowed since December 2001 (Kumari, 2007). The improvements in export intensity in textiles can largely be due to the potential benefit during the post-MFA regime. Such improvements in textiles, though slow in comparison to China, is impressive because it occurred despite, among other factors, low productivity, technological obsolescence, low scale of operation, rigid labor laws (Tewari, 2005).

On the other hand, the corresponding improvements are relatively small for electrical machinery and transport equipments[11]. Despite improvements, the average export intensity for electronics continues to remain low in the decade of 2000. This pattern is also true for ferrous metals, which is despite substantial increase in export intensity of steel products (Table A.1) [12].

There are further nuances underlying improvements in performance. It is important to understand whether export performance depends on ownership[13] of firms, given the common perception that foreign firms perform better than the domestic firms especially during post

[10] Calculation for the weighted average export intensity for each broad category of industry has been done taking the 2000 as the base year, as this was a normal year and post-reform export intensities across products are found to have improved since this year. The export share of each sub category within each industry for the year 2000 is taken as the weight.

[11] Transport equipments show an increase in export intensity, particularly after 2003. This is of particular importance as many joint ventures have been set up in India with foreign technical and financial collaboration with leading global manufacturers.

[12] China is one of the major iron and steel markets accounting for about 32 per cent of India's total exports of these products in 2006.

[13] Ownership in our analysis is not related to equity shares, as the equity data for firms are not available for the entire time period under consideration. Again, we could not use dummies as in that case we could not have dealt with the fixed effect specifications.

reforms. Table 2 reveals differences export performance between foreign firms and their domestic counterparts across manufacturing sectors. While foreign firms have significantly higher average export intensities than domestic firms, domestic firms in chemicals, metal and metal products and textiles industries are found to significantly perform better than foreign firms. However, the differences in the average export intensities between the two ownership categories

Table 2: Ownership-wise difference in firm-level average export intensity

Industry	Mean export intensity of the domestic firms	Mean export intensity of the foreign firms	t value	Implication
Food and Beverages	2.49	.32	1.2	No significant difference
Machinery	.08	.12	5.4	Significant difference[b]
Metal and metal products	.41	.10	4.5	Significant difference[c]
Textiles	.23	.16	6.9	Significant difference[d]
Chemicals	.13	.12	2.03[a]	Significant difference[e]
Transport Equipment	.15	.05	1.24	No significant difference

Note:

- t values calculated using two-sample (export intensity of the domestic and the foreign firms)mean comparison test with unequal variances.
- H_0: mean (export intensity of domestic firms)- mean (export intensity of foreign firms)=0
  H_A: mean (export intensity of domestic firms) - mean (export intensity of foreign firms)≠0
- For large sample the critical t value at 5% level of significance is 1.96 and at 1%level is 2.57.
- a: Null hypothesis rejected at 5% level but accepted at 1% level.
- b: Ha: diff < 0 , Pr(T < t) = 0.0000
- c: Ha: diff > 0,Pr(T > t) = 0.0000
- d: Ha: diff > 0,Pr(T > t) = 0.0000
- e: Ha: diff > 0, Pr(T > t) = 0.039

of firms in the food and beverages and the transport equipment industries. These findings of no better performance of foreign over domestic enterprises in the food and beverages, transport equipment, chemical, textile and the metal and metal product industries in India are in conformity with that of Kumar (1990), Pant (1993), and Siddharthan (1994).

On the whole, firm-level export intensity across manufacturing industries in India shows an increase in the post reforms period particularly after 2000. The industries that show an improvement are chemicals, food and beverages, textiles, non-ferrous metals, electrical machinery, non-electrical machinery and transport equipments. Electrical machinery and

transport equipments industries are however exceptions to this pattern. In particular, the improvements are spectacular for high/medium technology industries as chemicals and non-ferrous metals. For low technology industries like food and beverages and textiles, the improvements are noteworthy. Further, export intensities of multinational enterprises are not significantly higher than that of their domestic counterparts across industries with the sole exception of machinery. On the other hand, domestic firms show better performance than foreign-controlled ones. The above observations call for an analysis of determinants of firm-level export performance. The analysis that follows also show whether ownership pattern explains the difference in firm-level export performance across industries.

3 Determinants of firm level export performance

3.1 *Analytical framework*

MNEs not only bring in capital investment but also prove to be beneficial to the host country as they possess product/ process technology, marketing and managerial skills etc. and use the host country as export platform. MNEs can also potentially help the domestic firms particularly in terms of exporting. These perspectives with regards to MNEs help develop the framework for analyzing firm-level export performance in an emerging market economy. Aitken et al. (1997**)** tests the hypothesis that MNEs act as export catalysts to indigenous firms. Recent empirical evidence however reflects that heterogeneity of firms is crucial in understanding firm-level performance as well as international trade (Bernard, Eaton, Jensen and Kortum (2003), Melitz (2003), Helpman, Melitz and Yeaple (2004), Melitz and Octaviano (2008), Yeaple (2005)). Heterogeneity can be explained in terms of productivity of firms as well as in terms of

fixed/sunk costs of exporting. Schmitt and Yu (2001) present a model where they explain that heterogeneity comes from specific costs rather than marginal costs.

The model that follows is essentially a supply side one based on Aitken, Hanson and Harrission (1997). Aitken et al. (1997) analyzes the decision of a representative domestic firm to choose between serving the domestic market, to export in the foreign market or to do both in order to maximize profit. The profit function of a typical firm, which depends on prices, the quantities sold in the domestic and the foreign market and the costs, is as follows:

$$\Pi = p_d q_d + p_f q_f - h(q_d + q_f) - m(q_d) - m(q_f) \qquad (1)$$

$$st, q_d, q_f \geq 0$$

The subscripts d and f are for the domestic and the foreign markets respectively. The costs in this framework are divided into three categories. The $h(.)$ function signifies the production costs. As production cost is independent of the market the commodity is sold, h is a function of $(q_d + q_f)$. The cost of distribution, as Aitken et al. (1997) put forth, varies according to destination and it is assumed that domestic distribution costs are lower than foreign distribution costs. $m(q_d)$ and $m(q_f)$ respectively represent the cost of distribution in the domestic and foreign markets. The representative firm maximises profit Π. The cost function in Equation (1), as specified by Aitken et al. (1997), is as follows:

$$h(q_d + q_f) = a/2 * (q_d + q_f)^2 + g(q_d + q_f) \text{ and,} \qquad (2)$$

$$m_i(q_i) = 1/2 * b_i {q_i}^2 + c_i q_i$$
$$i = f, d$$
$$where, g = g(X, \Omega, \Psi)$$
$$c_d = c_d(X, Z_d)$$
$$c_f = c_f(X, Z_f, \Gamma_{EX}, \Gamma_{MNE})$$

X is the cost common to both markets. There are also specific market costs represented by Z_i. $\Gamma_{EX}, \Gamma_{MNE}$ are respectively total export activity and total MNE export activity. Ω and ψ respectively imply competition effects and imitation/demonstration effects. a, g, b_i, c_i are scalar parameters.

Given the data limitations, the above model by Aitken et al. (1997) is modified to exclude market specific costs. In this model, sunk cost of production and distribution incurred by the representative firm is included. For instance, a firm's R&D expenditure is treated as the sunk cost of production, and the costs borne by the firm for advertising, creating export infrastructure, developing market channels are sunk costs of distribution. The profit maximizing function of representative firm can be written as:

$$\Pi = p_d q_d + p_f q_f - h(q_d + q_f) - s \qquad (3)$$

where s is lump sum sunk cost of production and distribution.

Profit maximisation gives rise to the export function. Here exports not only depend on the sunk costs of production and distribution, other supply side factors like size and age of a firm, productivity, import of technology and in-house R&D, and ownership of a firm play important roles. We also attempt to establish a case where exporting activity of MNEs may lead to reduction in costs of exporting by the domestic firm. This in turn explains export spillovers. In what follows is a detailing out of various factors that determine firm-level export performance and spillovers.

3.2.1 *Firm size*

Firm size is often considered to be a proxy for the resource base, risk perception and economies of scale that determines the export attitude and performance of the firm (Kumar and Pradhan, 2003). Smaller firms with their resource constraints are mostly scale inefficient, while larger firms can exploit economies of scale. A positive relationship between firm size and export performance is thus expected. The empirical literature however has mixed findings on the relationship between firm size and export performance[14]. Some studies including Bonaccorsi, (1992), Kumar and Sidhharthan (1994), and Sterlacchini (2001) establish a nonlinear relationship. In view of the presence of this possible nonlinearity our analysis considers a nonlinear relationship between size and firm-level export performance.

3.2.2 *Age*

Age of a firm is often used in the literature to capture the extent of a firms' learning experience leading to greater experimental and tacit knowledge. Older firms also might have superior cost structure, as they are experienced from exporting and therefore able to bear the sunk costs of exporting. Age of firms is considered to be positively associated with exporting (Rasiah, 2003; Iyer, 2010). In our study we consider age of a firm to be positively related to export intensity. Age is represented by the number of years the firm is in operation since inception.

[14] For instance, Bernard and Jensen (1999), Bernard and Wagner (1997) establish a linear relationship, and Kumar and Siddharthan (1994), Bernard and Wagner (2001) establish a nonlinear relationship.

3.2.3 *Productivity*

Empirical works find that trade forces least productive firms to exit [see, among others, Aw, Chung and Roberts (2000) and Clerides, Lack and Tybout (1998)]. These works imply that a few productive firms within a sector, which expect a profit stream sufficiently high to cover the sunk costs of entry into a foreign market, find it profitable to export. Following Melitz (2003), models postulate that firms are heterogeneous and only productive firms self select into export markets. In order to incorporate heterogeneity of firms in our model, following the literature we use firm productivity. We postulate that firm-level export performance is positively related to productivity.

3.2.4 *Research and Development*

In an increasingly knowledge based world, technological capacity is seen as an important component of a country's international competitiveness and growth (Kumar & Aggarwal, 2005), and in most cases the government emphasizes on improving the innovative capacity of the enterprises which is often referred to as techno-protectionism (Kumar & Sidhharthan, 1997). It is believed that with research and development[15] a firm becomes cost competitive and thereby has an improved export performance (Fargerberg, 1988; Soete, 1981). Firm-level studies on Indian manufacturing [for instance, Aggarwal (2001), Kumar and Sidhharthan (1994), Patibandala (1995), Hassan and Ralini (2002)] also focus on export augmenting role of R&D expenditure. In

[15] A complex debate exists in literature regarding the relationship between imports of foreign technology and undertaking R&D by the manufacturing enterprise. Some studies explain a complementary relationship while others argue substitution (Kumar and Aggarwal, 2005). Most studies have dealt with disembodied technology imports and R&D expenditure. In case of India a complementary relationship is found between technology imports and R&D expenditure in most of the cases (Lall, 1983, Katrak, 1989, Kumar, 1987, Aggarwal, 2000). It is believed that when knowledge is imported, further research is taken up by the enterprises to absorb and adapt the imported knowledge. Without in-firm research and development and local adaptation of foreign technology, it does not confer cost effectiveness on firms automatically. Embodied knowledge can also aid R&D activities of a firm (Basant, 1997). Following this we would consider complementarity between import of foreign technology and local R&D.

our study, we postulate in-house R&D as a determinant of export performance. The expenditure of a firm on research and development is basically sunk in nature. Since cost functions are inherently nonlinear, we postulate a nonlinear relationship between R&D expenditure and export performance of a firm.

3.2.5. ***Import of technology***

For most developing countries, research and development is mainly adaptive rather than fundamental in nature and, since the late sixties, most developing countries have relied extensively on technology import (Kathuria, 1998). In countries like India, import of technology forms one of the major channels through which knowledge is acquired. Technology can be imported in both embodied and disembodied forms. Embodied technology is imported in the form of raw materials, intermediate goods and mostly capital goods, while imported disembodied technology includes patented knowledge, technical know-how, drawings and designs etc. It is believed that imported technology makes a firm cost competitive. We hypothesize that, in the post-reforms period, imports of technology, embodied and disembodied are likely to positively impact on firm-level exports. The relationship can possibly be non-linear as well. In this analysis three variables, namely, imports of raw materials, import of capital goods, foreign technical know-how to account for both embodied and disembodied technology imports are considered. Further, foreign technical know-how and import of capital goods are summed up to arrive at a new variable, import of foreign technology.

3.2.6 *Specific costs*

Exploring a foreign market requires strong marketing and distribution networks. If a firm incurs expenditure on marketing and distribution, advertises for its product then it might attain cost competitiveness in exporting its product in a foreign market. Hence, in our model we have considered advertising expenditure, marketing expenditure, and distribution expenditure as determinants positively influencing export performance. The data on firm-level expenditure on advertising, marketing and distribution show a wide heterogeneity among the firms. As a result, we expect non-linearity. For the purpose of our analysis and to avoid multicollinearity, expenditures on marketing, distribution and advertising are added up to arrive at a single variable, marketing and distribution costs.

3.2.7 *Availability to Credit*

There are empirical studies, which explain the trade- finance linkage and show the impact of credit constraints on firm's export performance[16]. There is also a growing body of recent theoretical literature that looks at the impact of credit market imperfections on firms within the Melitz (2003) framework [e.g. Chaney (2005); Helpman, Melitz and Rubenstein (2006); Manova (2008)]. The main results of these studies show that in addition to heterogeneity of firms in terms of productivity and capability to overcome sunk costs, credit constraints also affect exports of firms. In the Indian context, Kapoor, Ranjan and Raychaudhuri (2011) have established a causal link from credit constraints to real outcomes of exporting firms following two exogenous policy changes in India that affected the availability of subsidized credit to small firms. This study takes into account availability of credit to a firm to impact on its export intensity. We hypothesise that higher credit availability leads to better firm-level export performance.

[16] See Mirabelle (2008) for Belgian firms, Greenaway, Guariglia and Kneller (2008) for UK firms and Paravisini, Rappaport, Schnabl and Wolfenzen (2011) for Peruvian firms.

3.3 *The Estimation Model*

The estimation model, in its general form, is:

$$EXPI=\alpha_0 + \alpha_1(SIZE)+\alpha_2(SIZE)^2+ \alpha_3(IMPR)+ \alpha_4(IMPR)^2+ \alpha_5(KI)+ \alpha_6(KI)^2+ \alpha_7(FPTR)$$

$$+ \alpha_8 (FPTR)^2+ \alpha_9(MKTCOST)+ \alpha_{10}(MKTCOST)^2+ \alpha_{11}(AGE)+ \alpha_{12}(PDTIVITY)$$

$$+ \alpha_{13} (PDTIVITY)^2+ \alpha_{14} (CRDT) + \alpha_{15}(RDI)+ \alpha_{16} (RDI)^2 + u_{it} \quad (4)$$

where $\alpha_{i,\ i=1\ to\ 16} > 0$

SIZE: Ratio of firm sales to industry sales.

IMPR: Ratio of imports of raw materials to sales.

KI: Ratio of imports of capital goods to sales.

FPTR: Ratio of technical fees and royalties paid abroad to sales.

MKTCOST: Sum of ratio of advertising expenditure to sales, ratio of marketing expenditure to sales and ratio of distribution expenditure to sales.

AGE: Absolute age of the firm in number of years.

PDTIVITY: Ratio of value of output to salaries and wages.

CRDT: Ratio of total borrowing to value of output.

RDI: Ratio of R&D expenditure to sales.

The model showing spillovers can be specified as:

$$DOMX=\alpha_0 + \alpha_1(SIZE)+\alpha_2(SIZE)^2+ \alpha_3(IMPR)+ \alpha_4(IMPR)^2+ \alpha_5(KI)+ \alpha_6(KI)^2+ \alpha_7(FPTR)$$

$$+ \alpha_8 (FPTR)^2+ \alpha_9(MKTCOST)+ \alpha_{10}(MKTCOST)^2+ \alpha_{11}(AGE)+ \alpha_{12}(PDTIVITY)$$

$$+ \alpha_{13} (PDTIVITY)^2+ \alpha_{14} (CRDT) + \alpha_{15}(RDI)+ \alpha_{16} (RDI)^2 + \alpha_{17} FOR + u_{it} \quad (5)$$

where $\alpha_{i,\ i=1\ to\ 17} > 0$, and $\alpha_{17} > 0$ indicates positive export spillovers

DOMX: Export intensity of domestic firms.

FOR: Average Export intensity of foreign firms.

3.4 *The Method and Data*

In our analysis we have used the Ordinary Panel data estimation technique. To estimate time series and cross sectional data in a single equation framework, Panel data estimation technique is widely used in literature. It helps to simultaneously accommodate large volume of data set across time and distinguishes between time-series movement and cross-sectional movement of the data.

For estimation purposes[17] of the model, both Fixed and Random effects specifications are considered. When cross-sectional heterogeneity is correlated with the other explanatory variables of the model, then fixed effect model provides an efficient estimator. On the other hand, if the unobserved cross-sectional heterogeneity is assumed to be uncorrelated with other explanatory variables of the model, then random effect model provides efficient estimator of the parameters. In our model, the Hausman Specification test is taken into consideration to distinguish between fixed and random effects. Both the fixed and random effects estimators are efficient Feasible GLS estimators. The significance of F statistic and the Wald statistic for the fixed and random effects respectively suggest that the explanatory variables significantly explain variations in the dependent variable, which in this case is export intensity. The problem of multicollinearity is avoided by studying the correlation matrices.

Firm-level data is obtained from Prowess Database published by the Centre for Monitoring Indian Economy (CMIE) for the period 1991-2010 for the food and beverages, textiles, chemicals, metal and metal products, machinery and transport equipments industries. Statistical information are collected only for exporting firms in this database. A total of 204 observations for the Food & Beverages industry, 763 observations for the textiles and garments

[17] The estimation is done using statistical software STATA 10.

industry, 1830 observations for the chemicals industry, 219 observations for the metal and metal product industry, 972 observations for the machinery industry and 439 observations for the transport equipments industry are thus obtained. These observations include both domestically owned and foreign owned firms. Panel structures for each of the six industries are constructed over a period of twenty years. In what follows is a discussion of the findings from various estimations of model (3) for the food and beverages, textile and clothing, chemicals, metal and metal products, machinery and transport equipment industries.

4 *The Empirical Results*

The panel data estimation results of equation (4) showing the determinants of firm-level export performance are presented in Table 3. Both fixed and random effect results are considered depending on the Hausman specification test results. If the individual time invariant effects are correlated with the time varying independent (exogenous) variables then fixed effect method is consistent. On the other hand, if the time invariant effects are uncorrelated with the independent variables then random effect model is consistent and efficient. Our estimation exercise shows fixed effect estimators to be efficient for the food and beverages, textiles, chemicals and transport equipment industries, while random effect estimators are efficient for machinery and metal products. The F and the Wald statistic for fixed and random effects respectively suggest that the explanatory variables significantly explain the variations in firm-level export intensity. The model thus fits the data well for all industries as well as across sectors.

Table 3 reflects that the Indian manufacturing industries heavily depend on imported raw materials and foreign technological know-how for exporting. However, local R&D and the age of the firms are also crucial in explaining the export performance of the Indian firms. The various factors that explain export performance across industries are as follows.

Table 3: Determinants of firm-level export performance

	Food and Beverages	Textiles	Chemical	Transport equipment	Machinery	Metal and metal products	All industries
	Fixed effect results	**Fixed effect results**	**Fixed effect results**	**Fixed effect results**	**Random effect results**	**Random effect results**	**Fixed Effect results**
SIZE	1.69 (0.07)	41.05 (0.81)	**.194.39*** (4.08)	-33.12 (-1.60)	-.0006 (-0.03)	**58.63*** (4.26)	.002 (0.87)
$SIZE^2$							
AGE	.028 (0.15)	.115 (0.58)	**.5919*** (7.40)	**.694*** **(**8.48)	.042 (0.84)	**.641*** (5.58)	**.312*** (6.03)
IMPR	2.6 (0.05)	**.168*** (4.60)	**7.07*** (4.71)	-1.24 (-0.19)	**.047*** (2.80)	.019 (0.41)	**.055*** (4.87)
$IMPR^2$		**-.00003*** (-4.65)		**7.62**** **(**1.89**)**	**-.00001*** (-2.19)	-.0006 (-0.47)	**-.00001*** (-4.93)
TECH	71.07 (1.43)	**75.61*** (3.54)	**37.13*** (4.24)	**-13.97*** (-3.05)	4.95 (0.75)	**74.22***** (1.76)	**5.54**** (2.15)
$TECH^2$		**-50.76*** (-3.03)	**-.901*** (-4.22)				**-.135**** (-2.14)
MKTCOST	**314.97*** (3.23)	**68.04*** (3.85)	128.26* (7.86)	**264.12*** (6.20)	**52.17**** (2.75)	-.271 (-0.29)	.009 (0.06)
$MKTCOST^2$	**-1617.19*** (-2.94)	**-22.14*** (-3.57)	**-353.41*** (-8.59)	**-1452.4*** (-5.15)	**-153.12*** (-2.50)	.0034 (0.26)	
RDI	--351.07 (-0.26)	154.3 (0.21)	**34.7*** (1.78)	132.94 (0.85)	-44.2 (0.35)	.964 (0.14)	**60.2*** (3.14)
RDI^2			**-11.65*** (-1.86)				**-19.7*** (-3.19)
PDTIVITY	.001 (0.17)	.010 (1.38)	-0.14 (-0.96)	-.054 (-0.61)	**.011*** (1.72)	.001 (0.48)	.002 (0.76)
$PDTIVITY^2$			6.35 (0.91)	.0004 (0.56)			
CRDT	.028 (1.08)	-.007 (-0.24)	-1.23 (-0.22)	**1.82*** (3.80)	-.0002 (-0.19)	.002 (0.14)	-5.67 (0.92)
$CRDT^2$				**-.054*** (-0.61)			
R^2 (overall)	0.10	0.002	0.002	0.18	.05	0.26	.0001
F/wald statistic	1.64•	25.69•	34.32•	148.65•	21.12••	73.61•	7.45*
Hausman test X^2	18.77**	35.88*	51.33*	84.06*	5.61	3.25	44.18*
Number of observations	204	763	1830	439	972	219	4386

Note: 1. t/z values are provided in parentheses

2. * denotes 1% level of significance, ** denotes 5% level of significance, *** denotes 10% level of significance.

4.1.1 *Firm size*

It is found that size turns out to be significant in impacting on firm-level export performance of chemicals and metal industries (see Table 3). Both of these industries are medium or high tech industries. The relationship is however linear which is not in conformity with the earlier works of Kumar and Siddharthan (1994) and Bernard and Wagner (2001) for German manufacturing firms.

4.1.2 *Age*

Our estimation results show that Age of the firm, measured in terms of number of years in operation since inception plays a significant role in determining the firm-level export behaviour of the high tech industries like Chemicals, metals and metal products and transport equipments. These industries are medium or high technology industries. This suggests that older firms have acquired the capability to penetrate in the world market. For firms in low technology industries like food and beverages and textiles, on the other hand the relationship between age and export intensity remains insignificant. This might suggest that post reforms low old technology industries of Indian manufacturing are concentrating more on the domestic markets (Kumar and Pradhan, 2003), whereas older medium /high technology firms have become globally competitive.

4.1.3 *Productivity*

Firm productivity is one of the major ways to explain firm heterogeneity. Estimation results show that productivity of firms is significant in explaining the variations in firm-level export intensity in the machinery industry. For the food, textiles and metal industry the

relationship is positive though not significant. These results are in conformity with low productivity in most manufacturing industries during this period. These results however do not conform to the pattern as shown in the theoretical conjectures by Melitz(2003).This is despite the fact that technology variables are found to be significant determinants of firm-level export intensity.

4.1.4 *Research and Development*

As expected, the impact of research and development intensity (RDI) is positive and statistically significant on firm-level exports of chemicals. Non-linearity holds good in this relationship. As chemicals industry is a knowledge-based research and development turns out to be significant along with technology imports. R&D and technology imports play a complementary role in acquiring global competitiveness. This result is in line with the evolutionary school of thought, which suggests that building up own technological capabilities is essential for competitiveness. However, RDI is not significant in explaining the export intensity of the food, textile, machinery, metal & metal product and the transport equipment industries.

4.1.5 *Import of technology*

Import of raw materials capital goods and foreign technology by firms is one of the major sources of acquiring knowledge from rest of the world and in achieving cost competitiveness by by using frontier technology and cheaper inputs. Being better in quality than the local available substitutes, imported raw materials and capital goods improve global competitiveness of firms and thereby impact on export positively. Disembodied foreign technology aids the process. It is found that for exports of textiles, chemicals, machinery and the transport equipment import of

raw materials (IMPR) has significant positive impact on firm-level export intensity. This is as per our expectation as most of these industries except textiles are knowledge based industries and they crucially depend on imported raw materials to be globally competitive. A significant non-linear relationship between import of raw materials and export intensity exists in case of textile, machinery and transport equipment industry. For the transport equipment industry the relationship is U shaped, while for the textile and the machinery industry it is inverted U shaped. This implies that there is a threshold beyond which the export intensity either rises or falls with import of raw materials. Import of capital goods (KI) is another important way to bring in foreign knowledge in embodied form and foreign technology (FPTR) brings in foreign design, technological expertise and knowledge in disembodied form. In our analysis, KI and FPTR are clubbed together as TECH and also used separately (See Appendix). With the exception of the food & beverages and machinery TECH turns out to be significant in explaining export performance. Non-linearity also exists in the relationship between TECH and export intensity for medium technology industries like textiles and chemicals. For transport equipments TECH is negative and significant. However, as shown in Appendix Table A.5, KI and FPTR significantly explain export intensity of transport equipment in a non-linear way.

4.1.6 *Specific costs*

In this study advertisement, marketing and distribution cost (MKTCOST) explain the sunk cost incurred to penetrate in the foreign market. We find that, as hypothesized, MKTCOST turns out to be positive and significant for all the industries excepting metals and metal manufactures. Non-linearity in the relationship exists in most cases where $MKTCOST^2$ is negative and significant. While firm-level sunk cost like in-house R&D does not impact on exports in a significant way, expenditures on advertising, marketing and distribution networks

become important in exporting across most industries. It is important to note here while the later has significantly increased over the years, the former continues to remain low in most industries. These results conform to the theoretical conjecture that firms are heterogeneous in terms of sunk costs and the capability of overcoming this sunk cost of entering a foreign market is quite an important factor to explain export intensity.

4.1.7 *Credit availability*

Availability of credit is found to be significantly affecting the export intensity of transport equipment industry. Thus the trade-finance linkage empirically suits well for this industry .We also find presence of non-linearity in the relationship between credit availability and export performance in this sector. However, in addition to heterogeneity in firm productivity and the presence of sunk costs, credit availability does not contribute much in the exporting behavior of the overall Indian manufacturing.

4.2 *Export Spillovers*

For the analysis of export spillovers we have segregated the firms according to ownership patterns as domestic and foreign enterprises for machinery, transport equipment, food and beverages and chemical industries. Textiles and metal and metal products are excluded as the database does not indicate any firm to be of foreign ownership in these sectors. The only way to get rid of such a problem relating to data is to look into the equity structure, which in the present analysis could not be done on account of lack of information for the entire period. Considering the number of foreign firms exporting each year we have calculated the average export intensity of the foreign firms (FOR) over the years 1991-2010 for each industry. While estimating export

spillovers we postulate that the positive impact of foreign firms' exporting behavior on the exporting behavior of the domestic firms is indicative of export spillovers from foreign to domestic enterprises. As specified in equation (4) we have considered FOR being one of the variables determining the domestic firms' export intensity (DOMX). We have a cross section of 228 domestically owned firms for food and beverages, 1601 firms for chemicals, 893 firms for machinery, and 610 firms for transport equipments industries. Both fixed and random effects are used in estimation. The Hausman specification test for the two effects is also carried out. However, since we are studying four separate industries, which by nature are widely different, the model specification has been changed depending upon the industry concerned. The export spillover results are presented in Table 4.

The indirect approach to the theory of spillovers explains some important channels of spillovers namely competition, demonstration and imitation and information externalities. The direct approach on the other hand relates to spillovers that are directly linked to foreign presence. From the estimation results presented in Table 4 it is evident that FOR have significant positive effects for the chemical-exporting firms. This suggests presence of export spillovers from foreign to domestic firms in this industry. For most other industries FOR remains positive though insignificant. This implies that inflow of FDI and improved exporting activities of foreign firms do not necessarily augment exporting activities of domestic firms in the Indian manufacturing. Rather, the other controlling factors like in-house R&D, marketing and distribution costs and import of raw materials explain the export performance of the domestic firms.

As MNCs are equipped with better technology, it puts added pressure on domestic firms to remain competitive. Thus competition from foreign affiliate can have positive spillover effect on the domestic firms. Hence upgradation of existing technology becomes important for the

Table 4: Determinants of firm-level export spillovers

	Machinery	Transport equipment	Food & Beverages	Chemicals
	Fixed effect results	**Fixed effect results**	**Random effect results**	**Random effect results**
FOR	.009 (0.07)	-11.9 (-0.52)	.078 (0.24)	**.383**** (2.56)
SIZE	-.0005 (-0.28)		2.64 (0.07)	**252.06*** (3.39)
$SIZE^2$				**-473.58**** (-2.56)
AGE	.017 (0.30)	**.654*** (5.28)	.004 (0.04)	
IMPR	**0.53*** (3.07)	-1.87 (-0.47)	76.25 (0.56)	**8.32*** (5.08)
$IMPR^2$	**-.00001*** (-3.06)		-632.47 (-0.56)	
TECH	-.396 (-0.06)	.134 (0.05)	102.08 (0.81)	14.77 (1.54)
$TECH^2$		-.0001 (-0.04)		-.305 (-1.52)
MKTCOST	9.80 (1.02)	**210.45*** (4.45)	**306.97*** (3.76)	**23.95**** (2.29)
$MKTCOST^2$		**-1128.02*** (-3.87)	**-1646.86*** (-3.30)	
RDI	-40.3 (-0.80)	135.37 (10.72)	-58.17 (-0.02)	**5.03**** (2.25)
RDI^2				**-16.08**** (-2.24)
PDTIVITY	.009 (1.42)	-.024 (-0.67)	.001 (0.16)	-.025 (-1.59)
$PDTIVITY^2$		**.0002*** (4.20)		9.89 (1.36)
CRDT	-.0002 (-0.15)	.089 (0..21)	.020 (0.79)	-1.84 (-0.32)
$CRDT^2$		-.0007 (-0.23)		
R^2 (overall)	0.03	0.12	0.14	0.03
F/wald statistic	12.75•	11.48•	27.74••	71.47•
Hausman test Chi square	2.34*	123.29*	2.58	2.30
Number of observations	893	610	228	1601

Note: 1. t values are provided in parentheses

2. * denotes 1% level of significance, ** denotes 5% level of significance, *** denotes 10% level of significance.

domestic firms to face the competition from the MNCs. This may be one of the reasons why R&D significantly explains the export intensity of the domestic chemical firms. However, there are other factors as well that strongly determines exports of most domestic firms. Exporting requires very strong distribution networks, good infrastructure and linkages, knowledge of the consumers' tastes and preferences, regulatory arrangements in overseas markets etc. Investment in advertising, marketing and distribution gives the Indian domestic firms in the transport equipment, food and beverages and chemical industries an edge in exporting. Again, domestic firms learn to export from the MNCs. This is perhaps true for the transport equipment firms who have foreign collaborators. Therefore, older firms with high productivity are better performers. So, not much of a direct spillover effect is felt in this sector either. For the machinery industry heavy dependence on the imported raw materials is the major driving force.

5 Conclusions and Implications for Policy

In the present study we made an attempt to understand the behaviour of firm-level export intensity in Indian manufacturing in the post reforms era. We identified the factors that determine export performance of Indian manufacturing highlighting on whether foreign ownership is important for export performance. Further, we investigated whether exporting activity of the MNEs has spillover effects on exporting behaviour of the domestic firms. Panel data estimation technique has been used for the empirical analysis.

The study establishes rising average export intensity across Indian manufacturing industries including food and beverages, textiles, chemicals, metal and metal products, machinery and transport equipment since 1991, in particular after 2000. This has happened

particularly in conjunction with rising FDI across sectors. Such stylized facts led us to inquire into, in particular, whether firm level exports have responded to foreign direct investment.

Evidence from the estimation results show that with liberalization the manufacturing industries for almost all technology groups have grown competitive with the import of raw materials, foreign capital good, capability to bear sunk costs and technical know-how. This is true for both the medium and high tech industries. Firm productivity and availability of credit do also play significant role in the high tech industries like machinery and transport equipments. Size also plays a major role particularly for the high tech industries. However, these results have a possibility of improvement with dynamic panel data estimation. The evidence of varying performance across sectors is indicative of the continuing existence of various constraints operating in each sector, which by itself creates a case for industrial policy interventions.

Even though there can be several possible spillover channels, we investigated into direct export spillovers from MNEs to domestic firms in India. Estimation results show significant presence of direct export spillovers only in the chemical industry. With an exception of the machinery industry, average export intensity of domestic firms are higher that for MNEs, and hence, that explains insignificant direct spillovers across most industries. The better performance of domestic enterprises is largely a result of import of raw materials and foreign knowledge and technical know-how. The capability to cover sunk costs by domestic firms also turns out to be very significant. However, excepting the chemical industry not much of in-house R&D has promoted export. This can be one of the major areas of policy concern. The process of liberalization thus played a strong role in augmenting exports from India and there is evidence of FDI having some spillover effects on domestic firms.

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Appendix Table A.1

Industry	Export intensity	
Ferrous metals	**Pre 2000 average**	**Post 2000 average**
Casting & forging	0.11	0.16
Metal product	0.11	0.11
Pig Iron	0.04	0.04
Sponge Iron	0.00	0.01
Steel	0.07	0.12
Steel, tubes & pipes	0.08	0.17

Calculations based on PROWESS database, CMIE.

Table A.2: Weighted Average Export Intensity

Year	Food & beverages	Textiles	Chemical	Ferrous Metals	Non - Ferrous Metals	Electrical Machinery	Electronics	Non-Electrical Machinery	Transport Equipments
1991	0.13	0.15	0.07	0.05	0.10	0.04	0.00	0.07	0.09
1992	0.21	0.18	0.08	0.05	0.11	0.05	0.00	0.07	0.10
1993	0.27	0.19	0.08	0.05	0.15	0.05	0.01	0.07	0.11
1994	0.29	0.19	0.09	0.05	0.14	0.08	0.01	0.08	0.12
1995	0.27	0.22	0.10	0.04	0.12	0.07	0.01	0.07	0.12
1996	0.28	0.24	0.11	0.04	0.12	0.06	0.01	0.06	0.10
1997	0.25	0.26	0.11	0.04	0.16	0.06	0.01	0.08	0.10
1998	0.25	0.29	0.12	0.04	0.15	0.07	0.01	0.06	0.12
1999	0.26	0.30	0.12	0.04	0.12	0.07	0.01	0.08	0.12
2000	0.25	0.28	0.13	0.04	0.19	0.07	0.01	0.10	0.09
2001	0.32	0.29	0.14	0.04	0.22	0.08	0.01	0.10	0.10
2002	0.25	0.27	0.16	0.04	0.22	0.09	0.01	0.13	0.09
2003	0.27	0.28	0.17	0.04	0.24	0.08	0.01	0.11	0.11
2004	0.26	0.28	0.18	0.04	0.24	0.09	0.01	0.13	0.11
2005	0.26	0.30	0.20	0.04	0.26	0.07	0.01	0.14	0.11
2006	0.26	0.29	0.21	0.04	0.28	0.07	0.01	0.12	0.12
2007	0.29	0.34	0.24	0.04	0.37	0.07	0.01	0.14	0.13
2008	0.40	0.35	0.25	0.04	0.34	0.07	0.01	0.15	0.14

Note: Calculations based on PROWESS database, CMIE.

Table A.3: Determinants of firm-level export performance (considering linear relationship)

	Food and Beverages	Textiles	Chemical	Metal and Metal Products	Machinery	Transport
SIZE	-.019 (-0.01)	.513 (1.13)	5.12* (9.74)	.59 (0.59)	.137** (2.65)	-1.41 (-0.77)
IMPR	-.54* (-35.52)	.034 (1.37)	.006 (0.93)	.04** (1.91)	-.0005** (-1.6)	.013** (2.16)
KI	.003 (0.09)	.0004 (0.41)	-.268 (-0.50)	-.03 (-1.540	.0001 (0.37)	0.002 (1.32)
FPTR	.49 (0.07)	-.02 (-0.8)	.07 (0.23)	-.071 (-0.26)	-.003 (-0.96)	.249 (0.51)
ADI	-1.00* (-3.18)	-.77 (-2.07)	-4.06 (-2.01)	-5.5* (-11.73)	-.318* (-4.44)	0.73* (8.71)
MI	-2.25* (-7.09)	-.014 (-0.37)	-.103 (-0.00)	1.21 (0.41)	-.003 (-050)	.024 (0.99)
DI	7.81* (51.18)	.56* (2.86)	-.109 (-0.16)	33.8* (16.78)	.408 (6.11)	2.73* (18.97)
RDI	-.14 (-0.27)	.26 (0.31)	.011 (0.00)	64.72* (46.79)	-.015 (-0.73)	-.021 (-0.44)
R^2 (overall)	0.99	0.01	0.4	0.39	.003	0.25
F F/Wald Chi square	75555*	1.69***	182.36*	356.29*	7.13*	45.13*

Note: 1. t/z values are provided in parentheses

2. * denotes 1% level of significance, ** denotes 5% level of significance, *** denotes 10% level of significance.

Table A.4: Determinants of firm-level export spillovers (considering linear relationship)

	Food and Beverages	**Chemical**	**Machinery**	**Transport**
FOR	1.5* (3.13)	.005 (0.3)	0.45* (3.00)	.35* (5.02)
SIZE	-.06 (-0.02)		.051 (0.70)	
IMPR	-.57* (-28.30)	1.54* (8.62)	-.0006** (-1.74)	.024* (3.48)
KI	.355 (0.18)	-.001 (-0.15)	.0004 (0.97)	-.0005 (-0.49)
FPTR	.132 (0.02)	-.024 (-0.28)	-.002 (-0.62)	3.61 (0.98)
ADI	-1.3*** (-1.82)	1.5* (39.56)	-.46** (-2.05)	.048 (0.15)
MI	-2.77 (-5.52)	1.05* (30.87)	.322* (2.78)	.42* (3.51)
DI	8.3* (46.92)	-.79* (-30.40)	.54* (5.03)	2.92* (16.26
RDI	6.54 (0.26)	-.002 (-0.34)	.096 (0.58)	-.379 (-1.80)
R^2	0.99	0.24	0.02	0.28
F/Wald χ^2	82335.46*	289.21*	5.77*	40.35*

Note: 1. t/z values are provided in parentheses 2. * denotes 1% level of significance, ** denotes 5% level of significance, *** denotes 10% level of significance.

Table A.5: Determinants of firm-level export performance (considering KI, FPTR)

	Food and Beverages	**Textiles**	**Chemical**	**Transport equipments**	**Machinery**	**Metal and metal products**
	Fixed effect results	**Fixed effect results**	**Fixed effect results**	**Fixed effect results**	**Random effect results**	**Random effect results**
SIZE	-14.00 (-0.50)	40.15 (0.79)	**.194.23*** (4.08)	-33.12 (-1.60)	-.0005 (-0.03)	**56.56*** (3.86)
AGE	.046 (0.80)	.114 (0.58)	**.594*** (7.43)	**.704*** **(**7.33)	.044 (0.88)	**.763*** (5.87)
IMPR	1.88 (0.04)	**.169*** (4.62)	**7.07*** (4.71)	**-20.70.4**** (-2.47)	**.051*** (3.02)	
$IMPR^2$		**-.00003*** (-4.66)		**55.4*** **(**1.89**)**	**-.00001*** (-3.00)	
FPTR	284.09 (0.26)	-40.51 (-0.20)	.181 (0.64)	**-107.12*** (-3.06)	-87.56 (-1.61)	-384.38 (-0.91)
$FPTR^2$				**123.91**** (2.06)		
KI	70.44 (1.42)	**76.87*** (3.58)	**36.76*** (4.27)	**18.96**** (1.96)	6.40 (0.96)	66.08 (1.37)
KI^2		**-51.64*** (-3.06)		**-25.7*** (-3.35)		
MKTCOST	**315.5*** (13.24)	**67.75*** (3.83)	**128.43*** (7.88)	**259.21*** (6.22)	**50.66**** (2.67)	-.030 (-0.34)
$MKTCOST^2$	**-1637.6*** (-2.98)	**-22.04*** (-3.55)	**--354.42*** (-8.60)	**-1495.85*** (-5.52)	**-152.15*** (-2.48)	
RDI	-1753.32 (-0.95)	155.91 (0.83)	**34.52*** (1.77)	142.53 (0.95)	-47.03 (0.98)	-1129.64 (-2.31)
RDI^2			**-11.5*** (-1.84)			
PDTIVITY	.0008 (0.11)	.010 (1.38)	-0.14 (-0.96)	-.1036 (-1.13)	**.011*** (1.67)	.003 (0.81)
$PDTIVITY^2$			6.31 (0.90)	.0007 (1.02)		
CRDT	.028 (1.10)	-.007 (-0.24)	-1.23 (-0.22)	**-9.51*** (-5.03)	-.0002 (-0.19)	.007 (0.54)
$CRDT^2$				**2.55*** (5.23)		
R^2 (overall)	0.10	0.003	0.002	0.16	.04	0.33
F/wald statistic	1.60•	4.28•	16.71•	35.03•	24.13••	73.93•
Hausman test Chi square	15.30**	34.40*	51.66*	60.61	9.91	3.52

Note: 1. t/z values are provided in parentheses

2. * denotes 1% level of significance, ** denotes 5% level of significance, *** denotes 10% level of significance.

Table A.6: Determinants of firm-level export spillovers (considering KI, FPTR)

	Food & Beverages	**Transport equipment**	**Machinery**	**Chemicals**
	fixed effect results	**Fixed effect results**	**Random effect results**	**Random effect results**
FOR	.075 (0.21)	.39 (0.25)	.006 (0.05)	**.364**** (2.45)
SIZE	-38.6 (-0.74)	-11.74 (-0.51)	-.0005 (-0.28)	**238.85*** (3.21)
$SIZE^2$	37.31 (0.58)			**-447.67**** (-2.43)
AGE	.042 (0.21)	**.637*** (5.16)		
IMPR	12.49 (0.09)	-2.91 (-0.71)	.0199 (0.35)	**8.22*** (5.03)
$IMPR^2$	-100.1 (-0.09)		**0.58*** (3.33)	
KI	-60.66 (-0.48)	.131 (0.45)	**-.00001*** (-3.06)	**82.63*** (3.63)
KI^2	743.62 (1.11)	-.0002 (-0.04)	1.41 (0.22)	**-72.78*** (-3.30)
FPTR	381.78 (0.32)	-17.4 (-0.43)	**-113.04*** (-2.00)	-5.40 (-0.06)
$FPTR^2$	643.90 (0.02)		-	.136 (0.07)
MKTCOST	**292.29*** (3.25)	**211.5*** (4.48)	8,.26 (0.85)	**27.7*** (2.64)
$MKTCOST^2$	**-1464.20*** (-2.84)	**-1153.39*** (-3.97)		
RDI	1368.51 (0.34)	119.3 (0.64)	-43.093 (-0.80)	**47.64**** (2.15)
RDI^2	-603313.3 (-0.59)			**-15.32**** (-2.13)
PDTIVITY	.003 (0.46)	-.029 (-0.79)	.009 (1.36)	-.023 (-1.47)
$PDTIVITY^2$		.0002 (4.32)		9.06 (1.24)
CRDT	.021 (0.88)	.075 (0..18)	-.0002 (-0.16)	-1.72 (-3.30)
$CRDT^2$		-.0006 (-0.20)		
R^2 (overall)	0.07	0.12	0.01	0.03
F/wald statistic	1.19••	10.44•	16.83•	82.63•
Hausman test Chi square	17.13*	64.28*	5.37	12.79
Number of observations	228	610	893	1601

Note: 1. t/z values are provided in parentheses 2. * denotes 1% level of significance, ** denotes 5% level of significance, *** denotes 10% level of significance.