# Determinants of outward foreign direct investment: a study of Indian manufacturing firms

Ronny Thomas and K. Narayanan*

*In this paper we analyze the determinants of outward FDI (OFDI) with reference to Indian manufacturing firms. Mainly we examine the impact of firm-specific characteristics such as productivity, exports, imports of technology, and research and development (R&D) intensity on the OFDI of firms for the period from 1998 to 2009. We use dynamic random-effects Probit and Tobit models to examine the determinants of OFDI. The results support the theoretical argument that more highly productive firms undertake OFDI as a mode of internationalization. The study reveals a complementary relationship between OFDI and exports by Indian firms. R&D investment and imports of technology in the form of capital goods play important roles in both the probability of undertaking OFDI and the share of OFDI.*

*JEL Classification: F14, D21, F10, D24*
*Keywords: exporting, productivity*

## 1. Introduction

Many studies on international trade and investment highlight the fact that the liberalization of trade and equity ownership adopted by many countries during the late 1980s accelerated the growth of cross-border FDI flows. This worldwide liberalization of FDI norms encouraged Indian firms to undertake investment abroad as well. Following the experience of many countries, the Indian economy also witnessed rapid growth in outward FDI (OFDI) from the late 1990s. Indian firms generated revenue from foreign markets not only through exporting but also by investing in foreign markets in the form of OFDI[1] during this period. This outward investment started increasing in the latter half of the 1990s and maintained a phenomenal growth after 2000. In 2009, manufacturing accounted for almost 46 per cent of the total flow of OFDI from India. During this period, the share of manufacturing in the stock of OFDI

* Ronny Thomas (corresponding author) is Assistant Professor (Economics) at Rajagiri Business School (RBS), Kakkanad, Kochi- 682039, Kerala. E-mail: ronny@rajagiri.edu. K. Narayanan is Institute Chair Professor at the Department of Humanities and Social Sciences, Indian Institute of Technology Bombay, Mumbai. E-mail: knn.iitb@gmail.com.

[1] The nature of outward investment in India contrasts sharply with that in other developing countries in terms of sectoral composition and geographical destination (see Pradhan, 2007).

from developing countries remained about 13.5 per cent. The total stock of OFDI from India increased from 0.01 to 0.41 per cent of the world total during the period from 1990 to 2009 (see table A1 in the appendix).

The growth of OFDI and its changing pattern put forward several issues regarding the factors that determine OFDI from India. This paper addresses these issues by studying the determinants of OFDI from India in the context of the Indian manufacturing sector. Although there exist a number of studies pertaining to various economies, attempts to address the issue in the context of India remain limited. Against this background, the main objectives in this paper are first, to test whether the OFDI decision of firms depends on firm-level productivity; second, to test whether exports and OFDI are complements or substitutes in the Indian manufacturing industry; and third, to analyze the role of technological efforts in the form of R&D and technology imports in determining OFDI. This study is an improvement over previous studies in two aspects. First, in contrast to previous work, the empirical framework in this paper explicitly controls for unobserved heterogeneity and allows for endogenous initial conditions simultaneously by using dynamic Probit and Tobit models. Second, the study includes technology efforts (in terms of R&D and technology imports) as a heterogeneity factor other than firm-level productivity and examines the impact of this factor in determining the OFDI of Indian manufacturing firms.

The study is organized as follows: Section 2 discusses the theoretical reasoning and empirical literature. Section 3 discusses the methodology. Section 4 discusses the data sources, hypotheses and variables. Section 5 discusses summary statistics, and Section 6 puts forward the results of the regression analysis. Section 7 concludes with the findings.

## 2. Theoretical reasoning and literature review

The theoretical propositions put forward by Hymer (1976), by Caves (1971) and later by Dunning (1977) explain the major reason for the emergence of multinational enterprises and cross-border investments. The approach taken by Hymer (1976) and by Caves (1971) asserts the importance of intangible assets in determining the growth of multinational firms. Intangible assets such as technology, managerial skills and technology know-how determine the nature and ability of a firm to undertake cross-border investment. Dunning (1977), through his eclectic approach, highlighted ownership, location and internalization advantages as key factors determining the development and growth of multinational firms. The arguments put forward by Hymer (1976), Caves (1971) and Dunning (1977) have dominated the research on cross-border investment for many years. Most of the empirical studies that have been based on these theoretical propositions have highlighted the growing importance of firm-specific characteristics such as firm size and technology as important factors

determining outward investment from home countries (Blomstrom and Lipsey, 1991; Lall, 1983; Pradhan, 2004; Kumar, 2008).

However, in recent years, the theoretical literature has adopted formal models in which the primary drivers for internationalization choices are not industry characteristics such as intangible assets, transport costs, trade barriers and exchange rates but the heterogeneity in firm-level productivity (see, for example, Melitz, 2003; Helpman, Melitz and Yeaple, 2004).[2] Some studies argue that fixed costs are higher for engaging in direct production abroad than for exporting, but foreign production permits firms to curtail transportation costs (Brainard, 1997; Helpman et al., 2004). In this context, only the most productive firms are able to manage production abroad; firms with lower productivity export, and the least productive firms operate only in the domestic market. Hence, a positive relationship exists between firm productivity and the degree of participation in international markets. Firms with low productivity serve only the home market, whereas better performers can succeed in export markets and firms with the highest productivity can establish production plants in foreign markets and engage in horizontal FDI.

The theoretical literature highlights home-country exports as an important determinant of OFDI. However, it postulates both a complementary and a substitutive relationship between exports and OFDI. Markusen (1984) predicted a complementary relationship between exports and vertical FDI. By using a general equilibrium model, he predicted that if identical countries are involved in producing identical bundles of goods then direct investment could act as a complement to commodity trade. Brainard (1997) proposed a model of trade with differentiated goods to identify the trade-off between proximity to customers in terms of direct manufacturing abroad and concentration of production based on economies of scale. The findings indicate a proximity-concentration trade-off between exports and horizontal FDI. The basic assumption of the model is that firms are likely to choose FDI over exports in the context of higher transport costs and trade barriers and low economies of scale at the plant level. Transportation costs imply that exports are more costly, and investment barriers imply that FDI is costly. In this case, firms give up concentration of production at one plant, as the foreign plant is an affiliate of the domestic one, and reap the advantages of proximity to the foreign market by setting up foreign production facilities. Economies of scale at the plant level would make it advantageous to concentrate production at

[2] Models of industry dynamics proposed by Javanovic (1982), Hopenhayn (1992), and Ericson and Pakes (1995) discuss in detail the extent of productivity heterogeneity that decides the entry, exit, growth and failure of firms in the market. Empirical reviews of these productivity studies are provided by Caves (1998), Bartelsman and Doms (2000), and Syverson (2011). Melitz (2003) introduced Hopenhayn-type industrial dynamics to explain the dynamics of firm-level participation in international trade. Following this study, Helpman et al. (2004) used a model based on firm heterogeneity to explain the choice between exports and FDI as alternative modes of internationalization for firms.

one plant and subsequently choose to export to other locations. In such a case, the firm gives up the proximity of the producing plant and the foreign market.

Markusen and Venables (2000), following the Hecksher-Ohlin structure with the presence of iceberg trade costs, demonstrate how the presence of trade costs and factor mobility decides the internationalization of firms. Technology and factor endowment were identified as important determinants of domestic production and MNE activity. In their model, technology and factor endowment differences lead to the agglomeration of production and MNE activity in the host country.

The empirical evidence on complementarity and substitution between OFDI and exports remains mixed. On the basis of the level of aggregation and methods used, empirical studies can be classified as country level, industry level and firm level. Country-level studies report a dominant complementary effect between OFDI and exports. Clausing (2000) examined multinational firms in the United States (from 1977 to 1994) and found strong positive relationship between exports and OFDI. Subsequently, they concluded that there was a complementary relationship between OFDI and exports. Pfaffermayr (1994) reports similar results in Austria, using time-series econometrics for the period from 1969 to 1991. He found a two-way causality between exports and FDI. Again, the empirical studies on the industry level have produced mixed results. Lipsey and Weiss (1981) show a positive relationship between United States exports and FDI for in 1970 in 14 industries. The results indicate that the higher a firm's output in the foreign market, the higher its exports from the home country. Brainard (1997) validated her theoretical proposition on "proximity-concentration trade-off" by using bilateral trade and investment information obtained from the United States for 1989, disaggregated at country and industry levels. The evidence in the study suggests that multinational activity is more likely in the presence of transport cost and trade barriers. Hence, Brainard concluded that there is a substitution effect between trade and FDI. Blonigen (2001) reports a substitution effect between the production of Japanese automobile parts in the United States and Japanese exports of automobile parts to the United States. However, Blonigen also found a complementary relationship in the case of final goods that are vertically linked. At the firm level, Lipsey and Weiss (1984) report strong complementary effects between United States production of intermediate goods in the host country and United States exports in the same region for 1970. Oberhofer and Pfaffermayr (2012), using a Probit model, identified a complementary relationship between exports and OFDI for Austrian firms.

Pradhan (2007), using data from Indian manufacturing firms for the period 1991–2000, explains complementarities between export intensity and OFDI. Firm-level studies also identified the role of firm size, firm age and R&D in determining the OFDI of home-country firms. Narayanan and Bhat (2011) studied technology sourcing and OFDI in 130 firms in the high-tech information technology industry in India. Their

findings indicate that in-house research and development (R&D) efforts and import of capital goods and technology are important determinants of outward investment for the information technology industries in India. Again, detailed examination of FDI and exports depends highly on the intervening factors and firm-level characteristics (Brainard, 1997). In this context, technology acquisition efforts at the firm level play an important role in determining firm-level heterogeneity and hence firms' internationalization activity (see, for example, Girma et al., 2008; Aw et al., 2011; Bustos, 2011). Therefore, a study of the relationship between OFDI, exports and technological efforts in an emerging country such as India remains highly relevant.

## 3. Method for identifying the determinants of probability of OFDI and OFDI share

Drawing on the literature discussed in section 2, we examined the determinants of OFDI in Indian manufacturing firms. We used a dynamic Probit model to estimate the determinants of the probability of OFDI and a Tobit model for the share of OFDI ($OFDI_{share}$). In this study, the dynamic, random-effects, Probit method proposed by Wooldridge (2005) was used for analyses. By using this method, we take care of two problems: first, the treatment of unobserved heterogeneity, especially in relation to the covariates and, second, the initial status of the OFDI.

The decision of the firm to invest abroad may depend on its past OFDI status. Several approaches are proposed to deal with this problem. Heckman (1981) considered the initial values as endogenous variables with a probability distribution conditional on exogenous variables and unobserved heterogeneity. His method is to approximate the conditional probability of initial values with reduced-form equations using the available pre-sample information. The main problem with this method in practice is that the approximation of the conditional probability of initial values leads to a simultaneous estimation problem of the reduced form and the structural model, and creates a computational burden (for discussion, see, for example, Wooldridge (2005)). The method used by Wooldridge (2005) has two advantages compared with the approach proposed by Heckman (1981). First, in Wooldridge (2005), observed covariates and the initial condition determine the unobserved firm-specific heterogeneity, where unobserved heterogeneity follows a specific distribution; second, it takes into account the problem of attrition bias, where attrition is made to depend on the initial condition.[3] Therefore, we use the Wooldridge (2005) method and assume a distribution of the unobserved heterogeneity that allows unobserved,

[3] This has a major advantage because otherwise a lot of observations must be deleted, as the estimation techniques do not allow the use of panels with gaps. For details, see Wooldridge (2005).

time-invariant, firm-level heterogeneity to be correlated with the initial condition and moments of the covariates.[4] We use the following specification of the model:

$$OFDI_{it} = \begin{cases} 1 & \beta_1 EXP\text{int}_{i,t-1} + \beta_2 TFP_{i,t-1} + \beta_3 OFDI_{i,t-1} + \beta_4 X_{i,t-1} + \beta_5 Z_{it} + u_i + \varepsilon_{it} > 0 \; i = 1,\ldots..,N, \\ 0 & otherwise \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad t = 1,\ldots..,T. \end{cases} \quad (1)$$

Here, the dependent variable $OFDI_{it}$ takes the value 1 if the firm undertakes OFDI in period $t$ and 0 if it does not. $EXPint_{i,t-1}$ is the variable that captures lagged export intensity. $X_{it-1}$ captures the technology efforts (this includes the lagged values of R&D intensity (*RDint*), import of technology capital (*Impcint*) and import f technology know-how (*Imprint*)). $Z_{it}$ is a set of firm-specific characteristics that include firm size (Size), age (Age) and ownership (FP). $\mu_i$ is unobserved, time-invariant, firm heterogeneity, and $\varepsilon_{it}$ is an idiosyncratic error that is assumed to be normally distributed and uncorrelated with the regressors. In our model we assume that $EXP\text{int}_{i,t-1}$, $X_{i,t-1}$ and $Z_{i,t-1}$ are strictly exogenous, conditional on $\mu_i$.

In other words, here it is assumed that unobserved heterogeneity could be expressed as a linear combination of firm-specific time averages of the regressor and the initial condition of the dependent variable as follows:

$$\mu_i = \alpha_0 + \alpha_1 OFDI_{i0} + \alpha_2 \overline{EXP\text{int}_t} + \alpha_2 \overline{X_i} + \alpha_2 \overline{Z_i} + a_i \text{ and } \left(a_i \mid OFDI_{i0}, \overline{EXP\text{int}_{i,}}, \overline{X_{i,}}\ \overline{Z_{i,}}\right) \sim N\left(0, \sigma_a^{\,2}\right) \quad (2)$$

where it is assumed that

$$\left(\varepsilon_{it} \mid OFDI_{i,t-1,} EXP\text{int}_{it-1}, X_{it-1}, Z_{it}, \mu_i\right) \sim N\left(0, \sigma_a^{\,2}\right) \quad (3)$$

Hence, for example, in our model the probability of OFDI at time $t$ is given by the following equation:

$$\Pr(OFDI_{it} = 1 / OFDI_{io}, \ldots., OFDI_{i,t-1,}, EXP\text{int}_{it-1}, X_{it-1}, Z_{it}, \overline{EXP\text{int}_i}, \overline{X_i}, \overline{Z_i})$$

$$= \varphi\left(\beta_1 OFDI_{i,t-1}, \beta_2 EXP\text{int}_{i,t-1} + \beta_3 X_{it} + \beta_4 Z_{it} + \alpha_0 + \alpha_1 OFDI_{i0} + \alpha_2 \overline{EXP\text{int}_i} + \alpha_2 \overline{X_i} + \alpha_2 \overline{Z_i} + a_i\right) \quad (4)$$

Estimation is carried out with a standard random-effects Probit model, with $EXP\text{int}_{i,t-1}$, $X_{i,t-1}$ and $Z_{i,t-1}$ as additional regressors. We use a Tobit model to examine the determinants of OFDI share (OFDI divided by total assets). Here, a lot of firms report a zero value for OFDI; hence, left censoring must be taken into account. The

[4] One solution to this problem is to use a "fixed-effects approach". The conditional distribution of unobserved heterogeneity does not play an important role in the estimation process of this approach. However, the fixed-effects approach may lead to biased results as it suffers from the so-called "incidental parameter problem". For detailed discussions, see Honore (1993) and Orme (2001).

OFDI share is modeled by the following random-effects tobit specification:

$$OFDI_{Share\,it} = \max\left[0, \alpha_1 OFDI_{i,t-1} + \alpha_2 EXP\text{int}_{i,t-1} + \alpha_3 X_{i,t-1} + \alpha_4 Z_{it} + u_i + \varepsilon_{it} \;\; if \; OFDI_{share} > 0\right] \quad (5)$$

The rest of the specification remains similar to the Probit model.

## 4. Data source, hypotheses and variable description

The study used firm-level data from the Prowess database. The sample period was from 1998 to 2009. The data were collected by the Centre for Monitoring Indian Economy from company balance sheets and income statements; the data cover both listed and unlisted firms from a large cross-section of manufacturing, services, utilities and financial industries. In our study we used only data on manufacturing firms – an average of 4,000 firms for each year in the period. Prowess includes data on exporting, non-exporting (domestic), foreign and outward-investing firms. We have filtered the data on the basis of the National Industrial Classification (NIC-2008) provided by the Central Statistical Organization. For a few missing data and for cross-checking, we accessed data on overseas investment from the Reserve Bank of India and from company websites.

In this study we propose that the OFDI of Indian manufacturing firms depends on firm-level characteristics such as productivity, exports, firm size, technology imports, ownership and firm age. Investment by Indian multinationals in their overseas subsidiaries divided by total assets is taken as an indicator of OFDI in the case of Indian manufacturing firms. We include those firms that undertake OFDI in manufacturing activity (excluding trading firms). Seven hypotheses related to specific characteristics have been put forward for empirical investigation, as described in the following paragraphs.

### (a) Firm-level Total Factor Productivity (TFP):

Firm-level productivity is likely to influence the decision to invest in OFDI by Indian firms. Helpman, Melitz and Yeaple (2004) show that highly productive firms tend to invest in foreign countries rather than export. Hence we expect a positive relationship between firm-level productivity and OFDI. In this study, firm-level total factor productivity (TFP) is estimated using Levinsohn and Petrin's (2003) semi-parametric estimation technique (using electricity expense as a proxy variable).[5] The variables for estimating production have been constructed from input variables; namely output, labour, capital and materials. We employed Srivastava's (1996) method for

[5] A similar method was used by Topalova and Khandelwal (2011).

the construction of capital stock at the firm level. Output is arrived at by subtracting purchases of finished goods from the sales of goods at the firm (and adding a positive inventory change). The number of workers employed at a firm is arrived at by calculating the average wage rate from the Annual Survey of Industries database and dividing it by the salaries and wages reported by the firm. A similar method was followed by Balakrishnan et al. (2000) and Topalova and Khandelwal (2011). Firm-level materials expenses have been constructed from the raw materials expenses incurred at each firm and deflated at the 1993–94 base year prices of materials using the special weights constructed from the input-output table provided by the Central Statistical Organization.

(b) Import of Technology:

Import of technology provides firms with important advantages in terms of transferring foreign-grown technologies to domestic subsidiary firms (Pradhan, 2004; Kumar, 2008). We use two channels for the import of technology by manufacturing firms: imports in the form of capital goods (embodied technology import) and imports in the form of know-how (i.e. import payments made in terms of royalties and fees, or disembodied technology imports). Capital goods import intensity (*Impcint*) is the ratio of the value of imports of capital goods to sales turnover, and disembodied technology import intensity is the ratio of the value of total import payments on royalties and fees and the like to sales turnover (*Imprint*).

(c) Export Intensity (*Expint*):

The export orientation of firms is likely to influence the OFDI decisions of firms. Firms with export experience are expected to have better information regarding foreign market and distribution networks, consumer tastes and preferences in the foreign market, and institutional mechanisms in the foreign countries. This information may help exporting firms to undertake OFDI. The ratio of exports to sales turnover is used as the export intensity of the firm.

(d) Firm Size (*Size*):

The relationship between firm size and OFDI at the firm level has been widely studied in the literature. Studies indicate that larger firms are more likely to venture abroad and to set up production facilities abroad (see, for example, Caves, 1996). The deflated value of sales turnover is taken as the size variable. The value of sales is deflated using the appropriate wholesale price index (1993–94 base).

(e) Age of the Firm (*Age*):

The experience of a firm in the market could positively influence its decision to undertake OFDI. Studies indicate that experienced firms may have accumulated business and production experience that could be cumulative and may be helpful

for initiating OFDI (Tseng et al., 2007; Pradhan, 2004). Accumulated knowledge also helps firms to learn by doing and to absorb technology know-how (Kumar, 2008). Hence, in this study we expect that the older and experienced firms in the industry have a higher probability of undertaking OFDI and a higher share of OFDI. The year of incorporation of the firm is used to calculate the age of the firm.

(f) Ownership (*FP*):

The ownership structure of the firm is likely to influence the OFDI decision for two reasons. Many foreign firms tend to invest in India primarily to expand their business there; hence their expansion outside India is very unlikely and tends to be dependent on the decision taken at the corporate headquarters (Kumar, 2008). Thus, in the case of foreign-owned firms we expect a negative sign with reference to OFDI. Using the definition of the Reserve Bank of India, the equity ownership of the firm is used to classify firms as foreign and domestic. Firms in which foreign promoters have a share greater than 10 percent are considered to be foreign firms.

(g) R&D Intensity (*RDint*):

R&D initiatives at the firm level may guarantee certain monopolistic advantages to firms by helping them in adapting foreign technologies to domestic conditions and mastering those technologies. Studies carried out in the Indian context highlight positive and significant relationships between R&D investments at the firm level and OFDI decisions (see, for example, Narayanan and Bhat, 2011; Kumar, 2008; Pradhan, 2004). The ratio of the firm's R&D expenditures to its sales is taken as the R&D intensity of the firm in the year of the study.

## 5. Descriptive statistics

Table 1 reports the summary of key firm characteristics for the study period (total sample). In our study, the dataset includes 100 percent export-oriented firms as well as firms that cater to the domestic market (export intensity range from 0 to 100). The average age of the firms in the sample is 27 years, which indicates that on average, firms in the sample are fairly experienced. The average value of imports of technology in terms of capital goods (embodied) and imports of technology through payment of royalties (disembodied) shows that capital goods imports are the more preferred means of importing technology. The study includes only those firms that report capital, raw materials expense and energy (indicated by electricity expenses) of a minimum of one crore rupees (Rs 10 million).

Table 2 compares the mean for different types of firms: domestic, exporting and OFDI. The study uses a t-test to find out if the mean difference is significant (the comparison groups are domestic firms for exporting firms, and exporting firms for

**Table 1. Descriptive Statistics**

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Size | 164.79 | 1,353.22 | 0.0031 | 86,865.86 |
| Age | 26.69 | 19.40 | 1.00 | 121 |
| Expint | 12.64 | 26.44 | 0 | 100 |
| RDint | 0.16 | 1.20 | 0 | 54 |
| TFP | 1.18 | 1.30 | 0.02 | 3.14 |
| Impcint | 0.98 | 5.09 | 0 | 79.30 |
| Imprint | 0.22 | 26.16 | 0 | 10.78 |
| OFDI | 4.83 | 5.01 | 0 | 48.20 |

*Note:* Impcint = import of capital goods intensity (import of capital goods / sales turnover). Imprint = import of technology know-how intensity (disembodied technology import /sales turnover). RDint (R&D expenses as percentage of sales). Total number of observations: 44,421.

**Table 2. Comparison of means by different types of firm** (firm characteristics)

| Variable | Domestic | | Exporting | | OFDI | |
|---|---|---|---|---|---|---|
| | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation |
| TFP | 1.097 | 1.228 | 1.164328 | 1.271 | 2.345 * | 1.193 |
| Size | 43.018 | 4,411.435 | 263.2181* | 1,817.035 | 826.292* | 4,203.265 |
| Age | 25.878 | 19.87843 | 27.470* | 18.914 | 31.237* | 19.830 |
| OFDI | - | - | - | - | 29.935 | 741.413 |
| Expint | - | - | 23.187 | 32.222 | 26.62 | 26.45 |
| Impcint | 0.512 | 5.760 | 1.367 | 5.567 | 1.734 | 5.649 |
| Imprint | 0.053 | 0.400 | 0.365 | 35.418 | 0.090 | 0.420 |
| RDint | 0.110 | 2.392 | 0.241* | 1.094 | 0.646 | 2.335 |
| Number of observations | | 19,892 | | 21,353 | 3,177 | |

*Note:* Domestic firms correspond to firms with no internationalization activity (no export and OFDI). Exporting firms are categorized as firms that are exporting and not involved in OFDI. OFDI firms are MNEs from India (includes firms with OFDI and exports). Rme = raw material expenses. Impcint = import of capital goods intensity (import of capital goods / sales turnover). Imprint = import of technology know-how intensity (disembodied technology import /sales turnover). * indicates mean difference is significant at 5 percent level. The comparison group is for OFDI firms is exporting firms and for exporting firms is domestic firms. Total number of observations: 44,421.

OFDI firms). On average, exporting firms are more productive than domestic firms, but this productivity difference is not significant enough to enable a conclusion. However, it turns out that OFDI firms are more productive than exporting and domestic firms.

OFDI firms on average produce more output, labour and capital intensity than exporting firms. It is clear that on average the OFDI firms are bigger than the exporting firms. Furthermore, OFDI firms pay higher rates of worker compensation. The age of the firms indicates that OFDI firms are far more experienced in the market than the exporting firms.

## 6. Results and discussion

Table 3 reports results from the random-effects Probit model. The results for the subsample for the periods from 1998 to 2003 and from 2004 to 2009 are given separately. The full period result indicates a complementary relationship between OFDI and exports. The coefficient of the lagged value of the exports variable is positive and is significant. The lagged values of TFP are significant, indicating that the OFDI

**Table 3. Dynamic probit model**

| Pr(OFDI>0) | Full Period | | 1998–2003 | | 2004–2009 | |
|---|---|---|---|---|---|---|
| | Coefficient | SE | Coefficient | SE | Coefficient | SE |
| $RDint_{t-1}$ | 0.021** | (0.011) | 0.043** | (0.018) | 0.024*** | (0.003) |
| $Impcint_{t-1}$ | 0.022*** | (0.005) | 0.033*** | (0.005) | 0.008*** | (0.001) |
| $Imprint_{t-1}$ | -0.137 | (0.083) | -0.081 | (0.157) | -0.013 | (0.018) |
| $TFP_{t-1}$ | 0.027** | (0.004) | -0.005 | (0.179) | 0.149** | (0.030) |
| $TFP_{t-2}$ | 0.005 | (0.145) | 0.091 | (0.182) | -0.019 | (0.028) |
| $Expint_{t-1}$ | 0.256*** | (0.003) | 0.007*** | (0.002) | 0.321*** | (0.002) |
| $Expint_{t-2}$ | 0.019*** | (0.004) | 0.011** | (0.021) | 0.001 | (0.001) |
| $OFDI_{t-1}$ | 0.023*** | (0.001) | 0.027*** | (0.002) | 0.056*** | (0.002) |
| FP | -0.028 | (0.133) | -0.023 | (0.263) | -0.107** | (0.044) |
| Age | 0.022*** | (0.002) | 0.013*** | (0.003) | 0.027*** | (0.005) |
| Size | 0.012*** | (0.001) | 0.004*** | (0.002) | 0.062*** | (0.000) |
| Cons | -5.403*** | (0.099) | -6.571*** | (0.162) | -0.57*** | (0.081) |
| Year | Yes | | Yes | | Yes | |
| Industry | Yes | | Yes | | Yes | |
| Wald $chi^2$ | 598.34 | | 102.55 | | 601.08 | |
| Log likelihood | -4160.52 | | -1137.52 | | -4151.94 | |
| Number of observations | 4,4421 | | 17,349 | | 27,072 | |

*Note:* ***Significant at the 1% level. **Significant at the 5% level. SE = standard error. Rme = raw material expenses. Impcint = import of capital goods intensity (import of capital goods / sales turnover). Imprint = import of technology know-how intensity (disembodied technology import /sales turnover).

of firms is based on past productivity levels. R&D and capital goods import intensity indicating the technological efforts undertaken by firms turn out to be significant and positive. Following the approach of previous studies, here we control for age, size and ownership. The lagged values of R&D intensity are significant for the full period as well as for the subperiod. This indicates that OFDI depends greatly on firm-level efforts to spend on innovative activities. The import of technology through capital goods turns out to be a significant determinant of the probability of undertaking OFDI, rather than importing technology in the form of know-how by paying royalties and fees. Furthermore, the probability of undertaking OFDI is also dependent on the experience of the firm in the market, as shown by the coefficient of the variable Age.

Both subperiod results also indicate that exports are a significant and positive determinant of OFDI of firms in the Indian manufacturing industry. The more experienced the firm is in the industry, the higher is the chance of it undertaking

**Table 4. Dynamic tobit estimation results**

| $OFDI_{Share}$ | Full Period | | 1998–2003 | | 2004–2009 | |
|---|---|---|---|---|---|---|
| | Coefficient | SE | Coefficient | SE | Coefficient | SE |
| $RDint_{t-1}$ | 0.023*** | (0.002) | 0.021** | (0.004) | 0.029** | (0.007) |
| $Impcint_{t-1}$ | 0.566*** | (0.037) | 0.022*** | (0.002) | 0.015*** | (0.002) |
| $Imprint_{t-1}$ | 0.389 | (0.984) | -0.317 | (0.371) | -0.451 | (0.267) |
| $TFP_{t-1}$ | 0.148*** | (0.005) | 0.299 | (0.322) | 0.019*** | (0.006) |
| $TFP_{t-2}$ | 0.083** | (0.022) | 0.182 | (0.287) | 0.001 | (0.015) |
| $Expint_{t-1}$ | 0.153*** | (0.008) | 0.034*** | (0.006) | 0.044** | (0.007) |
| $Expint_{t-2}$ | 0.025 | (0.407) | 0.003 | (0.107) | 0.165*** | (0.001) |
| $OFDI_{share\ t-1}$ | 0.029** | (0.010) | 0.017** | (0.001) | 0.021*** | (0.005) |
| FP | -0.467 | (0.463) | -0.012 | (0.084) | -0.556 | (0.638) |
| Age | 0.513*** | (0.095) | 0.012** | (0.008) | 0.873*** | (0.004) |
| Size | 0.054*** | (0.003) | 0.003*** | (0.000) | 0.068*** | (0.005) |
| _cons | -13.567*** | (0.911) | -10.809*** | (0.387) | -14.321*** | (0.151) |
| Year | Yes | | Yes | | Yes | |
| Industry | Yes | | Yes | | Yes | |
| LR $chi^2$ | 7710.48 | | 11500.92 | | 5790.44 | |
| Log likelihood | -19796.12 | | -27008.55 | | -15004.81 | |
| Number of observations | 44,421 | | 17,349 | | 27,072 | |

*Note:* ***Significant at the 1% level. **Significant at the 5% level. SE = standard error. Rme = raw material expenses. Impcint = import of capital good intensity (import of capital goods / sales turnover). Imprint = import of technology know-how intensity (disembodied technology import /sales turnover).

OFDI. Furthermore, the OFDI in the current period also depends on previous OFDI decisions. Experiences in the OFDI market allow firms to reap the economies of scale associated with participating in FDI. However, the TFP is significant only in the later period of liberalization (2004–2009).

The study uses a Tobit model to identify the determinants of OFDI share. This explains the success of firms in the international market or the extent of OFDI undertaken by firms. Table 4 reports the results from the Tobit model. The lagged variable indicating past export status is positive and significant, indicating a complementary relationship between OFDI and the past export performance of firms. The results are similar to the findings from the Probit model.

## 7. Conclusion

In this paper, we examined the factors driving OFDI in Indian manufacturing firms. First, we tested the outward investment decision of firms, depending on firm-level productivity. Second, we tested whether exports and outward investment are complements or substitutes, and third, we analyzed the role of technology-enhancing efforts in the form of R&D investment and import of technology (both embodied and disembodied technology imports) in determining firm-level OFDI. The preliminary analysis indicated that, on average, OFDI firms are bigger, more experienced in the market, invest more in technology (having high R&D intensity and technology imports) and pay higher wages than the exporting firms. OFDI firms are more productive than both the exporting firms and the non-exporting firms. We employed dynamic Probit and Tobit models to analyse the determinants of probability of OFDI and OFDI share. In the case of the probability of undertaking OFDI, both full period and subperiod results indicate strong evidence that OFDI and exports are complementary. R&D intensity and embodied technology imports are significant determinants of the probability of OFDI. Our findings also support the hypothesis that OFDI decisions depend on firm-level productivity. Results from the Tobit model reveal that export intensity is positive and significant in determining OFDI share, indicating a complementary relationship between two alternative modes of internationalization, exports and OFDI. Again, R&D intensity and imports of embodied technology are important determinants of OFDI share. TFP is a positive and significant determinant of OFDI.

The findings from the study raise several policy concerns regarding support mechanisms for OFDI activity from India. The findings that OFDI firms are highly productive suggests the need for special-focus initiatives from the Government for the promotion of Indian multinationals. This productivity growth in the Indian manufacturing sector could be attributed to pro-market liberalization policies adopted by the Government since 1991. However, to enhance productivity at the firm level

appropriate policy measures are required. One aspect of government policy that is highly relevant here is deregulation and proper regulation. Poorly regulated markets can create perverse incentives that reduce firm-level productivity (Syverson 2011). Deregulation and incentive-based regulation may increase firm-level productivity and OFDI from India. Apart from productivity, Indian firm-level OFDI is also dependent on the technological efforts undertaken in India. These efforts take the form of R&D activities and imports of technology. Hence, specific policy measures could be envisaged to promote in-house R&D efforts and the establishment of collaborative research laboratories by Indian MNEs. The incentives could be provided in the form of tax credits and subsidies for firms conducting R&D. Furthermore, the restriction on imports of capital goods could be eased to make available adequate resources for adoption of technology by Indian firms.

## *Appendix*

**Table A1. FDI inflow, OFDI and trade in India, 1990–2009 (%)**

| Year | FDI Inflow/ World Total | OFDI/World Total | Imports/World Total | Exports/World Total |
|---|---|---|---|---|
| 1990 | 0.08 | 0.01 | 0.65 | 0.51 |
| 1991 | 0.07 | 0.01 | 0.56 | 0.5 |
| 1992 | 0.08 | 0.01 | 0.6 | 0.52 |
| 1993 | 0.1 | 0.01 | 0.59 | 0.57 |
| 1994 | 0.12 | 0.01 | 0.61 | 0.58 |
| 1995 | 0.16 | 0.01 | 0.66 | 0.59 |
| 1996 | 0.2 | 0.02 | 0.69 | 0.61 |
| 1997 | 0.23 | 0.01 | 0.73 | 0.63 |
| 1998 | 0.24 | 0.01 | 0.76 | 0.61 |
| 1999 | 0.21 | 0.02 | 0.8 | 0.62 |
| 2000 | 0.22 | 0.02 | 0.77 | 0.66 |
| 2001 | 0.26 | 0.03 | 0.79 | 0.7 |
| 2002 | 0.34 | 0.05 | 0.85 | 0.76 |
| 2003 | 0.34 | 0.06 | 0.93 | 0.78 |
| 2004 | 0.34 | 0.07 | 1.05 | 0.83 |
| 2005 | 0.37 | 0.08 | 1.33 | 0.95 |
| 2006 | 0.49 | 0.17 | 1.44 | 1 |
| 2007 | 0.59 | 0.23 | 1.61 | 1.07 |
| 2008 | 0.8 | 0.38 | 1.95 | 1.21 |
| 2009 | 0.94 | 0.41 | 2.03 | 1.31 |

*Source:* UNCTAD database. unctadstat.unctad.org.

## *References*


Aw, B.Y., Roberts, M.J., and Xu, D.Y. (2011), "R&D investment, exporting, and productivity dynamics", *American Economic Review*, Vol. 101, No. 4, pp. 1312-1314.

Balakrishnan, P., Pushpangadan, K., and Babu, M. S. (2000), "Trade liberalisation and productivity growth in manufacturing: evidence from firm-level panel data", *Economic and Political Weekly*, Vol. 35, No. 41, pp. 3679-3682.

Bernard, A., and Jensen, J.B. (1999), "Exceptional exporters performance: Cause, effect or both? " *Journal of International Economics*, Vol. 47, No. 1, pp. 1-25.

Bhat, S., and Narayanan, K. (2010), "Technological efforts and performance of IT MNCs from India", in Siddharthan, N. S., and Narayanan, K. (eds.), *Indian and Chinese enterprises: global trade, technology and investment regimes*, New Delhi: Routledge, pp. 241-269.

Blomstrom, M., and Lipsey, R.E. (1991), "Firm size and foreign operation of multinationals", *Scandinavian Journal of Economics*, Vol. 93, pp. 101-107.

Blonigen, B. (2001), "In search of substitution between foreign production and exports", *Journal of International Economics*, Vol. 53, No. 1, pp. 81-104.

Brainard, S. L. (1993), "A simple theory of multinational corporations and trade with trade-off between proximity and concentration", Working Paper No. 4269, NBER, Cambridge.

Brainard, S. L. (1997), "An empirical assessment of the proximity-concentration trade-off between multinational sales and trade", *American Economic Review*, Vol. 87, No. 4, pp. 520-544.

Buckley, P.J., and Casson, M.C. (1976), *The future of the multinational enterprise*, London: Homes and Meier.

Bustos, P. (2011), "Trade liberalization, exports, and technology upgrading: Evidence on the impact of MERCOSUR on Argentinian firms", *American Economic Review*, Vol. 101, No. 1, pp. 304-340.

Caves, R.E. (1971), "International Corporations: The Industrial Economics of Foreign Investment", *Economica*, Vol. 38, No. 149, pp. 1-27.

Caves, R.E. (1996), *Multinational Enterprise and Economic Analysis*, 2nd ed. Cambridge: Cambridge University Press.

Caves, R.E. (1998), "Industrial organization and new findings on the turnover and mobility of firms", *Journal of Economic Literature*, Vol. 36, No. 4, pp. 1947-1982.

Clausing, K. A. (2000), "Does multinational activity displace trade?", *Economic Inquiry*, Vol. 38, No. 2, pp. 190-205.

Dunning, John H. (1977), "Trade, location of economic activity and the MNE: A search for an eclectic approach", in Ohlin, B., Hesselborn, P.O., and Wijkman, P.M. (eds.), *The international allocation of economic activity*, London: Macmillan, pp. 395-418.

Dunning, John H. (1993), *Multinational enterprises and the global economy*, Wokingham, United Kingdom: Addison-Wesley.

Ericson, R., and Pakes, A. (1995), "Markov-perfect industry dynamics: A framework for empirical work", *Review of Economic Studies*, Vol. 62, No. 1, pp. 53-82.

Girma, S., Kneller, R., and Pisu, M. (2005), "Exports versus FDI: An empirical test", *Review of World Economics*, Vol. 141, No. 2, pp. 193-218.

Girma, S., Gorg, H., and Pisu, M. (2008), "Exporting, linkages and productivity spillovers from foreign direct investment", *Canadian Journal of Economics*, Vol. 41, No. 1, pp. 320–340.

Head, K., and Ries, J. (1999), "Rationalization effects of tariff reductions", *Journal of International Economics*, Vol. 47, No. 2, pp. 295-320.

Head, K., and Ries, J. (2003), "Heterogeneity and the foreign direct investment versus exports decision of Japanese manufacturers", *Journal of the Japanese and International Economies*, Vol. 17, No. 4, pp. 448-467.

Heckman, J. (1981), "The incidental parameters problem and the problem of initial conditions in estimating a discrete time - discrete data stochastic process", in Manski, C., and McFadden, D. (eds.), *Structural analysis of discrete data with econometric applications*, MIT Press, Cambridge.

Helpman, E., Melitz, M., and Yeaple, S. (2004), "Export versus FDI with heterogeneous firms", *American Economic Review*, Vol. 94, No. 1, pp. 300-316.

Honore, B. (1993), "Orthogonality – conditions for tobit model with fixed effect and lagged dependent variables", *Journal of Econometrics*, No. 2, Vol. 59, pp. 35-61.

Hopenhayn, H. (1992), "Entry, exit, and firm dynamics in long-run equilibrium", *Econometrica*, Vol. 60, No. 5, pp.1127-1150.

Hsieh, C., and Klenow, P. J. (2009), "Misallocation and manufacturing TFP in China and India", *Quarterly Journal of Economics*, Vol. 124, No. 4, pp. 1403-1448.

Hummels, D., Ishii, J., and Yi, K. (2001), "The nature and growth of vertical specialization in world trade", *Journal of International Economics*, Vol. 54, No. 1, pp. 75-96.

Hymer, S. (1976), *The international operations of national firms: A study of foreign direct investment*, Cambridge, Massachusetts: MIT Press.

Jovanovic, B. (1982), "Selection and the evolution of industry", *Econometrica*, Vol. 50, No. 3, pp. 649-670.

Kumar, N. (2008), "Internationalization of Indian enterprises: Patterns, strategies, ownership advantages, and implications", *Asian Economic Policy Review*, Japan Center for Economic Research, Vol. 3, No. 2, pp. 242-261.

Lall, S. (1983), "Multinationals from India", in Lall, S. (ed.), *The new multinationals: the spread of third world enterprises*, New York: John Wiley and Sons, pp. 21-87.

Levinsohn, J., and Petrin, A. (2003), "Estimating production functions using inputs to control for unobservables", *The Review of Economic Studies*, Vol. 70, No. 2, pp. 317-341.

Lipsey, R.E., and Weiss, M.Y. (1981), "Foreign production and exports in manufacturing industries", *Review of Economic and Statistics*, Vol. 63, No. 4, pp. 488-494.

Lipsey, R.E., and Weiss, M.Y. (1984), "Foreign production and exports of individual firms", *Review of Economics and Statistics*, Vol. 66, pp. 304-308.

Marchant, M.A., Manukyan, T., and Koo, W. (2002), "International trade and foreign direct investment: A focus on the free trade area of the Americas", *Journal of Agricultural and Applied Economics*, Vol. 34, No. 1, pp. 289-302.

Markusen, J.R., (1984), "Multinationals, multi-plant economies and the gains from trade", *Journal of International Economics*, Vol. 16, No. 3, pp. 205-226.

Markusen, J.R., and Venables, A.J. (2000), "The theory of endowment, intra-industry and multi-national trade", *Journal of International Economics*, Vol. 52, No. 2, pp. 209-234.

Melitz, M. (2003), "The impact of trade on intra-industry reallocations and aggregate industry productivity", *Econometrica*, Vol. 71, No. 6, pp. 1695-1725.

Mundell, R. (1957), "International trade and factor mobility", *American Economic Review*, Vol. 47, No. 3, pp. 321-335.

Narayanan, K., and Bhat, S. (2010), "Technological efforts and export performance of IT firms in India", in Siddharthan, N.S., and Narayanan, K. (eds.), *Indian and Chinese enterprises: Global trade, technology and investment regimes*, New Delhi: Routledge, pp. 241-269.

Narayanan, K., and Bhat, S. (2011), "Technology sourcing and outward FDI: A study of IT industry in India", *Technovation*, Vol. 31, No. 4, pp. 177-184.

Nayyar, D. (2008), "The internationalization of firms from India: Investment, mergers and acquisitions", *Oxford Development Studies*, Vol. 36, No. 1, pp. 111-131.

Olley, G.S., and Pakes, A. (1996), "The dynamics of productivity in the telecommunications equipment industry", *Econometrica*, Vol. 64, No. 6, pp. 1263-1297.

Oberhofer, H., and Pfaffermayr, O. (2012), "FDI versus exports: Multiple host countries and empirical evidence", *The World Economy*, Vol. 35, No. 3, pp. 316-330.

Orme, C.D., (2001), "Two-step inference in dynamic non-linear panel data models", mimeo, University of Manchester, United Kingdom.

Pfaffermayr, M. (1994), "Foreign direct investment and exports: A time series approach", *Applied Economics*, Vol. 26, No. 4, pp. 337-351.

Pfaffermayr, M. (1996), "Foreign outward direct investment and exports in Austrian manufacturing: Substitutes or complements", *Review of World Economics*, Vol. 132, No. 3, pp. 501-522.

Pradhan, G., and Barik, K. (1998), "Fluctuating total factor productivity in India: Evidence from selected polluting industries", *Economic and Political Weekly*, Vol. 33, No. 9, pp. M25-M30.

Pradhan, J.P. (2004), "The determinants of outward foreign direct investment: A firm-level analysis of Indian manufacturing", *Oxford Development Studies*, Vol. 32, No. 4, pp. 619-639.

Pradhan, J.P. (2007), "How do Indian multinationals affect exports from home country?", Working Paper No. 2007/07, Institute for Studies in Industrial Development, New Delhi.

Pradhan, J.P. (2011), "Emerging multinationals: A comparison of Chinese and Indian outward foreign direct investment", *International Journal of Institutions and Economies*, Vol. 3, No. 1, pp. 113-148.

Pradhan, J.P. and Singh, N. (2009), "Outward FDI and knowledge flows: A study of the Indian automotive sector", *International Journal of Institutions and Economies,* Vol. 1, No. 1, pp. 155-186.

Sauvant, K.P., and Pradhan, J.P. (2010), "Introduction: the rise of Indian multinational enterprises: revisiting key issues", in Sauvant, K.P. and Pradhan, J.P. (eds.), *The rise of*

*Indian multinationals: Perspectives on Indian outward foreign direct investment*, New York: Palgrave MacMillan, pp. 1-24.

Srivastava, V. (1996), *Liberalization, productivity and competition: A panel of Indian manufacturing*, Oxford University Press, Walton Street, Oxford, pp. 32-69.

Svensson, R. (1996), "Effects of overseas production on home country exports: Evidence based on Swedish multinationals", *Review of World Economics*, Vol. 132, No. 2, pp. 304-329.

Syverson, C. (2011), "What determines productivity?" *Journal of Economic Literature*, Vol. 49, No. 2, pp. 326-365.

Tseng, C., Tansuhaj, P., Hallagan, W., and McCullough, J. (2007), "Effects of firm resources on growth in multinationality", *Journal of International Business Studies*, Vol. 38, No. 6, pp. 961-974.

Topalova, P., and Khandelwal, A. (2011), "Trade liberalization and firm productivity: The case of India", *Review of Economics and Statistics*, Vol. 93, No. 3, pp. 995-1009.

Vernon, R. (1966), "International investment and international trade in the product cycle", *Quarterly Journal of Economics*, Vol. 80, No. 2, pp. 190-207.

Wooldridge, J.M. (2005), "Simple solutions to the initial conditions problem in dynamic nonlinear panel data models with unobserved heterogeneity", *Journal of Applied Econometrics*, Vol. 20, No. 1, pp. 39-54.