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THE INTERNATIONALISATION OF INDIAN FIRMS THROUGH OUTBOUND FOREIGN DIRECT INVESTMENT: NATURE, DETERMINANTS AND DEVELOPMENTAL CONSEQUENCES

This study is based on the doctoral dissertation titled "The Internationalisation of Indian Firms through Outbound Foreign Direct Investment: Nature, Determinants and Developmental Consequences" selected as the award winning entry for the EXIM Bank International Economic Research Annual (IERA) Award 2016. The dissertation was written by Dr. Isha Chawla, currently Associate Professor, Department of Economics, Lakshmibai College, Delhi University, under the supervision of Professor Aditya Bhattacharjea (Head of Department, Delhi School of Economics) and Dr. Bishwanath Goldar (Former Professor, Institute of Economic Growth) and was submitted to the Delhi School of Economics for award of the doctoral degree.

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GLOSSARY OF ABBREVIATIONS

By terms:	
ASI	Annual Survey of Industries
ATT	Average Treatment Effect on the Treated
BRICS	Brazil, Russia, India, China, and South Africa
cloglog	complementary log-log
CMIE	Centre for Monitoring the Indian Economy
CSO	Central Statistical Office
D	Purely domestic firm
DI	Firms that invest overseas but do not export
DID	Difference-in-Differences
DIDXI	Outward investing firms (includes DXI: firms that export and invest overseas, and DI: firms that invest overseas but do not export) categories merged to form the outward investing firms' category
DX	Pure export firms that also serve the domestic market
DXI	Firms that export and invest abroad
FDI	Foreign Direct Investment
FEMA	Foreign Exchange Management Act
FOSD	First Order Stochastic Dominance
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GLM	Generalised Linear Models
GO	Gross Output
GPS	Generalised Propensity Score
IMF	International Monetary Fund
IOTT	Input-Output Transactions Table
LBE	Learning-by-Exporting
NAS	National Accounts Statistics
NIC	National Industrial Classification
OECD	Organisation for Economic Co-operation and Development

OFDI	Outward Foreign Direct Investment
PH	Proportional Hazard
PIM	Perpetual Inventory Method
PSM-DID	Propensity Score Matching-Difference-in-Differences
R&D	Research and Development
RBI	Reserve Bank of India
S1	Specification 1: DX if export intensity is positive, DIDXI if export intensity is positive and foreign investment intensity is positive
S2	Specification 2: S2: DX if export intensity is ≥1%, DXI if export intensity is ≥1% and foreign investment intensity is ≥1%, DI non-exporter firms with foreign investment intensity ≥1%
TFP	Total Factor Productivity
UNCTAD	United Nations Council for Trade and Development
VA	Value Added
WIR	World Investment Report
By authors:	
ACF	Ackerberg, Caves and Frazer (2006)
BPS	Bhattacharya, Patnaik and Shah (2012)
HMY	Helpman, Melitz and Yeaple (2004)
HR	Head and Ries (2003)
KM	Kaplan and Meier (1958)
KS	Kolmogorov (1933)-Smirnov (1939)
LP	Levinsohn and Petrin (2003)
W-LP	Wooldridge (2009)-Levinsohn and Petrin (2003)

EXECUTIVE SUMMARY

Neoclassical theory predicts that to penetrate markets, seek resources and increase efficiency, capital should flow from the capital abundant to capital scarce economies. Contrary to this prediction, a burgeoning trend is the intensification of Outbound Foreign Direct Investment (OFDI)[1] flows from emerging markets and developing economies to developed economies (South-North), and other developing economies (South-South) either through cross border mergers and acquisitions (M&As) or greenfield investments. Although some firms from a small number of developing economies were investing overseas in the 1960s and 70s (namely, the 'Multinationals from the South'), it is only more recently that more and more firms are exhibiting a distinct preference for investing overseas, with the emergence of significant global and regional players from these countries.

From the establishment of a textile factory by the Birla group at Addis Ababa, Ethiopia in 1960 (Lall, 1986), and a wholly owned subsidiary (WOS), namely, Tata International AG by the Tata group at Zug, Switzerland in 1961 (Pradhan, 2011), the increase in the number of firms engaged in OFDI is phenomenal. The RBI disaggregated OFDI dataset, July 2007 to January 2012, shows that more than 3600 firms are engaged in OFDI.[2] Based on the Report of PricewaterhouseCoopers (2010), EXIM Bank (2014) comments that India is projected to be the largest source of emerging market multinational enterprises, overtaking China by 2018. Similarly, India Brand Equity Foundation (2014) notes that over 2,200 Indian firms are anticipated to invest abroad in the coming 15 years.

Correspondingly, FDI outflows from India over the last two decades have

[1]"The fifth edition of the International Monetary Fund's Balance of Payments Manual (BPM5) defines FDI as a category of international investment that reflects the objective of a resident in one economy (the direct investor) obtaining a lasting interest in an enterprise resident in another economy (the direct investment enterprise). The lasting interest implies the existence of a long-term relationship between the direct investor and the direct investment enterprise, and a significant degree of influence by the investor on the management of the enterprise. A direct investment relationship is established when the direct investor has acquired 10 percent or more of the ordinary shares or voting power of an enterprise abroad" (IMF, Foreign Direct Investment Trends and Statistics, 2003, pp. 6-7. http://www.imf.org/external/np/sta/fdi/eng/2003/102803.pdf).

[2]http://www.rbi.org.in/scripts/Data_Overses_Investment.aspx

increased considerably from US$ 0.006 billion in 1990, US$ 0.119 billion in 1995, US$ 0.514 billion in 2000, US$ 2.985 billion in 2005, US$14.285 billion in 2006 to US$14.752 billion in 2011, with outflows being nearly 50% of the inflows during 2007-12 (Figure A).

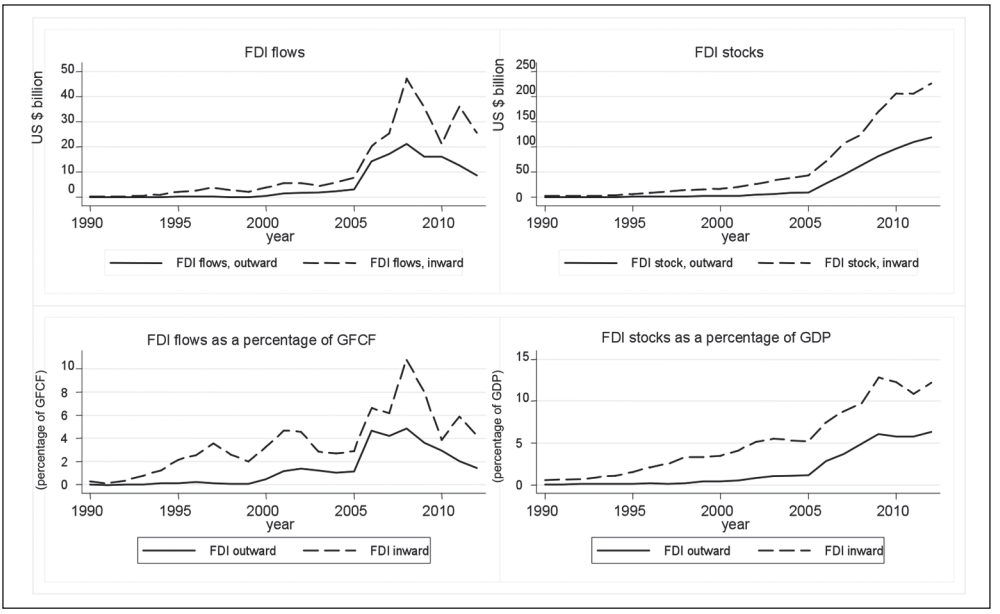
In percentages, over 2009-12, India's FDI outflows amount to 9.55% of that for BRICS (Brazil, Russia, India, China, and South Africa), 3.39% of that for developing economies and 0.92% of worldwide FDI outflows (Figure B).

In scale, India is thus still a small source of outward investments, though its position in FDI flows and stock, outward as well as inward, over 2008-11, amongst emerging economies is noteworthy (Figure C).

This study is motivated by the consideration that the increasing internationalisation of Indian firms through OFDI is of major interest in an emerging market context and builds on previous research on Indian firms' OFDI by focusing on some measurement and methodological issues, while yielding some important insights and policy implications.

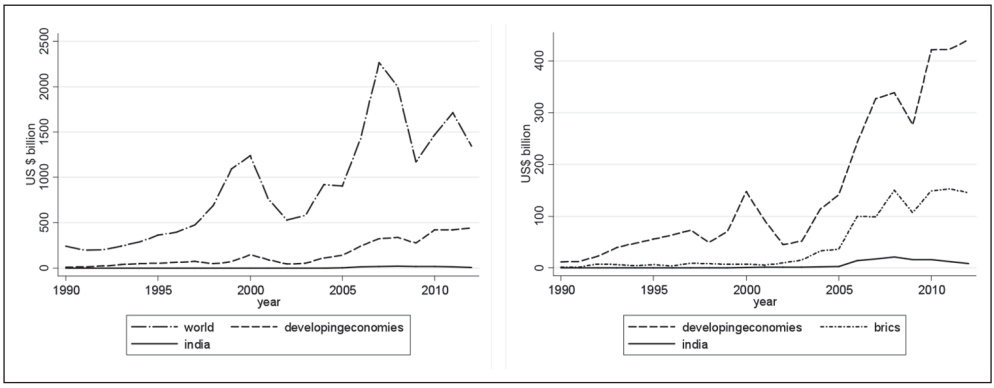
Using the firm-level database Prowess provided by the Centre for Monitoring the Indian Economy

Figure A: Trends in Indian aggregate FDI flows and stocks, outward vs. inward, 1990-2012



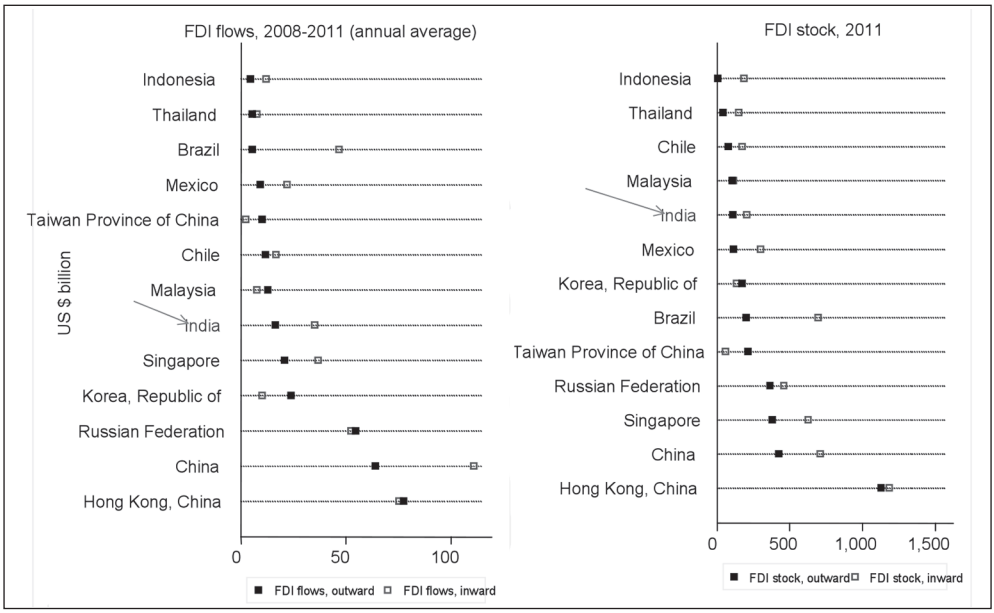
Source: Based on WIR, UNCTAD, 2013, annex tables.

Figure B: Trend of FDI outflows-India, BRICS, developing economies and worldwide, 1990-2012



Source: Based on WIR, UNCTAD, 2014, annex table 2.

Figure C: FDI flows and stock, by economy, outward vs. inward, 2008-2011



Source: Based on WIR, UNCTAD, 2013, annex tables 1, 2, 3, 4.

(CMIE),[3] the time period covered is 1995-2010 as this period has seen a sharp increase in the magnitude and number of firms engaged in OFDI. For the manufacturing sector, the analysis is based on data for about 6,068 firms (57,698 observations). Following Narayanan and Bhat

[3]Appendix I lists additional data sources used in this study.

(2010), identification of firms with foreign investments is done on the basis of the *investment outside India* (IOI) data field in *Prowess* wherein sector classification is done only on the basis of the activity of the outward investing firm, not its affiliates outside India.[4] The following three main issues are examined:

1. Whether involvement in OFDI is associated with higher productivity levels at the firm level (that is, whether OFDI firms are more productive than firms with purely domestic operations and those that organise international activities only through exports). Cross-sectional findings of a positive link between firm productivity and foreign involvement could however be due to the most productive firms *self-selecting* themselves into foreign markets, and/or *learning effects* through foreign engagements. Therefore, these two mechanisms are studied further.

2. Estimation and analysis of the determinants of the initial OFDI decision of Indian manufacturing firms: that is, test for a causal relationship between ex-ante (before initiating OFDI) firm characteristics and the firm's foreign involvement, namely, the *self-selection* hypothesis. Given the higher sunk costs of OFDI, this involves examining whether it is the *ex-ante* better performing firms that engage in foreign investments.

3. Estimation and analysis of the effects of OFDI on developmental outcomes, here, firm productivity and firm sales (in levels and growth rates), and export intensity: that is, test for a causal relationship between *ex-post* (after initiating OFDI) firm characteristics and OFDI. This involves examining whether there are any learning effects on firm productivity from doing OFDI-the *learning-by-outward investment* hypothesis.

The first two issues relate to theoretical constructs of the *new new trade theory* literature (Helpman, Melitz and Yeaple, 2004, below HMY). In examining the export substituting, horizontal or market-seeking OFDI, HMY posit firms to face the proximity-concentration trade-off. Self-selection entails the least productive firms to exit from the industry, less productive firms cater only to the domestic market, more productive firms choose to export as they can cover the higher cost of export. At some point, these firms are able to afford the sunk costs of OFDI and make the transition to the next level and invest abroad. The

[4]Following this definition, for the manufacturing sector, in 2008 for instance, the sample of firms *with investment outside India* (that may also export) is 447 out of nearly 4,303 firms in that year.

model predicts the sorting of firms into different organisational forms based on their productivity draw.

Head and Ries (2003) (below HR) develop an alternative model to get the HMY predictions and consider the empirical complementarity between exports and OFDI to extend the choice from exports *or* OFDI to exports *and* OFDI. The prediction of the productivity ordering between purely domestic firms, firms that also export, and firms that export and invest abroad is closer to the empirical literature in developing economies that suggests that it is exporters that graduate to the next level and invest overseas.

Key Contributions of the Research

This study attempts to build on the existing literature in the following respects. In the absence of information in the IOI data field about the percentage holding by Indian firms in their affiliates abroad, while some studies identify an OFDI firm on the basis of the existence of positive overseas assets, some use cut offs on the fraction of OFDI to total assets (as for instance, >1%).

We begin with a discussion of the criteria for firm categorisation based on the degree of foreign involvement (namely, D, DX, DXI, DI and DIDXI) as followed in this study and attempts to refine it.[5] D represents firms that only serve the domestic market; DX firms also export. DX thus covers not only the continuing exporters (that is, those firms that export continuously over the sample period) but also firms that switch their export status from domestic to exporter in the current year t. DXI export and also invest abroad. DI firms invest abroad but do not export. Further, the DXI and DI categories are also merged to form the OFDI firms' category, henceforth represented by DIDXI.

Firm-level total factor productivity (TFP) is the foundation for subsequent analysis. Methods/modifications are applied towards the construction of real output (gross output (GO); value added (VA)), and input series (combined intermediate inputs, namely, raw materials, energy and services;[6] labour and capital) required for estimating TFP. Given the incomplete coverage of the labour input in the database and the need to impute/ estimate it, two widely-used and two recently introduced approaches are reviewed and attempts are made to infer the strengths and weaknesses of the alternative methods based on results from a robustness check (Chawla, 2012). In the absence of the superiority of any of these approaches, while following the widely-used

[5]The nomenclature D, DX, DXI and DI follows Head and Ries (2003).
[6]Banga and Goldar (2007) highlight the importance of the inclusion of the services input in intermediate inputs.

Annual Survey of Industries (ASI) based approach to impute firm-level employment, an attempt is made to overcome the uniform wage rate criticism[7] by adjusting the labour input measure for a 'wage premium' based on firms' ownership categories.

The measure of physical capital, based on Perpetual Inventory Method (PIM)[8] allows for disaggregated growth of investment, and the capital stock series is formed by combining physical capital with 'knowledge' or 'Research and Development' capital stock.[9] To arrive at real measures from nominal measures, at the 3-digit industry level, price indices for output, raw materials, energy, and services are constructed separately.[10]

Next, two issues in the context of productivity estimation are discussed. First, comparisons are drawn between the alternative methods that attempt to overcome simultaneity bias, namely, Levinsohn and Petrin (2003) (below LP) and its modification proposed by Wooldridge (2009) (below W-LP). Second, in the context of studies that note that the relative superiority of exporters in comparison to purely domestic firms may also result from several sources of potential bias in productivity estimates (also related to functional form of the production function, namely, GO vs. VA), two sets of input coefficients (required for estimating TFP) at the 2-digit industry/ industry-group level are estimated to explore whether similar concerns are of importance when investigating the relative superiority of OFDI firms (that also export). The GO specification of the production function using LP approach, and the VA specification using W-LP approach are compared to examine whether functional form issues are more important than overcoming simultaneity bias in the present context.

1. Foreign Involvement and Firm Productivity

- For the first issue, in addition to manufacturing and service[11] sector firms, the under-investigated construction[12] and mining[13] sector firms are also considered. Descriptive statistics in manufacturing show that the median firm in D is smaller than firms in DX, while DXI are much larger, have higher export intensity than DX and also spend more on R&D. Further, while DXI have slightly lower capital-output

[7]Goldar, Renganathan and Banga (2004); Siddharthan and Lal (2004).
[8]Following Srivastava (1996), Balakrishnan et al. (2000) and Kato (2009).
[9]Following PIM as in Coe and Helpman (1995) with simplifying assumptions.
[10]Using Input Output Transactions Tables (IOTT) 1993/94 and 2003/04.
[11]The services sector includes information and communication sectors (5,145 observations).
[12]The construction sector covers construction of buildings and civil engineering (2,036 observations).
[13]The mining sector includes mining of coal and lignite, extraction of crude petroleum and natural gas, mining of metal ores, other mining and quarrying and mining support service activities (1,196 observations).

ratio, combined material, raw material and energy intensity, their services intensity is slightly higher than for D.

- The nonparametric approach of first-order stochastic dominance (Kolmogorov-Smirnov test) is used to examine the nature of productivity differentials between firm categories (based on foreign involvement). For firms in the manufacturing and construction sectors, cross-sectional differences in TFP between DIDXI, DX and D are found to follow the HMY and HR hypotheses, although in contrast to GO specification, VA specification of the production function suggests an upward bias in the productivity advantage of internationally engaged firms (suggesting that controlling the 'value added bias' is important and it is not sufficient to control only for the 'transmission bias').
- Productivity differentials vary, sometimes considerably, by 2-digit industry/industry-groups.
- In services, productivity comparisons show that DX dominate D, and DIDXI dominate D. However, between DIDXI and DX, no clear cut differences could be established, unlike a previous study for Indian software services suggesting the stochastic dominance of DX over DIDXI.
- In mining, only the dominance of DX over D could be established for the latter half of the sample period.
- Qualified support is thus found for the 'pecking-order' as predicted by heterogeneous firms' theories (Helpman, 2010). Productivity comparisons that include firms with marginal foreign investments, in manufacturing and services, are found to be broadly similar to those for firms with relatively larger positions abroad.

Next, this leads to an investigation into the direction of causality, for which some new econometric methods are applied to distinguish between the two alternative explanations for the observed relationship between firm productivity and OFDI.

2 Determinants of the Initial Decision to Invest Abroad

- 'Survival' analysis (or duration analysis) techniques applied to analyse what makes manufacturing sector firms start to invest abroad suggest that findings are consistent with the theoretical predictions of heterogeneous firms' literature that firm productivity explains the self-selection of firms into foreign markets.
- Nonparametric Kaplan-Meier estimates suggest positive effects of the firm's business

group affiliation on the 'hazard' of foreign entry. However, these effects are for large, not medium and small firms.

- Semiparametric results based on both continuous and discrete-time hazard models support the hypotheses that firm size, productivity, knowledge-based investments, export intensity, product differentiation, and cash flow are significantly related to early OFDI.
- Findings support the gradual internationalisation process, in which the firm serves the foreign market via exports before engaging in OFDI. Controls for within-industry peer effects ('domino' or spillover effects) from OFDI firms to other firms within the same industry are not found to be significant.

3 Effects of OFDI on Firm Performance

- Binary treatment analysis based on the propensity score matching-difference-in-differences (PSM-DID) estimator to get estimates of the *average treatment effect on the treated* (ATT) for 230 matched pairs over a three-year post-entry horizon indicates that the estimated causal effects of starting OFDI on TFP are insignificant in the OFDI entry year and in subsequent periods. OFDI appears to increase firms' export intensity, in the OFDI entry year and in subsequent years, suggesting a small complementarity between OFDI and exports. Sales of OFDI firms also increase with respect to comparable non-OFDI firms, with a significantly positive effect in the third year under OFDI.
- Industry differences (based on technology intensity) reveal that firms in high and medium high-technology industries (where the motivation for starting OFDI may be for sourcing strategic assets) experience an increase in TFP two years after foreign entry although it does not reach conventional significance levels. TFP in low and medium low-technology industries increases even more moderately. For export intensity and firm sales, the pattern of results for the two industry categories is reversed. While positive effects on export intensity and sales are strong for OFDI switching firms in low and medium-low technology industries, they are insignificant in high and medium-high technology industries.
- Results for a smaller number of matched pairs (116 matched pairs), for a four-year post-entry horizon, indicate that the effect on TFP (two-years later) is positive and significant, suggesting learning effects from OFDI.

- For continuous treatment, OFDI improves TFP growth but only within a sub-interval of the range of firms' foreign investment intensity. Analysing the effects of being a foreign investor in time period t on performance in subsequent time periods, estimated dose-response functions for all three outcome variables show varying effects of treatment levels, with significantly positive effects over a certain range of the treatment variable but an inverted U-shaped relationship overall. As the foreign investment intensity of Indian firms is still very low (about 8%) there appears to be a considerable treatment interval over which OFDI can positively and significantly impact the growth of TFP, sales, and export intensity.

- These findings assume importance in the context of the likely improvements in India's current account deficits that are likely due to such capital outflows.

- Comparisons of findings based on binary and continuous treatment suggest that the impact of *first-time* foreign investors may be very different from the effects of being a foreign investor in time period *t* on subsequent time periods. In assessing the learning effects of OFDI based on both binary and continuous treatment, this study finds that (1) binary treatment results based on 116 matched pairs (two-years later) is positive and significant; (2) continuous treatment reveals some evidence of differences in productivity growth between OFDI and non-OFDI firms; (3) it is only the estimate for 230 matched pairs that is statistically insignificant. Also, the numbers of ATT in both cases (for 230 and 116 matched pairs) are positive and high. It can thus be argued that two of the three estimates in this study, (1) and (2) above, suggest that OFDI favourably impacts firm productivity. While not dismissing the insignificant result, it is important to note that ambiguous/ insignificant results from binary treatment are consistent with significant non-linear effects with continuous treatment.

The key policy implication of the study is that policy measures by way of removing hindrances and providing broad support (such as financial and technological) especially to firms with small foreign investment intensities (small overseas investment positions) can help improve firms' competitiveness, export earnings and sales. This support can also be targeted towards export firms particularly if they are planning for technology-seeking OFDI.

Appendix I: Additional data sources

1. WPI series, obtained from the Office of the Economic Advisor (OEA), Ministry of Commerce and Industry of India, http://eaindustry.nic.in/, (1993/94=100 and 2004/05=100).
2. National Accounts Statistics (NAS), www.mospi.gov.in/cso_rept_pubn.htm.
3. Input-Output Transactions Table (IOTT) for the Indian economy for the benchmark years 1993/94 and 2003/04. www.mospi.gov.in/cso_rept_pubn.htm.
4. *Annual Survey of Industries (ASI) data from EPWRF for 1973/74 to 2003/04, Volume II*, Time-Series Data on ASI (1998/99 to 2007/08), ASI Summary Results for the Factory Sector 2008/09, ASI (Volume1) Factory Sector, 2009/10.
5. Concordance tables between NIC-1998 and NIC-2004 available at *mospi.nic.in/mospi_new/upload/nic_2004_concor_tab1.pdf* and between NIC-2004 and NIC-2008 available at *mospi.nic.in/mospi_new/upload/nic_2008_17apr09.pdf*

1. FOREIGN INVOLVEMENT AND FIRM PRODUCTIVITY[14]

1 Introduction

Based on a large sample of Indian firm-level data obtained from the CMIE Prowess database for 1995-2010, for the mining, manufacturing, construction and services sectors, this chapter seeks to establish if there is a positive link between firm productivity[15] and organisation of international activities through exports and/or OFDI. Although the positive link could be due to the most productive firms self-selecting themselves into foreign markets, it could also reflect learning effects through foreign engagements. Later chapters attempt to discriminate between these hypotheses.

Estimates of firm-productivity are obtained from applying two alternative specifications of the production function, gross output (GO) specification[16] based on Levinsohn and Petrin (2003) (below LP) approach,[17] and value added (VA) specification[18] based on Wooldridge (2009) (below W-LP)[19] approach. Within each of these two approaches, productivity estimates are also compared for the two alternative classifications of exporters and outward investing firms (specifications S1 and S2 respectively).[20]

This chapter begins in Section 2 by summarising the related theoretical

[14]For the manufacturing sub-sample, this chapter draws on Chawla, Isha, "Foreign Involvement and Firm Productivity: An Analysis for Manufacturing Firms in India", Conference Proceedings, pp. 273-309, Forum for Global Knowledge Sharing, Knowledge Forum 10th Annual Conference on "Technology, Growth and Sustainability", NIAS, Bangalore, India, 2015.

[15]In estimating firm productivity, taking firm i's production function at time *t* (in logs) as $y_{it}=f$ (capital$_{it}$, labour$_{it}$, intermediate inputs$_{it}$, ε_{it}, β_{it}) where ε_{it} (effect of unobserved determinants of production) and β (parameters). ε_{it} is assumed to be additively separable from other production factors and also additively separable in a transmitted component ω_{it} ('unobserved productivity', a state variable that impacts the firm's decision rules) and η_{it} (an unanticipated component). ω_{it}, the anticipated productivity shock that firm i observes before it makes its period *t* input decisions, the endogenous part of the error term is referred to as the firm's *total factor productivity* (TFP), taken to capture a systematic technology difference across firms.

[16]In the Cobb-Douglas, GO *specification* (with output as the dependent variable), the log of TFP (ω_{it}) is the residual from the linear regression of log of real output on log of capital, log of labour and log of intermediate inputs.

[17]LP is a semi parametric, proxy variables approach to control for simultaneity or transmission bias that results from the correlation between productivity and the primary inputs.

[18]In the VA *specification*, log of TFP (ω_{it}) is the residual from the linear regression of log of real value added on log of capital and log of labour inputs.

[19]Wooldridge (2009) is a modification of the LP estimator that proposes to address the collinearity issues raised by Ackerberg, Caves and Frazer, 2006 (below ACF).

[20]S1: DX if export intensity (exports/sales) is positive, DIDXI if export intensity is positive and foreign investment intensity (investment outside India/total assets) is positive. S2: DX if export intensity is ≥1%, DXI if export intensity is ≥1% and foreign investment intensity is ≥1%, DI non-exporter firms with foreign investment intensity ≥1%.

literature on firm productivity, exports and multinational firms. Section 3 presents descriptive statistics. Section 4 compares distributions of firm productivity for three categories of firms: (a) firms that serve the domestic market only, D, (b) pure exporters, DX and (c) those that export as well as invest abroad, DIDXI. Section 5 concludes. The appendices present additional tables and provide inter-industry productivity density plots as per internationalisation status of firms.

2. Theoretical review

Drawing on the theoretical propositions of the new new trade theory literature (Melitz, 2003; Helpman, Melitz and Yeaple, 2004, below HMY), recent explanations of the phenomenon assign a leading role to heterogeneity in firm productivity in explaining the self-selection of firms into foreign markets. Firm productivity is also expected to be enhanced by the learning effects from foreign contact. This two way cause and effect relationship between firm productivity and foreign involvement is expected to translate into a positive cross-sectional correlation between the two.

In HMY, for the export vs. OFDI decision, firms with the highest productivity are posited to cover the sunk costs of OFDI and invest abroad. Head and Ries (2003) (below HR) also note that an empirical complementarity between exports and FDI could result with differences in fixed costs across destinations. In hierarchy, the weakest firms are predicted to only serve the domestic market. Apart from serving the domestic market, better firms export, the even better firms export and invest abroad and the best firms invest abroad.

Further, while for manufacturing firms, predictors such as physical transport cost, sunk cost of OFDI (as in HMY) are considered to be fairly standard, for the services industry, different predictors, based on need for direct communication with consumers, the difficulty of contracting nonroutine activities to foreign affiliates (Oldenski, 2011); near-zero transportation costs and non-commoditised products are proposed to reverse the HMY prediction (Bhattacharya, Patnaik and Shah, 2012, below BPS).

3. Descriptive statistics

3.1 Sectoral classification and broad features by firm category

For sectoral sub samples, Table 1.1 shows the classification of firm-year observations by the category of foreign involvement.

In manufacturing, only a small fraction of observations (5.84% S1, 2.9% S2) correspond to foreign investors while a large proportion (51.89% S1, 45.82% S2) correspond to exporters.[21] Also,

[21]Unlike the empirical findings wherein few firms export, (e.g. Bernard et al., 2007 for US, where exporters represent only 18% of the total population), the relatively large share of exporting firms reflects the oversampling of the relatively large and medium firms in the data base.

Table 1.1: Firm-years (in percentages), by foreign involvement, 1995-2010

	S1					S2				
	D	DX	DXI	DI	DIDXI	D	DX	DXI	DI	DIDXI
Manufacturing	42.26	51.89	5.49	0.35	5.84	51.27	45.82	2.51	0.39	2.9
Services	33.43	40.58	23.71	2.27	25.99	39.75	37.8	20.43	2.02	22.45
Mining	48.24	46.66	4.85	0.42	5.10					
Construction	65.71	23.23	8.44	2.6	11.05					

Note: For the *mining and construction* sub-samples, percentages of observations are reported only for specification S1 due to the small absolute number of firm-years in DIDXI using specification S2.
Source: *Prowess* 4 and own calculations.

in 2009/10, for manufacturing, DIDXI accounted for 53% of sales of all firms in the sample (by S1) and 19.67% (by S2). For construction firms, DIDXI accounted for 62.75% of sales in the same year.

The export and foreign investment intensity varies greatly between firms. For instance, in 2009/10, for manufacturing, among the 1,771 exporters, about 18.4% export less than 1% of their sales, 34.5% export between 1 to 10 percent of their sales, 32.9% export 10-50% of their sales, 7.5% export 50-75% of their sales and 6.5% export 75 to 100% of their sales. Also, among the 444 outward investors in the same year, 48.4% firms have a foreign investment intensity of less than 1%, 35.6 % hold 1 to 10 % assets abroad; another 15% invest between 10 to 50 % assets abroad while 0.006% hold 50-75% assets abroad.

In the construction sector for the same year, of the 40 firms that export (DX+DXI), around 30% export less than 1% of sales, 37.5% export between 1 and 10% of sales, 27.5% export between 10 and 50% of sales and 6.66% export 50-100% of sales. Also, 73.3% firms have a foreign investment intensity of less than 1% while the remaining 26.6% invest between 1 to 10 % of their assets abroad.

Several empirical studies have shown that the exporting and foreign investing firms are generally larger in size. The size regularity is also found in the present data. Table 1.T1 in Appendix 1.1 indicates that firm size (measured by sales) is positively related with the percentage of firms participating in overseas investment in the manufacturing and construction sectors, while the overseas investors in the services sector are less concentrated in the largest size class. Table 1.2, for manufacturing, shows the broad features of the structure of firms with foreign operations as compared to those that do not.

Table 1.2: Descriptive statistics by foreign involvement (after data cleaning), manufacturing, 1995-2010

	S1								S2							
	D		DX		DI		DXI		D		DX		DI		DXI	
Variable	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range
Ln TFP index*	-.028	-.189/.139	.0005	-.151/.166	.068	-.078/.294	.061	-.114/.227	-.018	-.176/.150	-.0004	-.155/.165	.150	-.051/.360	.042	-.149/.189
Ln TFP	.170	-.04/.43	.249	.027/.489	.259	.048/.473	.306	.06/.541	.181	-.029/.443	.257	.029/.496	.343	.063/.543	.255	.049/.474
Sales (in Rs. cr)	21	7/ 55	65	24/173	117	30/772	385	133/1027	26	9/74	69	25/191	212	41/961	408	121/1137
Total assets (in Rs. cr)	18	8/44	60	24/166	143	41/610	414	145/1183	22	9/61	64	25/189	189	50/731	541	141/1421
R&D expenditure (in Rs. cr)	.1	.04/.4	.4	.1/1.4	1	.2/3	2.7	.7/13	.2	.1/.7	.5	.1/2	3	.44/8	4	.8/23
Export intensity (in %)	-	-	8.5	2/28	-	-	17.6	6/42	0	0/0	13	5/35	0	0/0	22	9/48
Foreign investment intensity (in %)	-	-	-	-	1	.4/4	.9	.1/.4	-	-	-	-	3	1/8	4.4	2/10
Output (in 1999/00 rupees)	19	7/49	59	23/157	103	25.4/560	314	112/810	24	8/65	62	23/171	198	31/773	325	100/888
Value added (in 1999/00 rupees)	5	2/13	17	6/52	33	8.5/15	111	37/307	6	2/19	18	6/57	52	15/297	122	34/336
R and D stock (in 1999/00 rupees)	0	0/0	0	0/.3	0	0/.1	.4	0/5	0	0/0	0	0/.3	0	0/.9	.4	0/8
Number of employees (imputed)	127	46/381	450	171/1227	529	216/1569	2074.5	776/5105	165	56/498	484	176/135	704	243/300	2031	744/5593
No. of observations	24,383		29,940		206		3,169		29,580		26,440		227		1,451	

Notes: *A relative firm-specific productivity index (ln TFP index) is constructed by subtracting the estimated productivity of a single reference firm that varies across 2-digit industries, from the estimated productivity of each individual firm-year observation (with the reference firm being a hypothetical firm with average output and input levels over all firms in the base year of the sample period, and with the respective industry groups' estimated input coefficients (Pavcnik, 2002; Topalova and Khandelwal, 2011).
Source: Prowess 4 and own calculations.

Table 1.2 shows that for both specifications S1and S2, the median firm in the outward investing firms' categories (DI and DXI) is more productive than firms that are not engaged in OFDI (DX and D), while the median DX firm is more productive than the D firm. The median firm in the D sample is smaller (in sales/ total assets/number of employees) than firms in the DX sample, while DXI are much larger. The median DX or DI/DXI firm produces more output and has higher value added than the D firm. DXI have higher export intensity than DX (reflecting market-seeking export behaviour, and interdependencies across the modes of internationalisation). DXI also spend more on R&D, indicating creation of 'knowledge' capital. Also, Table 1.T2 in Appendix 1.1 shows that DXI have slightly lower capital-output ratio, combined material, raw material and energy intensity although their services intensity is slightly higher than D.

Further, for manufacturing, it is examined whether there is any change in the mean productivity of OFDI firms over time, that is, in comparing the pre-and post-OFDI time periods. Using productivity estimates for the GO specification (based on LP approach), for specification S1, if t = 0 is the year in which a firm i switches into becoming an OFDI firm for the first time, for 599 OFDI entries over various years of the sample period, Table 1.3 shows the mean productivity *ln* TFP index of DIDXI at time $t \pm s$, where s = 1, 2, 3, that is, s years pre- and post- OFDI entry.

Merging the pre-and post-OFDI time periods (t-3, t-2, t-1) and (t+1, t+2, t+3), the mean productivity for the post-OFDI time period is significantly higher (at the 5% level) for the one sided t-test than that for the pre-OFDI time period. This anticipates the productivity results in Chapter 3.

Table 1.3: Mean productivity (ln TFP index) of OFDI firms, pre-and post-OFDI

(a)							
Time periods	*t-3*	*t-2*	*t-1*	*t0*	*t+1*	*t+2*	*t+3*
***Ln* TFP index**	.0323	.0545	.0557	.0659	.0718	.0725	.0731
(b)							
	Pre-OFDI		Post-OFDI			*t*-test	
	(merging time periods t-3, t-2, t-1)		*(merging time periods t+1, t+2, t+3)*			Post>Pre	
						(p-value)	
***Mean ln* TFP index**	.0477		.0724			0.0143	
(No. of obs.)	(n = 1520)		(n = 1560)				

Source: *Prowess* 4 and own calculations.

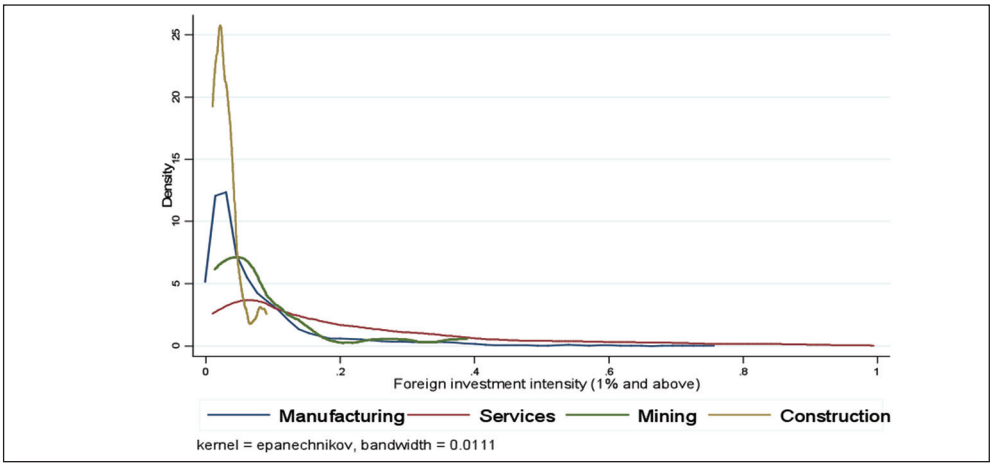
3.2 Inter-sectoral and inter-industry comparison

Through the density plots of the foreign investment intensity, Figure 1.1 shows inter-sectoral heterogeneity in the extent of the internationalisation of firms in the mining, manufacturing, construction and services sectors, conditional on outward investment.

Table 1.T3 in Appendix 1.1 shows substantial variation in the fraction of foreign investing firms across industries within the manufacturing sector. For instance, in 2009/10, the wood products industry has a much smaller fraction of foreign investors than the chemicals/pharmaceuticals industry.[22]

Figure 1.2 shows the scatter plot of the outward orientation of industries (as measured by the average industry export and foreign investment intensity) over 2008-2010 and is indicative of considerable heterogeneity at the 3-digit industry level. Industry specific effects, partly attributable to the nature of products produced are suggestive of the outward orientation of firms belonging to the industry groups.

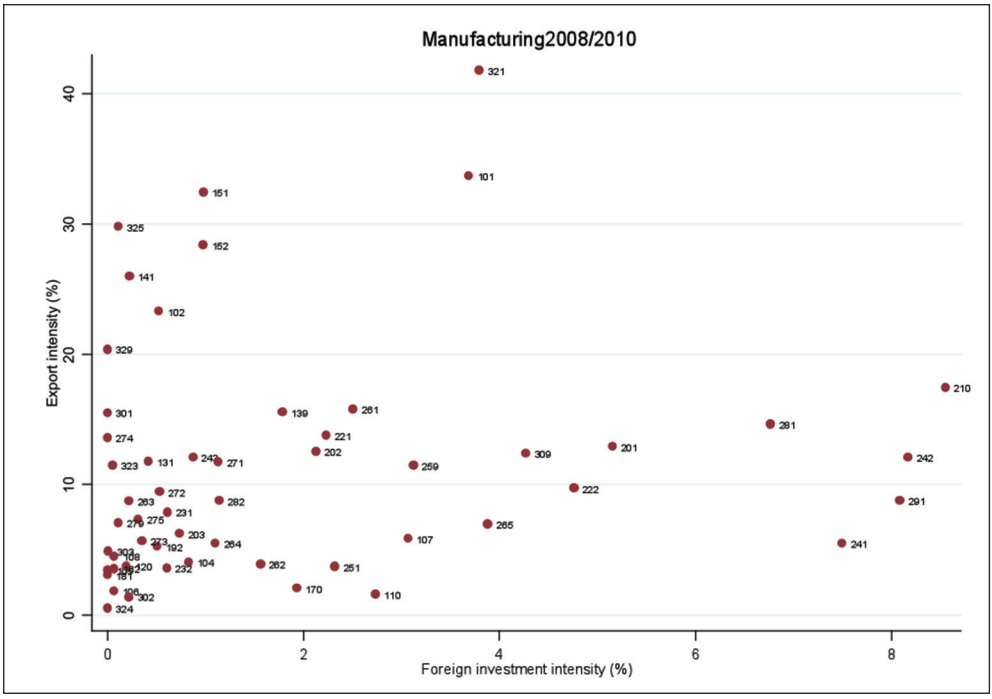
Figure 1.1: Density plots of foreign investment intensity by sector, for S2, 1995-2010



Source: *Prowess* 4 and own calculations.

[22]However, the largest home-based transnational corporations (TNCs) for 2010 as in UNCTAD (2013), India country sheet represent manufacturing industries with varying degrees of technological sophistication: Reliance Industries Ltd., Essar Oil Ltd. (coke, petroleum and nuclear fuel), Tata Steel Ltd., Hindalco Industries Ltd., MMTC Ltd., JSW Steel Ltd., Ispat Industries Ltd. (metals and metal products), Tata Motors Ltd., Mahindra and Mahindra Ltd., Bajaj Auto Ltd. (motor vehicles and other transport equipment), Suzlon Energy Ltd. (machinery and equipment), ITC Ltd. (food, beverages and tobacco), Hindustan Unilever Ltd., Ranbaxy Laboratories Ltd., Tata Chemicals Ltd., Dr Reddy's Laboratories Ltd., (chemicals and chemical products), Videocon Industries Ltd., Siemens Ltd., Crompton Greaves Ltd. (electrical and electronic equipment), Apollo Tyres Ltd. (rubber and plastic products), and Ambuja Cements Ltd., Ultratech Cement Ltd. (non-metallic mineral products).

Figure 1.2: Scatter plots: average export and foreign investment intensity by 3-digit industry, manufacturing, for S1, 2008-2010



Notes: NIC191 and NIC103 are excluded as the number of outward investing firms is below five.
Source: *Prowess* 4 and own calculations.

4 Productivity comparisons

For each sector, in section 4.2 below we first graphically compare productivity trends and distributions of the three firm categories, namely DIDXI, DX and D, followed by the Kolmogorov-Smirnov test (K-S test) as discussed below.

4.1 Testing procedure: Kolmogorov- Smirnov test (K-S test)

The nonparametric K-S test makes no assumption about the sample distribution, and tests for differences in all moments of the productivity distribution while differences in marginal moments such as the mean and standard deviation do not reflect the entire distribution of productivities.[23] Following Girma, Gorg and Strobl (2004), these are comparisons of unconditional distributions, that is, are not controlled for other covariates such as size, age, innovation, group and industry fixed effects.

[23]The test is more robust than the *t*-test that requires the normality assumption.

The hypothesis to be tested is that if productivity differences between firms at any point in time reflect self-selection and/or learning effects, the productivity distribution of the DIDXI firms should dominate that of the DX firms that should in turn dominate the productivity distribution of the D firms.[24]

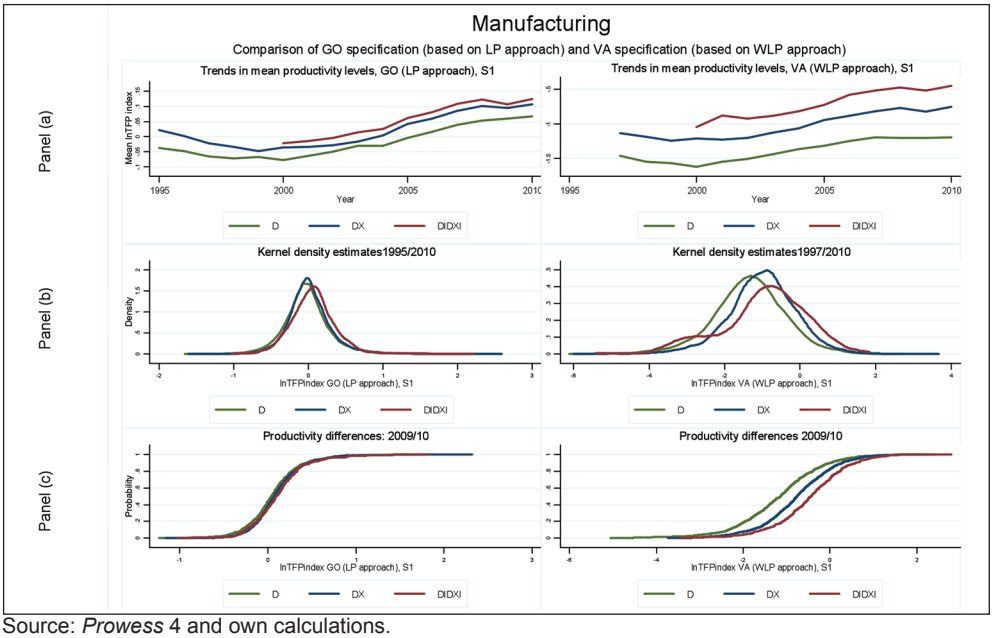
4.2 Results

4.2.1 *Manufacturing sector*

Figure 1.3 compares the productivity differences among the three firm types for the two alternative productivity measures for specification S1. Column (1) depicts the GO specification (based on LP approach) for 1995-2010, while column (2) depicts the VA specification (based on W-LP approach) for 1997-2010.

A comparison of the graphs in panel (a) for the trend in mean productivity (ln (TFP) index) for the three firm types[25] displays stronger differences under the VA rather than the GO

Figure 1.3: Differences among firm types (DIDXI, DX, D), based on TFP estimates, comparing methods, manufacturing, S1, 1995-2010



Source: *Prowess* 4 and own calculations.

[24]First order stochastic dominance (FOSD) of the distribution function of DIDXI relative to DX requires (1) that the two distributions are not identical and (2) that one distribution dominates the other. Graphically, the cumulative distribution function of productivity of DIDXI is to the right of DX, that is, is on the higher productivity side. Further, to maintain the independence assumption, the hypothesis is tested separately for each year of the sample period.

[25]The mean productivity for DIDXI is not shown for 1995-1999, as due to the small number of firms in this time period, the mean values are subject to larger variations.

specification.[26] Panel (b) shows that the kernel density estimates of the productivity distribution for DIDXI lies to the right of the distribution of DX and even further to the right from the distribution for D consistent with the HMY (and HR) prediction.[27] For 2009/10, panel (c) shows that the cumulative distribution function of firm productivity for DIDXI lies to the right of DX and more so for D indicating FOSD. Productivity rankings thus favour DIDXI over DX, DX over D, and DIDXI over D (which also follows by transitivity). Firms that invest abroad have higher productivity than firms that export only or that only operate domestically. The differences across firms are however more pronounced for the VA specification indicating a 'value added bias'[28] that remains even after controlling for the 'transmission bias' with the W-LP productivity estimation technique that is robust to the ACF (2006) criticism (Gandhi, Navarro and Rivers, 2013; Rivers, 2013).

Analysis of the density plots of the estimated productivity at the 2-digit level/combined groups indicates that the relationship between firm productivity and foreign involvement is stronger in some industries, for instance, in textiles (NIC 13), coke and refined petroleum products, chemicals (NIC 19, 20), pharmaceuticals (NIC 21), basic metal and fabricated metal (NIC 24, 25), and machinery and equipment n.e.c. (NIC 28) than in the rest.

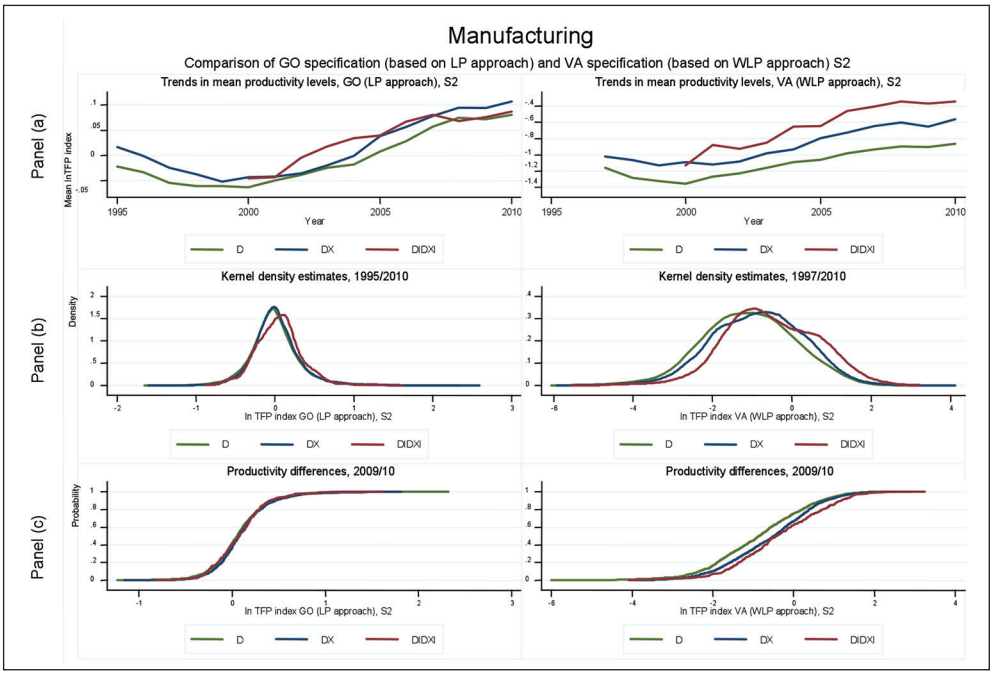
Figure 1.4 shows any effects that limiting the lower bound for qualifying as an exporter and foreign investing firm (S2), may have on the validity of the HMY (and HR) hypotheses. The K-S test results (not reported here) lend support to the HMY (and HR) models for most but not all years of the sample period. Graphically, differences in firm categories are however less pronounced for S2 than for S1.

[26]Both columns however show that the impact of the negative demand shock for Indian firms in 2008 (Q2) to 2009 (Q2) has been more so for firms with foreign engagements than purely domestic firms.

[27]As the HMY model deals with horizontal FDI alone, and although a large fraction of FDI by Indian firms goes to the developed countries for market-access (RBI Bulletins), it seems reasonable to test the HMY predictions. Nunnenkamp et al. (2012) also find that the location choice of Indian direct investors is dominated by the motive of market-related factors, much less so for access to raw materials or for superior technologies. In so far as OFDI is also guided by vertical or complex integration strategies, also related to the internationalisation of R&D, in the absence of the fraction of OFDI directed by the underlying motives, testing the HMY predictions may however yield partial insights.

[28]Value added bias results from the value added specification of the production function that requires stronger conditions on the production technology (separability of intermediate inputs and primary inputs of capital and labour), and ignores the role of intermediate inputs.

Figure 1.4: Differences among firm types (DIDXI, DX, D), based on TFP estimates, comparing methods, manufacturing, S2, 1995-2010



Source: *Prowess* 4 and own calculations.

4.2.2 *Services sector*[29]

Figure 1.5 shows similar comparisons for service sector firms (analysis restricted to NIC 61, 62 and 63) for S1.[30] Panel (a) shows that as in manufacturing, the trend in mean productivity (ln TFP index)[31] for DIDXI, DX, and D displays stronger differences under the VA specification

[29]Service sector DXI and DX firms are engaged in industries such as 'basic telecom services, internet access by the operator of the wireless infrastructure, other wireless telecommunications activities, other telecommunications activities, providing software support and maintenance to the clients (software service and consultancy), news agency activities (television broadcasting media, cable television broadcasting media (DX only), other information service activities n.e.c.(information technology enabled service/BPO), activities of maintaining and operating pageing, cellular and other telecommunication networks (DX only)'. Several firms in the services sector have established large overseas positions. For instance, in 2009/10, while the largest stock of overseas assets was held by Bharti Airtel Ltd. (Rs. 5,219.1cr), Silverline Technologies Ltd, H O V Services Ltd., Four Soft Ltd., and Mindteck (India) Ltd. had a foreign investment intensity of over 80%. Further, Bharti Airtel Ltd., Reliance Communications Ltd., Tata Communications Ltd., United Breweries Holdings Ltd. (transport, storage and communications), Tata Consultancy Services Ltd., Wipro Ltd., Infosys Ltd., HCL Technologies Ltd., Mphasis Ltd., Tech Mahindra Ltd. (business services, the high-skill intensive category of services) list in the largest home-based TNCs for 2010, UNCTAD (2013) Investment Country Profiles, India. Tata Consultancy Services Ltd., Infosys Ltd., Wipro Ltd., Tech Mahindra Ltd., HCL Technologies Ltd. were also the largest service exporters in 2010.

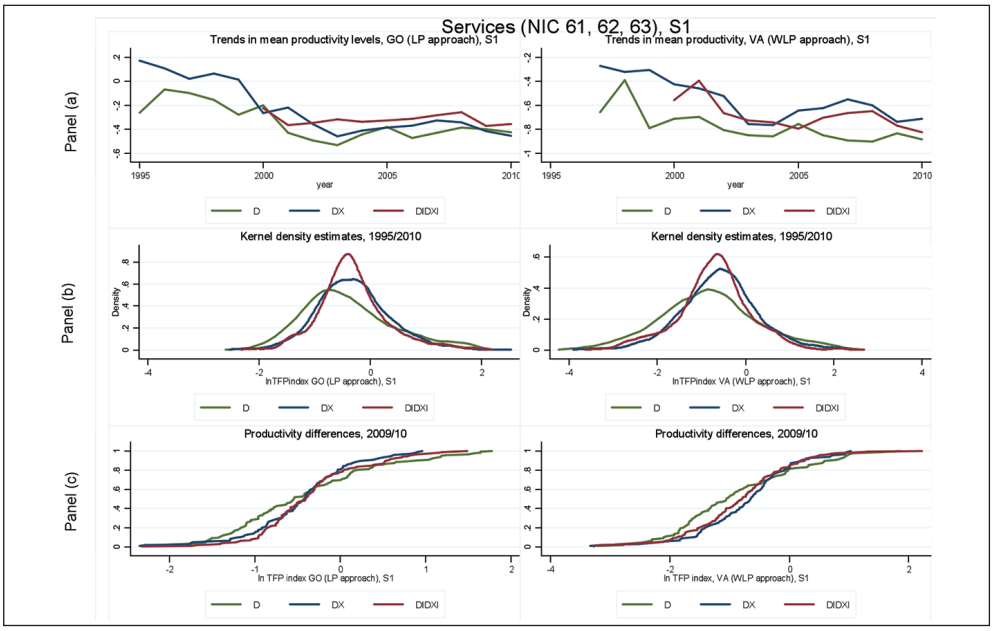
[30]Telecommunication (NIC 61), computer programming, consultancy and related activities (NIC 62) and information service activities (NIC 63).

[31]The mean productivity for the sample DIDXI is not shown for 1995-1999, as due to the small number of firms in this time period, the mean values are subject to larger variations.

(based on W-LP approach)[32] than under the GO specification (based on LP approach). While the mean productivity (ln TFP index) for D consistently lies below that of DX for both productivity measures, the left column for the GO specification shows that DIDXI lies above the other two categories for most time periods while the right column is more in line with the BPS theorising.

Panel (b) shows that the density plots for DX lie to the right of that for D for both the productivity measures although there is a small overlap with D towards the right tail. Further, due to the crisscrossing of DIDXI and DX kernel density plots, and the cumulative distributions of TFP (for 2009/10) in panel (c), graphically, the dominance of one group over the others is not very obvious over the whole distribution, although the cumulative distributions of TFP in the left panel seemingly favours DIDXI over DX while the right panel favours DX over DIDXI. Figure 1.6 for S2 conveys a similar picture, although several firms that are now classified as D raise the productivity of this category, so that its domination by DIDXI and DX is now less clear cut, more so in the left column.

Figure 1.5: Differences among firm types (DIDXI, DX, D) based on TFP estimates, comparing methods, services, S1, 1995-2010



Source: *Prowess* 4 and own calculations.

[32]Due to the relatively small number of firms in the services sector for which productivity could be estimated in the 1995-1999 period, the broad trends for this sector are more meaningful for the 2001 onwards time period.

Minondo (2012) refers to Francois and Hoekman (2010) in making the argument that since services face much larger barriers to trade than manufactures, as they require the coincidence of suppliers and customers in space and time, it is expected that there would be a very strong link between exporting and productivity in services. However, a weaker link is expected in services where the movement of the supplier is inherent to the activity, as in transport services, and in services that can be supplied through the Internet (e.g. call-centres), or whose final output can be digitised and transferred through the Internet. As the present sample under services mainly consists of IT, this reasoning could be relevant. Based on the same methodology, the results for the services and manufacturing firms are qualitatively similar. In such cases, Breinlich and Criscuolo (2011) note that the existing goods trade models might be suitable for firm-level services trade as well.[33]

Unlike manufacturing where there are significant productivity differentials between DIDXI and DX, and BPS wherein the TFP distribution of DX dominates over that for DXI,[34] in the present chapter, the productivity ranking of DX lying to the right of DIDXI indicating stochastic dominance could not be established. For 2009/10, the VA approach in Panel (c) however suggests DX domination, although not for the entire distribution.

Part of the difference in results between BPS and this chapter could be due to the specification of the production function. For software services, BPS adopt a two input GO production function. On another view, the HMY model deals with horizontal OFDI alone, motivated by market-seeking considerations. As a large fraction of OFDI by Indian IT firms goes to the developed countries, OFDI could also be guided by vertical or complex integration strategies, related to the internationalisation of R&D with firms investing abroad for technology seeking motives, or agglomeration economies (due to clustering in specific regions).[35]

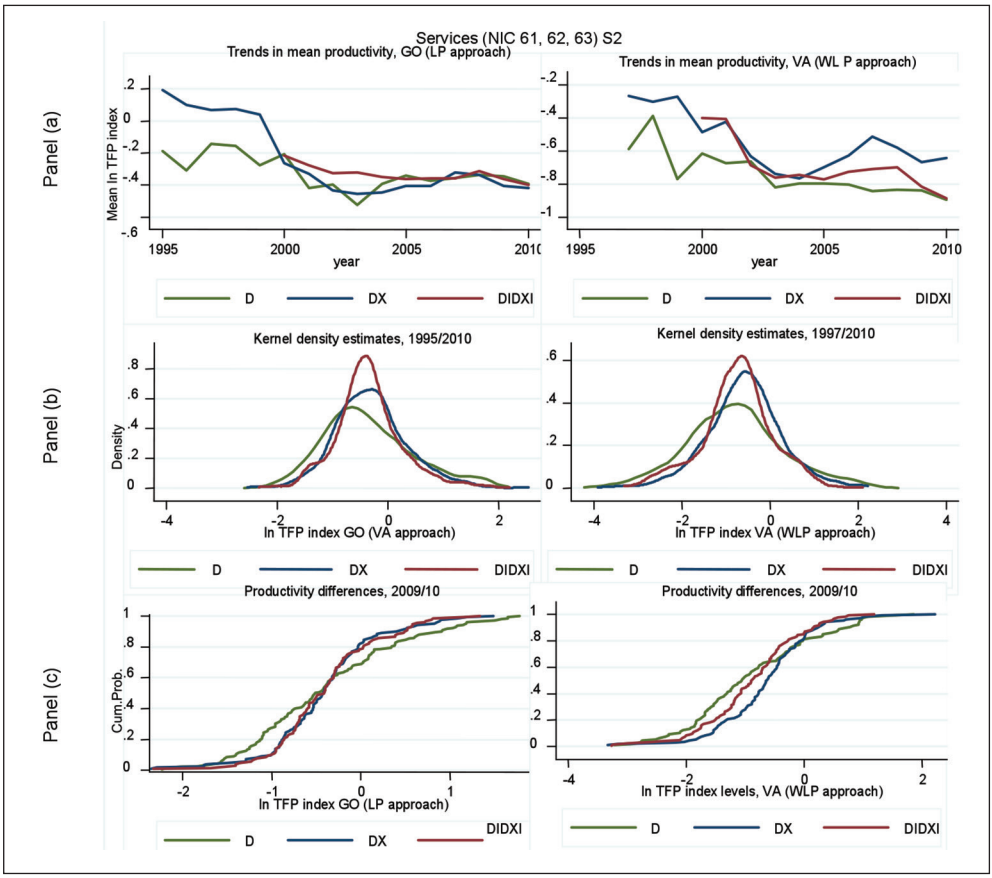
These considerations could also have a bearing on the observed relationship between firm productivity and foreign involvement. These results also differ from Engel and Procher (2012) who find the HMY ranking for French firms in manufacturing, wholesale and retail trade, transport, financial

[33]BPS compares DXI to DX but not DX to D.

[34]Two key characteristics that identify the software service companies are the non-zero transportation costs for software services that are posited to encourage production at home while software services being non-commoditised, with a range of intangible characteristics, is posited to make customers feel it is risky to buy software services from a distant country, and this is considered to encourage FDI.

[35]In this regard, Rattankumphu (2006) suggests that for 1996-2002 Indian software firms were not fully efficient.

Figure 1.6: Differences among firm types (DIDXI, DX, D), based on TFP estimates, comparing methods, services, S2, 1995-2010



Source: *Prowess* 4 and own calculations.

intermediation, real estate, IT services and services for companies. Even while DX do not differ significantly from DIDXI, the K-S test confirms that DIDXI are significantly more productive than D (supporting Tanaka (2011) for Japan).

4.2.3 *Construction sector*[36]

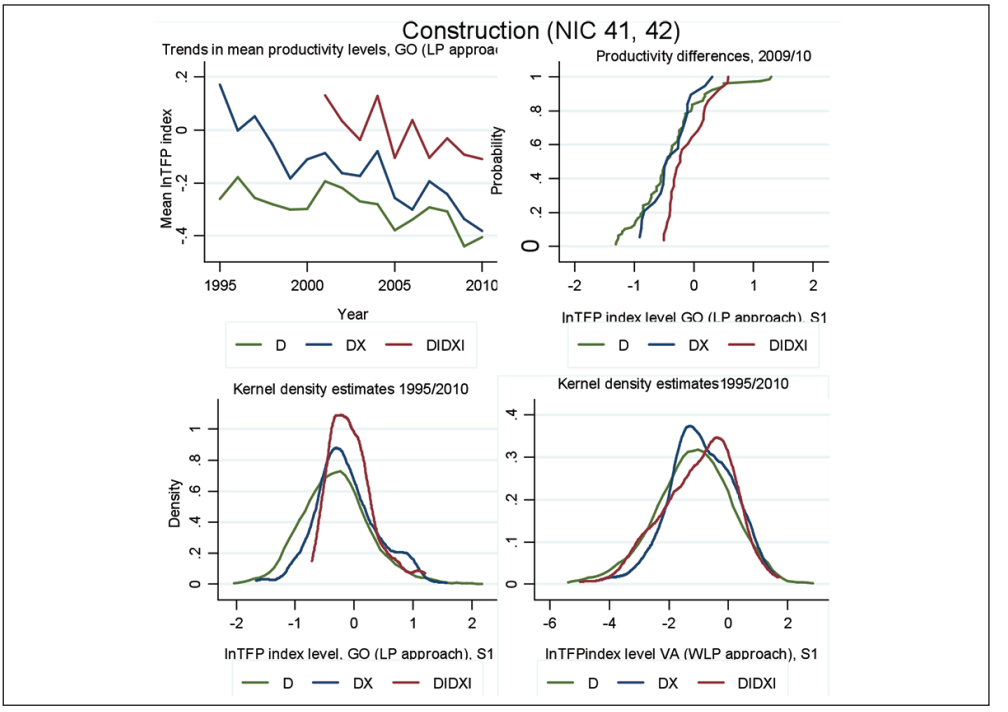
Due to the relatively small number of outward investing firms from this sector, results are presented for S1 only (Figure 1.7). For comparison, the VA specification (based on W-LP

[36]Construction firms involved in exports and OFDI belong to industries such as 'construction of buildings carried out on own-account basis or on a fee or contract basis, construction and maintenance of motorways, streets, roads, other vehicular and pedestrian ways, highways, bridges, tunnels and subways, construction of utility projects n.e.c., and other civil engineering projects n.e.c.', (Prowess4). For 2010, Larsen and Toubro Ltd., Punj Lloyd Ltd., and Gammon India Ltd. are the largest home-based TNCs from the construction sector (UNCTAD, 2013).

approach) is shown in the right bottom panel only. Trends in mean productivity suggest an ordering of DIDXI, DX and D respectively.[37] The density plot for DX lies to the right of D for both productivity measures, and for DIDXI even further to the right (for the GO specification (based on LP approach)) although there is an overlap with DX towards the right tail. The cumulative distributions for the three firm categories for 2009/10 suggest the stochastic dominance of DIDXI. The comparison of DIDXI with DX for the VA specification (based on W-LP) is less marked. Both productivity measures suggest the productivity advantage of DIDXI over D.

Results for the construction sector in this study are at odds with those for construction firms in France (Engel and Procher, 2012) who do not find any clear productivity patterns between foreign investors, exporters

Figure 1.7: Differences among firm types (DIDXI, DX, D), based on TFP estimates, comparing methods, construction, S1, 1995-2010



Source: *Prowess* 4 and own calculations.

[37]Over 1995-2010, the estimated average annual growth rate of real physical capital stock (real Net Fixed Assets) for this sector is comparatively higher. If output has not risen in accordance, this could partly explain the downward slant in mean TFP over the years. The yearly fluctuations in mean productivity could reflect the small sample size in each category for which the mean has been computed.

and domestic firms. Engel and Procher (2012, p. 15-16) point out:

> The construction and building market is dominated by local players and transport costs play a fundamental role because of typically bulk-sized and low-margin products (Handelsblatt, 2007, p.12). Closeness to the customer is of utmost importance. Hence, transnational expansion in this industry might be governed by different motivations compared to other industries. In addition, temporally project-oriented co-operations with the involvement of a large number of consortium partners are quite common in the construction industry. Here, sunk costs of OFDI might be comparatively low so that the difference between exporters and multinational becomes negligible.

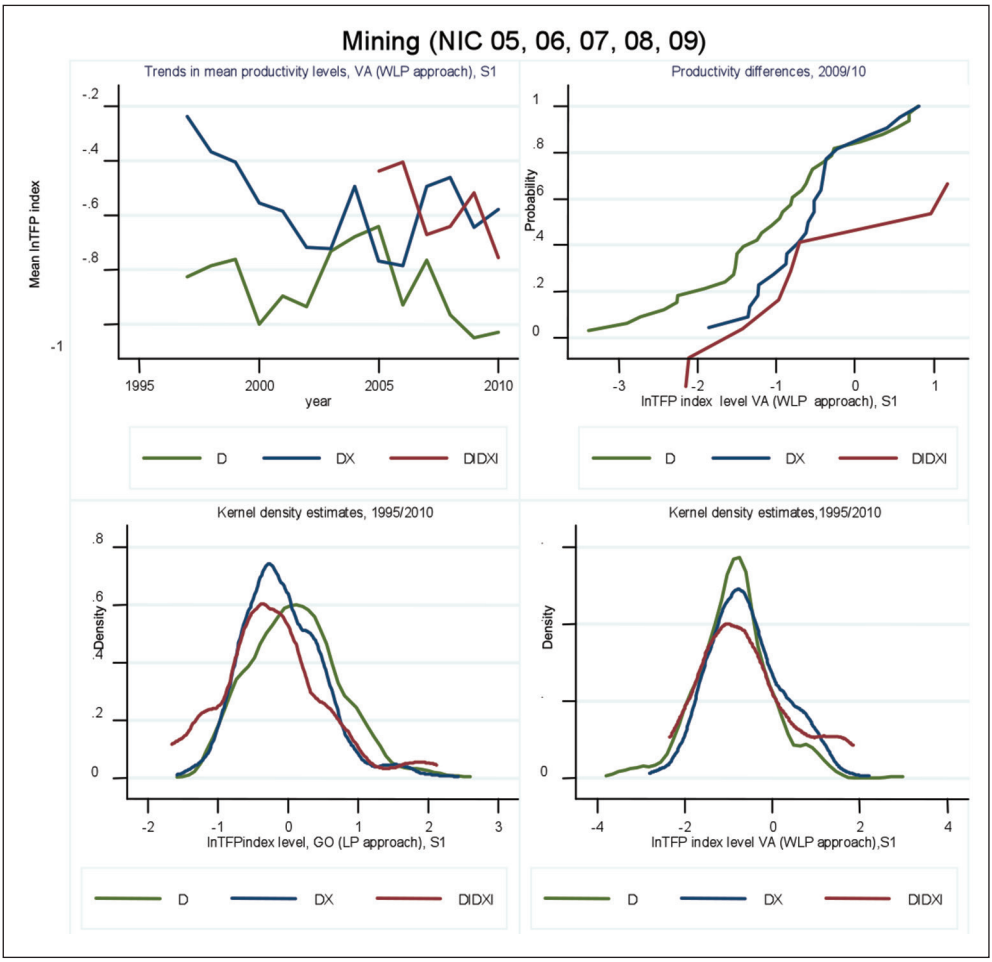
Results of this study are consistent with the HMY (and HR) models for most but not all years in the sample period. In 2009/10 for instance, according to the RBI dataset on 'Overseas Investments by Indian Companies', construction firms have mainly invested in several developing countries with major investments in Mauritius (likely due to round tripping), United Arab Emirates, Spain, Cyprus and Singapore. These infrastructure and real estate developments indicate that Indian overseas investors could be providing appropriate level technology at a reasonable cost, an idea associated with an earlier literature (UNCTAD, 1993) on the ownership advantages of firms from developing countries and as in the product cycle model of Vernon (1966).

4.2.4 *Mining sector*

Overseas investments (mainly acquisitions of oil and gas assets) by Indian natural resource based firms have mainly been directed at the extractive sector of Africa and elsewhere as a source for energy and raw material supplies.[38]

[36]DX and DXI in the mining sector belong to industries such as 'on shore extraction of crude petroleum and natural gas, mining of iron and other ores, quarrying of granite, mining of clays, salt mining, quarrying, screening etc., extraction and agglomeration of peat, services incidental to off shore oil extraction, and other operations relating to mining and agglomeration of hard coal.' Oil and Natural Gas Corp. Ltd. (ONGC), Sterlite Industries (India) Ltd. TFP estimates for ONGC could however not be obtained as its raw material data is not available. Even though the firm has large overseas stakes in exploration, it is thus not part of the sample of firms.

Figure 1.8: Differences among firm types (DIDXI, DX, D), based on TFP estimates, comparing methods, mining, S1, 1995-2010



Source: *Prowess* 4 and own calculations.

Figure 1.8 shows that the trend of mean productivity for DX is higher for most years than for D, and although that of DIDXI and DX is not perceptibly higher or lower than the other, that for DIDXI is higher than that of D. The kernel density plots show that the GO specification (based on LP approach) suggests that the productivity distribution of D lies to the right of DX that in turn lies to the right of DIDXI. The VA specification, however, shows no clear pattern except in the right tail. The CDF based on VA specification (based on W-LP approach) also suggests that DX dominates the other two categories but not over the entire distribution. Although the fact that there are only a small number of outward investing firms in mining

severely restricts checking of the validity of HMY (and HR) models, the hypotheses may nevertheless not hold good as the underlying motives for OFDI may be mixed, resource-driven as well as market-driven.

4.3 Robustness analysis

For manufacturing, results are robust to covering the data set that includes firms with small overseas positions, to the choice of TFP measure (GO vs. VA) though VA based distributions suggest stronger differences among firm categories, and choice of method (LP and W-LP) for production function estimation.

5 Conclusions

The Kolmogorov-Smirnov test was used to establish first order stochastic dominance (FOSD) of the cumulative distribution functions (CDF) of firm productivity for various firm categories. These productivity comparisons are not controlled for size, age, innovation, group and industry fixed effects. For manufacturing, overseas investing firms (DIDXI) were found to be more productive than the other firm categories, while pure export firms (DX) have intermediate productivity levels. These results are in agreement with such results from similar studies for several countries including Tian and Yu (2012) for China who also find a positive correlation between firm productivity and OFDI.

Although DIDXI and DX categories dominate over the purely domestic firms (D) for both production function specifications, the gross output (GO) specification (based on LP approach) suggests quantitatively smaller differences in productivity between firm categories. The value added (VA) specification (based on W-LP approach) thus validates the HMY (and HR) hypotheses more strongly than the GO specification (based on LP approach). These results compare with Gandhi, Navarro and Rivers (2013) and Rivers (2013) that show that accounting for intermediate inputs using the GO specification, substantially reduces the estimated productivity advantage of exporters over non-exporters. This suggests that controlling the 'value added bias' is important and it is not sufficient to control only for the 'transmission bias'. Although similar patterns obtain, yet graphically, differences in firm categories are less pronounced for S2 than for S1.

For services, for both productivity approaches and specifications, DX have higher productivity than D as found in several other studies. The stochastic dominance of DX over DIDXI as suggested for software services in Bhattacharya, Patnaik and Shah (2012) could not be established. This suggests that Indian IT firms' OFDI that is mainly located in developed

countries could also be guided by vertical or complex integration strategies, related to the technology seeking motives and agglomeration economies. DIDXI however come out to be more productive than D. Furthermore, expanding the sample of outward oriented firms to include firms with small international positions does not qualitatively alter the nature of the relationship between firm productivity and foreign involvement.

For construction, results suggest the HMY (and HR) ordering of DIDXI, DX and D respectively for most years in the sample period. This could mainly reflect advantages built at home. Demirbas, Patnaik and Shah (2013) do not include the construction firms in their sample as they note that the concepts of exporting vs. OFDI are blurred in the construction industry. Further, as a limitation of the present exercise, Hall and Mairesse (1995) note that the concept of both labour productivity and TFP is better measured and more meaningful in manufacturing than in other sectors such as construction and business services.

For mining, graphically, productivity distributions for the GO (based on LP approach) and VA (based on W-LP approach) suggest a different ranking pattern. As the number of outward investing firms is considerably smaller, DX that includes relatively more observations is more indicative of the productivity characteristics of internationalised firms. Also, the underlying motives for OFDI in mining may be both resource-driven as well as market-access.

The chapter thus finds qualified support for the HMY (and HR) models- at the sectoral level, in manufacturing and construction but not in services and mining. Within manufacturing, at the 2 digit/industry level, graphically, the predicted relationship is more obvious in several but not in all industries.

In seeking to enhance India's OFDI flows, an OFDI policy framework has evolved in recent years. For instance, under the EXIM Bank's Overseas Investment Finance (OIF) programme,[39] financial support measures are being offered both for setting up manufacturing units and acquiring overseas companies for a variety of motives such as seeking foreign markets, raw materials, technology and intellectual property rights (IPRs). Funded/non-funded assistance is provided over the entire cycle of Indian firms' overseas investments, particularly to outward oriented small and medium enterprises (SMEs) (EXIM Bank, 2014). Financial assistance takes the form of term loans for making equity investments in and extensions of loans towards firms'

[39]http://www.eximbankindia.in/overseas-investment-finance-programme.

overseas joint ventures (JVs) and wholly owned subsidiaries (WOSs) and guarantee facility to the overseas JVs and WOSs for raising term loans/ working capital.

The following policy implications that can be drawn from this study support the above measures by drawing focus towards firms with small international engagements. As noted in the chapter, the sample of OFDI firms as per specification S1 is much larger than that under specification S2. For the manufacturing sector, the productivity and other firm characteristics of OFDI firms that initially start small are observed to be qualitatively similar to those with larger positions abroad. If a constraint on financing is found to be an issue for these firms, the government should support a more liberal financial system for the purpose of overseas investment that could also aim specifically at firms with initially small OFDI flows. Findings in Chapter 3 for manufacturing sector firms also indicate that there is a range over which it is possible to increase firms' OFDI intensity and increase the benefits from OFDI.

Appendix 1.1: Additional tables

Table 1.T1: Percentage of D, DX, DXI and DI group of firms in various size classes

	Mining			Manufacturing				Construction				Services			
Size class (in Rs Cr)	D	DX	DXI	D	DX	DI	DXI	D	DX	DI	DXI	D	DX	DI	DXI
< 1	8.2	0.5	0	3.1	0.3	0.9	0.1	2.7	0.8	0	0	23.0	7.1	17.0	0.9
1 to 10	37.2	25.0	0	28.4	10.1	7.0	1.5	22.8	6.0	0	0	38.5	26.1	36.4	18.8
10 to 50	16.9	33.2	41.7	41.4	32.6	31.9	9.4	29.2	21.0	1.9	4.0	19.6	28.6	27.1	27.5
50 to 100	3.9	17.6	11.7	13	18.4	11.8	10.1	13.6	17.7	16.7	7.3	3.8	11.5	1.7	12.2
100 to 500	9.6	16.8	26.7	12.0	29.7	23.1	36.4	22.1	35.9	40.7	34.5	7.0	1.8	5.9	25.2
500 to1000	1.3	3.1	10	1.3	5.0	9.2	17.4	4.3	10.3	20.4	22.6	0.7	4.2	1.7	7.8
> 1000	23.0	3.9	10	0.7	3.9	16.2	25.1	5.3	8.3	20.4	31.6	7.4	5.0	10.2	7.6

Notes: *Mining* excludes DI as the number of firms is very less and thus unrepresentative.
Source: *Prowess* 4 and own calculations.

Table 1.T2: Descriptive statistics by foreign involvement (after data cleaning), manufacturing, additional variables1995-2010

	S1								S2							
	D		DX		DI		DXI		D		DX		DI		DXI	
Variable	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range
Capital output ratio	.5	.3/1	.5	.3/.8	.4	.2/.8	.5	.3/.7	.5	.3/1	.5	.3/.9	.4	.2/.7	.5	.3/.8
Capital labour ratio	.1	.03/.2	.1	.03/.1	.1	.03/.2	.1	.03/.1	.1	.03/.2	.1	.03/.1	.1	.03/.2	.1	.04/.1
Material output ratio	.7	.6/.8	.7	.6/.8	.6	.5/.8	.6	.5/.7	.7	.6/.8	.7	.6/.8	.6	.5/.8	.6	.5/.7
Raw material intensity (raw material /output)	.5	.4/.7	.5	.4/.6	.5	.3/.6	.5	.3/.5	.5	.4/.6	.5	.4/.6	.4	.3/.6	.4	.3/.5
Energy intensity (energy /output)	.03	.01/.1	.03	.01/.1	.01	.003/.03	.02	.008/.04	.03	.01/.1	.02	.01/.1	.01	.00/.03	.01	.0/.03
Services intensity (services /output)	.1	.1/.2	.1	.1/.2	.1	.1/.2	.1	.1/.2	.1	.1/.2	.1	.1/.2	.1	.1/.2	.1	.1/.2
No. of observations	24,383		29,940		206		3,169		29,440		26,440		227		1,451	

Source: *Prowess* 4 and own calculations.

Table 1.T3: Distribution of outward investing firms (DIDXI) by 2-digit industry, manufacturing, 2009/10

Industry (NIC-2008)		Number of firms		Percentage distribution	
		S1	**S2**	**S1**	**S2**
10	Food products	30	19	6.36	7.76
11	Beverages	3	1	0.64	0.41
12	Tobacco products	3	-	0.64	-
13	Textiles	38	12	8.05	4.9
14	Wearing apparels	7	1	1.48	0.41
15	Leather and related products	8	2	1.69	0.82
16	Wood and products of wood and cork, except furniture	2	-	0.42	-
17	Paper and paper products	4	2	0.85	0.82
19	Coke and refined petroleum products	2	-	0.42	-
20	Chemicals and chemical products	70	34	14.83	13.88
21	Pharmaceuticals, medicinal chemical and botanical products	60	40	12.71	16.33
22	Rubber and plastics products	35	20	7.42	8.16
23	Other non-metallic mineral products	20	10	4.24	4.08
24	Basic metals	39	17	8.26	6.94
25	Fabricated metal products, except machinery and equipment	14	7	2.97	2.86
26	Computer, electronic and optical products	22	17	4.66	6.94
27	Electrical equipment	22	11	4.66	4.49
28	Machinery and equipment n.e.c.	33	15	6.99	6.12
29	Motor vehicles, trailers and semi-trailers	5	2	1.06	0.82
30	Other transport equipment	37	24	7.84	9.8
32	Other manufacturing	18	11	3.81	4.49
		472	245	100	100

Notes: S1: DIDXI = DXI+DI, where DXI if firm export intensity and foreign investment intensity is positive and DI if non-exporter firm with positive foreign investment intensity.
S2: DIDXI = DXI+DI, where DXI if firm export intensity is ≥1% and foreign investment intensity is ≥1% and DI if non-exporter firm with foreign investment intensity ≥1%.
Source: *Prowess* 4 and own calculations.

2. DETERMINANTS OF FIRMS' INITIAL DECISION TO INVEST ABROAD: AN APPLICATION OF 'SURVIVAL' ANALYSIS

1 Introduction

Cross-sectional sorting patterns (even if for each year of the sample period) (Chapter 1) while validating the hypothesis that non-symmetry of firm characteristics induces some firms to invest abroad and others to export, leads to the follow-up question of causality. To support the view that the direction of causation runs from firm characteristics to OFDI, based on timing of firms' entry into OFDI, firm characteristics of OFDI starters should be relatively superior to those of non-OFDI firms *prior* to the foreign entries.

This chapter, using data on Indian manufacturing firms for 1995-2010, tests for a causal relationship between ex-ante firm characteristics and the firm's foreign involvement, namely, the *self-selection* hypothesis. In doing so, the question that is analysed is: 'what factors influence the probability that a firm starts investing abroad (makes an OFDI entry) within a short interval of time, conditional on OFDI not having occurred up to the starting time of the interval?' These factors may influence the firm's timing of OFDI entry (i.e., early, late or no OFDI during the sample period) that has a bearing on the rate of internationalisation of firms, with implications for government policy.

The empirical methodology of '*survival' analysis (duration analysis)* is employed for addressing these issues.[40] One of the first papers to apply 'survival' analysis towards examining related questions, in the context of Japanese FDI is Tan and Vertinsky (1996) that estimates a Cox proportional hazard (PH) model as originally proposed by Cox (1972). While the use of the Cox PH model may help analyse what causes firms to start OFDI, some concerns have been raised with this approach from a methodological perspective by Hess and Persson (2012) who argue theoretically and show empirically that *discrete*-time duration models are more appropriate than *continuous*-time Cox PH model. The analysis of the determinants of the probability

[40]'Survival' analysis allows us to handle the problems associated with attrition, delayed entry, and right censoring (as subjects may not be observed long enough for all of them to invest abroad).

of OFDI entry is thus also performed using the more appropriate discrete-time methods in addition to the Cox PH method.[41]

Further, in examining factors that affect the OFDI decision, following the trade literature (Baldwin, 1993), we study whether within-industry peer effects ('domino or spillover effects')[42] encourage firms to engage in OFDI.

This chapter is organised as follows. Section 2 presents a brief review of the literature. Section 3 discusses the methodology used to estimate the 'hazard' of foreign entry. Section 4 discusses the determinants of the OFDI entry decision and their predicted impact on the 'risk' of foreign entry. Section 5 discusses the data and presents descriptive statistics. Section 6 presents estimation results and Section 7 concludes.

2 Brief review of 'OFDI decision' studies that also model the *timing* of investments

Tan and Vertinsky (1996) in studying the sequence of OFDI by Japanese electronics firms in the US and Canada over 1966-1990, note that traditional logit and probit approaches ignore the role of 'time of entry' despite its significance to corporate strategy and host country policies. The study applies the Cox PH model that relates the instantaneous probability of OFDI to the timing of entry. In studies that include the timing aspect, the hypothesis is that the higher the risk-adjusted expected net benefits[43] from OFDI, *ceteris paribus*, the higher is the probability of making an investment at any particular moment and thus the probability of investing earlier.[44]

3 Empirical methodology: 'survival' analysis

'Survival' analysis analyzes time (or duration) to the occurrence of an 'event' (also known as 'failure') and factors that explain 'survival' time, e.g. time until 'firm closure'. Three alternative modelling approaches with respect to the assumptions regarding distribution of 'failure' times, lead to nonparametric, parametric and semiparametric 'survival' analyses respectively. 'Survival' time ('duration' or 'failure' time) is length of time to 'failure', that can be modelled either as continuous (defined on (0, ∞)) or discrete (taking a finite set of values, $t1$, $t2$,…, t_n), leading to continuous

[41]Furthermore, Hess and Persson (2011) demonstrate that non-proportional hazard specifications such as logit or probit (including random effects) should be preferred over the proportional complementary log-log specifications.

[42]Initially formalised as the 'domino theory of regionalism' in Baldwin (1993), the 'domino or spillover effect' has been applied in a number of economic settings where economic actions might be 'contagious'.

[43]Risk-adjusted expected net benefits from OFDI by a firm are taken to be a function of its possession of certain types of intangible, transportable assets.

[44]Also, Raff and Ryan (2008) show that the relative significance of firm-specific investment determinants could differ depending on whether firms' overseas investment histories are pooled as against dividing the firm's overseas investments total into a sequence of individual investment decisions, postulating that pooled data studies ignore potentially valuable information in understanding OFDI decisions.

(e.g. Cox PH) or discrete (e.g. logit, probit, complementary loglog) survival time analyses respectively.

Wooldridge (2002, p. 685) notes that "The hazard function allows us to approximate the probability of exiting the initial state within a short interval, conditional on having survived up to the starting time of the interval". The related concept of the 'survivor' function defines the probability of 'surviving' (or being 'event' free) longer than time *t*. In our case, the 'event' ('failure') of interest is OFDI entry of a firm, a binary variable (0 for no OFDI, and 1 for positive OFDI) at time *t*. Time until a firm leaves the initial state and becomes an OFDI firm (DIDXI) is relevant. Each firm is considered to be a foreign investor potentially, i.e., it faces the choice of investing or not investing abroad. Examining the time spell between observation in the sample and the first OFDI, two different time spells can be described: a complete time interval from the firm's entry time in the sample until transition to investment abroad by 2010; and a right-censored time interval where the firm is observed from the firm's entry time in the sample and has not invested abroad by 2010.

3.1 Nonparametric approach

Kaplan-Meier (KM) estimate of the empirical 'survival' function

Firstly, taking no covariates, or when the covariates are qualitative in nature, the Kaplan-Meier (1958) estimator is used to estimate the probability of 'survival' past a certain time (equivalently, the probability of 'failing' after *t*) or to compare the 'survival' experiences across different firm cohorts. The KM estimator considers any point in time as a series of steps defined by the observed 'survival' and censored times. Differences in 'survival' curves across different values of the covariates is however not strong evidence that the considered covariate influences 'survival' as other factors may be correlated with both the covariate and with 'survival'.

3.2 Semiparametric approach

3.2.1 *Continuous-time hazard model: Cox PH model*

When the firm first transforms its status from a non-OFDI firm to become an OFDI firm (i.e. transforms itself from D or DX to DIDXI), that is regarded as the 'event' of interest, the OFDI entry. Subsequent *investments outside India* made by the firm after becoming an outward investor firm are disregarded as is the case with single-'failure' analysis. Assuming a parametric form for the effect of the covariates on the 'hazard' (i.e., the probability that firm i starts investing abroad at time *t*), with a nonparametric framework for the underlying hazard function yields:

$$h(t \mid x_i) = h_0(t) \times exp(x_i' \beta)$$

where $x_i(t)$ is a vector $(k \times 1)$ of the i^{th} firm's covariates at time *t* that influence

the investment likelihood, β is a vector *(k×1)* of the parameters, and $h_0(t)$ is the baseline hazard function (the 'hazard' when each covariate x_{it} = 0) and is not estimated.[45]

Each explanatory covariate multiplicatively shifts the baseline hazard proportional to its effect on OFDI likelihood. The hazard ratio $\frac{h(t \mid x_i)}{h(t \mid x_h)} = \exp\big((x_i' - x_h')\beta\big)$ is proportional (hazard functions are strictly parallel).[46] Variables that positively (negatively) influence the probability of OFDI entry, associated with higher (lower) investment likelihood, produce hazard ratios greater than (less than) 1 i.e., higher values of x are associated with shorter (longer) durations of non-OFDI status.

3.2.2 *Continuous-time vs. discrete-time hazards*

Even though trade or FDI takes place in continuous time, data on OFDI entries is grouped into yearly intervals. Hess and Persson (2012) show that many (or heavy) *tied* duration times (spells of trade with exactly the same duration), the difficulty to properly control for *unobserved heterogeneity* ('frailty')[47] leading to spurious and negative duration dependence and the restrictive and empirically questionable assumption of *proportional hazards* that cause biases in estimated covariate effects make the Cox PH model inappropriate compared with discrete-time duration models.

3.2.3a *Discrete (or grouped)-time hazard*

The discrete-time hazard rate is the conditional probability that a firm invests abroad in a given time interval, given that OFDI has not occurred up to the beginning of the interval. A semiparametric approach allows the form of the underlying baseline hazard function (that captures duration dependence) to be specified in a flexible way (by means of a full set of duration dummies that enable the estimation of period-specific intercepts) while assuming a parametric form for the effect of the determinants on the probability of OFDI entry. The estimated coefficients on the duration interval dummies reflect the shape of the baseline hazard. Larger (less negative)

[45]The hazard rate (or function) $h_i(t)$ (i.e., the probability that firm i starts investing abroad at time t) depends only on time at risk $h_0(t)$ (the baseline hazard) and on explanatory variables affecting the 'hazard' independently of time ($\exp(x_i'\beta)$). $h_i(t)$ is the proportion of $h_0(t)$ determined by the effects of the firm-specific explanatory variables. $h_0(t)$ is interpreted as an unknown function of time reflecting changes in base rates of entry that capture the influence of factors outside of the firm that affect all firms in a similar way.

[46]An exponentiated coefficient ($\exp(\beta)$, is similar to relative risk) represents the hazard ratio for a one unit change in the corresponding covariate, controlling for the other covariates.

[47]'Frailty' or the individual unobserved heterogeneity component is the unobserved propensity to experience an event caused by incomplete specification of the model and measurement errors.

values are associated with higher 'hazards'.[48, 49]

3.2.3b *Discrete-time hazard models (with controls for unobserved heterogeneity)*

Ignoring unobserved heterogeneity when it is important can cause overestimation of the degree of negative duration dependence in the 'hazard', and the proportionate response of the hazard rate to a change in a regressor is no longer constant but declines with time. Hess and Persson (2012) note that in studying a large set of observations it is not possible to allow for unobserved heterogeneity ('random effects', εi,) in the Cox model while that can be done in discrete-time hazard models.[50]

4 Determinants and predicted impact on OFDI entry

Firms that start OFDI are identified with the variable OFDI entryi,*t* that is 1 if a firm has positive *investment outside India (IOI)* in year *t*, but had no previous *IOI*. Most firms, for whom *IOI* assumes positive values in year *t*, continue to have positive IOI in the following years, signalling long-term investments. For firms with intermittent OFDI, the first year of positive OFDI stocks is taken as the entry year.[51]

4.1 Predicted impact on 'risk' of OFDI entry

The likelihood of OFDI entry of Indian firms is posited to depend on firm-specific characteristics, industry characteristics and policy factors. In this, the *endogeneity* of variables due to the potential reverse causality from the OFDI decision is controlled for by lagging the explanatory variables by one year. Table 2.T1 in Appendix 2.1 provides the definition of the variables.

4.1.1 *Firm-specific characteristics*

Size

As entry rate increases with the ability to meet the size of the fixed cost needed to move abroad, earlier knowledge about market opportunities, ability to develop activities and products, raise capital, obtain approvals earlier and operate strategically, larger firms may

[48]The equivalent of the continuous-time Cox PH model in discrete-time is the Complementary log-log cloglog$(h_{i,s})=\alpha_1 d_{1,s}+\alpha_2 d_{2s}+\ldots+\alpha_J d_{J,s} + x'_{i,s}\beta+_{uis}$
where $u_{i,s}$~ (reverse) extreme value, $h_{i,s}$ denotes the discrete-time hazard function for firm *i* at year *s,* d_{1s},…, d_{JS} are dummy variables for years *1,…,J, J* referring to the last time period observed for any firm in the sample, with d_{ts} = 1 if *s* = *t*, 0 otherwise. The sign and significance of the *β* parameters shows the importance of that variable on the probability of firms undertaking initial OFDI, with a direct relative risk interpretation. The time-specific constants α_t can be written as a function of the baseline hazard function $h_0(t)$.

[49]In the logistic hazard model $u_{i,s}$~ logistic and in the probit hazards model $u_{i,s}$~ standard normal.

[50]For instance, the discrete-time complementary log-log model with unobserved heterogeneity becomes: cloglog$(h_{i,s})=\alpha_1 d_{1,s}+\alpha_2 d_{2s}+\ldots+\alpha_J d_{J,s} + x'_{i,s}\beta+_{i,s}+\varepsilon_i$ where ε_i is generated according to a given parametric distribution function, usually assumed to be a Gaussian distribution.

[51]For instance, *Futura Polysters* (NIC 20) reports OFDI for 2003 and then for 2008. The year of OFDI entry is taken as 2003.

have a higher entry rate than the small-sized firms.[52] A positive relationship between firm size (measured by sales) and the OFDI likelihood is thus expected.

Productivity

Based on the HMY hypothesis, more productive firms are more likely to *self-select* themselves into OFDI.[53] It follows that the greater is firm productivity, the shorter is the time to invest (Tan and Vertinsky, 1996). We thus expect firm productivity to increase the likelihood of OFDI entry. *Ex ante* (before initiating OFDI) differences in firm productivity (controlling for other firm characteristics, industry and year fixed effects) could thus explain the productivity patterns for DIDXI, DX and D as found in Chapter 1.

Export orientation

Market-seeking (horizontal FDI) suggests that exports and OFDI may be considered as substitute means for serving foreign markets. In a dynamic set up with uncertainty, Conconi et al. (2014) however note that exports and FDI may be complements over time as prior export experience may help acquire information about demand and supply conditions in the foreign market and in testing for product demand. Also, in the absence of recognised brand names for several developing country products, the firm's physical presence in the foreign market may have an export-supporting role. Foreign presence could also be for servicing of goods exported. Export presence may also suggest distribution-oriented OFDI. The Indian data also shows that the vast majority of firms doing foreign investment also export. A firm's export orientation is thus expected to have a positive effect on the probability that it starts investing abroad, implying early OFDI.

Technological effort

a. In-house R&D activity

While technology investments in the form of in-house R&D expenditures proxy for the firm's intangible technological advantages/knowledge assets that it can exploit abroad, they also reflect the firm's ability to acquire or assimilate sophisticated technologies through increased absorptive capacity. The need to monitor foreign technologies that may not be available otherwise may make early presence in technology-intensive markets critical. Also, while firm productivity may reflect firm innovation, technological variables may exert a direct influence on the likelihood of OFDI (Goldar, 2013).

[52]Pradhan (2004) and Kumar (2007) also find a quadratic relationship between size and OFDI, i.e., firms with very large or very small market shares in their domestic industry are *ceteris paribus*, less likely to expand abroad.
[53]For India, see Goldar (2013), and Thomas and Narayanan (2013).

Data should support the hypothesis that firms with a greater capacity for R&D are significantly more likely to make an OFDI entry.

b. Technology imports

Following Kumar (2007) and Goldar (2013) it is expected that technology imports (against the payment of royalty and technical know-how fees) do not have a significant influence on the probability of making overseas investment.

Product differentiation and advertising

For India, Lall (1986), (based on the third world multinationals view), posits that aggressive marketing intensity is unlikely to cause firms to invest abroad while Pradhan (2004) and Kumar (2007) for a later time period find a significant association between advertising and the ability of the firm to undertake OFDI. While the ability to differentiate products (as proxied by the advertising intensity) is expected to reflect the presence of intangible assets, Indian firms with highly differentiated products but weak marketing network overseas, may be keen to develop their marketing skills or acquire brand names through OFDI. Marketing ability at home (captured though the firm's selling and distribution intensity) is thus expected to make a firm more likely to make an OFDI entry.

Financial ability

A strong financial structure, cash flow in particular is taken as informing about the firm's general financial health, positively related to the firm's balance sheet position. Access to liquid assets is likely to reduce the capital and transaction costs involved in OFDI. A low opportunity cost is generally assigned to internally generated funds leading to earlier OFDI.

Ownership structure

We distinguish four categories to reflect structural differences between firms on account of ownership/ affiliation:

a. Ownership (business group)/ business-group affiliation

Firms belonging to large business groups in India may behave differently in their OFDI activity in contrast to single private/standalone (Indian) firms. Horizontal business group's membership may stimulate earlier entry (as compared to non-members with similar firm-specific characteristics) by earlier information sharing through networking connections, intelligence gathering, easier finance and reducing risks, similar to those of size (Tan and Vertinsky, 1996). The membership effect is thus postulated to be favourable to the firm's OFDI decision and its timing.[54]

[54]The literature also suggests either weak evidence or no effect of group affiliation on OFDI likelihood.

b. Ownership (foreign)

Evidence suggests that firms receiving inward FDI are expected to be for the most part oriented towards the domestic market, with no more likelihood of OFDI from India than the domestically owned firms. A negative relationship of foreign participation with OFDI entry is thus expected.

c. Ownership (government)

Unlike the expectation for state-owned-enterprises (SOEs) in China, government owned firms in India are expected to be no more likely to engage in OFDI on the basis of a more active government policy towards their OFDI behaviour.[55]

d. Ownership (private (Indian))

The category of standalone Private (Indian) firms is taken as the base category.

Age

In comparison to the oldest firms that may suffer from erosion of technology and products over time (obsolescence), new firms may have higher ability to gather information, modify strategy and newness in process and/or product. Aging may thus reduce the probability of foreign entry. However, older firms may benefit from strong brand names, goodwill and a superior cost structure. Longevity in the domestic and/or foreign market may thus facilitate foreign entry due to the experience effect. Mixed empirical effects of age on OFDI entry are thus expected.

4.1.2 *Industry characteristics*

'Domino effect'/spillovers

Export market participation of some firms in an industry and/or geographic region may affect the likelihood of other domestic firms becoming new exporters. OFDI participation may similarly be attributed to a 'domino/ peer group effect'. That is, the firm's probability of investing abroad may be influenced by whether or not other firms within the same industry made OFDI entry in the previous time period. We consider intra industry or horizontal spillovers through learning effects, due to the movement of workers, information externalities, demonstration and competition effects.[56]

[55]Some government firms however actively engage in seeking resources abroad (e.g. ONGC Videsh Limited).

[56]To capture the degree of OFDI firms' presence in industry *j*, at time *t*, the horizontal spillover variable is measured by

$$OFDI\ by\ other\ firms_{jt} = \frac{\sum_{i \in j} DIDXI_{it} * Y_{it}}{\sum_{i \in j} Y_{it}}$$

where Y_{it} is the sales by firm *i* in year *t*. *OFDI by other firms*$_{jt}$ *is share of OFDI firms* in industry *j's* sales (where OFDI firms are identified by DIDXI$_{it}$, a dummy variable that takes the value 1 if firm i belongs to DIDXI in year *t* and 0 otherwise).

Industry dummies

Industry-specific influences are controlled using industry affiliation dummies created for each investing firm at its 2-digit/industry group NIC code.

4.1.3 *Factors common to all firms*

Year dummies

The probability of OFDI entry may vary over time due to factors common to all firms in a given year, but that vary over time. *Year dummies* are included to control for such latent factors.

Policy effects

Promulgated in 1992, the OFDI policy 'Guidelines for Indian Joint Ventures (JVs) and Wholly Owned Subsidiaries (WOSs) abroad' provided a legal framework by allowing Indian firms to invest up to $2 million under the automatic route while the approval route continued. The limit under the automatic route was further increased to $15 million in 1995. Major liberalisation measures in the overseas investment policy were adopted with the introduction of the Foreign Exchange Management Act (FEMA) in 1999. In 2001, the earlier limit of $50 million over three years was converted into $50 million *per financial year*; the limit being relaxed to $100 million in 2002. In 2003, the quantitative limit was transformed into a percentage limit of the net worth of the Indian party, although the guidelines still stipulated the limit to be the minimum of $100 million or 100% of the net worth. The 2004 guidelines dispensed with the previously imposed quantitative limits, and the percentage limit of 100% of the net worth was maintained. Progressive relaxations to 200% of the net worth in 2005 and 2006, 300% from June 2007, and 400% from September 2007 have been carried out.[57] To capture the effects of the government's outward FDI policy changes on the probability of OFDI entry, a policy effects dummy for the period 2001-10, with period 1995-2000 taken as the base period is included.

Table 2.1 lists the set of variables considered to impact the firm's OFDI entry and the expected sign of the respective coefficients. In 'survival' analysis, the covariates are included upto the time of failure only.

5 Data description and summary

[57]The August 2013 reduction in capital control limits (to 100% of the net worth of the Indian investor) do not lie within the sample period and are thus not listed above.

Table 2.1: Determinants of OFDI entry decision

Determinant	Impact on risk of OFDI entry (predicted sign)
Firm characteristics	
Time invariant	
Firm is part of:	
Ownership (Business group)	+
Ownership (Foreign)	-
Ownership (Government)	-
Time varying	
Size	+
Productivity	+
Export orientation	+
Technological effort:	
In-house R&D activity	+
Technology imports	-/+
Product differentiation	+
Financial ability	+
Aging	-/+
Industry characteristics	
Peer effects (spillovers)	+

statistics

5.1 Data

Manufacturing firms from the Prowess database, 1995 to 2010, belonging to the following 14 two-digit industrial groups are considered: food, beverages, tobacco (NIC 10, 11, 12); textiles (NIC 13); apparel, leather, wood (NIC 14, 15, 16); paper, printing (NIC 17, 18); coke and refined petroleum products, chemicals (NIC 19, 20); pharmaceuticals (NIC 21); rubber and plastics (NIC 22); other non-metallic mineral (NIC 23); basic metal, fabricated metal products (NIC 24, 25); computer, electronic and optical (NIC 26); electrical equipment (NIC 27); machinery and equipment n.e.c. (NIC 28); motor vehicles and other transport equipment (NIC 29, 30) and other manufacturing (NIC 32). OFDI entrants are firms that did not invest abroad in earlier time periods but invest in year *t*. Table 2.T2 in Appendix 2.1 provides the number and distribution of OFDI entrants over 1997-2010.

We started with an unbalanced panel

of 51,627 firm-years (after excluding firm-years with missing information on the new covariates that did not feature in Chapter1). Modifications to the data set resulting from taking lags of variables and forming spells of time before and after OFDI entry (45,562), reduces the number of observations (spell durations) to around 42,000.[58] The sample includes firms that had invested and those that did not invest abroad during the sample period (about 5,982 firms, all considered 'at risk' of OFDI). An OFDI firm is defined as one with *positive* foreign investment intensity (investment outside India/ total assets) and may also export i.e., have *positive* export intensity (exports/sales). Guidelines for OFDI, notified by the Reserve Bank of India from time to time (available at http://www.rbi.org.in/scripts/Fema.aspx) are used to delineate the sub-periods for construction of the *policy effects dummy* variables.

5.2 Descriptive statistics

Table 2.2 presents the median and the inter quartile (IQ) range of the variables of interest.

Table 2.2: Descriptive statistics, by foreign involvement, 1996-2010

	D		DX		DI		DXI		Total sample	
Variable	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range	Median	IQ range
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
log of sales in Rs. Crore	3	1.9/3.9	4.1	3.1/5	4.7	3.4/6	5.7	4.8/6.8	3.7	2.7/4.8
log TFP index	-.034	-.189/.126	-.005	-.153/.153	.074	-.05/.273	.049	-.127/.207	-.014	-.166/.147
log TFP	.16	-.04/.4	.2	.02/.5	.3	.1/.5	.3	.1/.5	.2	-.01/.5
R&D expenses to sales (in %)	0	0/0	0	0/.0009	0	0/0	.0004	0/.007	0	0/0
Export intensity (in %)	-	-	7.4	1.3/26	-	-	16.4	5.5/43	.8	0/12.6
Age (in years)	18	11/28	21	13/35	17	11/25	25	17/44	20	12/33
Selling and distribution intensity (in %)	.01	.01/.04	.03	.02/.06	.03	.01/.07	.04	.02/.07	.02	.009/.05
Cash flow (in %)	.04	.01/.08	.06	.03/.1	.07	.02/.1	.08	.05/.1	.06	.02/.1
Analysis time (time at 'risk')	18,462		24,311		158		2,629		45,562	
Analysis time (time at 'risk')%	40.52		53.36		0.35		5.77		100	
No. of firms (2009)	1,635		1,944		26		409		4,014	
No. of firms (2009)%	40.74		48.44		0.63		10.19		100	

Notes: D: purely domestic firm; DX: pure export firms that also serve the domestic market; DI: firms that invest overseas but do not export; DXI: firms that export and invest overseas.
Source: *Prowess* 4 and own calculations.

[58]The number of observations (spell durations) is less than the spells of time, as the spells of time after the firm's OFDI entry are disregarded due to single-'failure' analysis approach.

It is observed that DXI and DI (6.12% of spells) representing foreign direct investors are older, more productive, larger in size, have a higher selling and distribution intensity and greater intangible assets compared to D and DX. This preliminary evidence indicates that in a number of dimensions, firms that also invest abroad are different from those that do not. As the foreign involvement status of a firm is year-specific (given the transitions from D into DX, DXI and DI), with panel data, the number of firms in each of these categories would vary from year to year. Table 2.2 shows this only for a single year, 2009. Even so, DI and even DXI for the entire sample period are quite small in relation to the total number of firms.

The pair-wise correlation between these characteristics (not reported here) is relatively low. However, the log of *sales* is somewhat correlated with the TFP measure and with the dummy for business group firms.

6 Empirical findings and comparisons

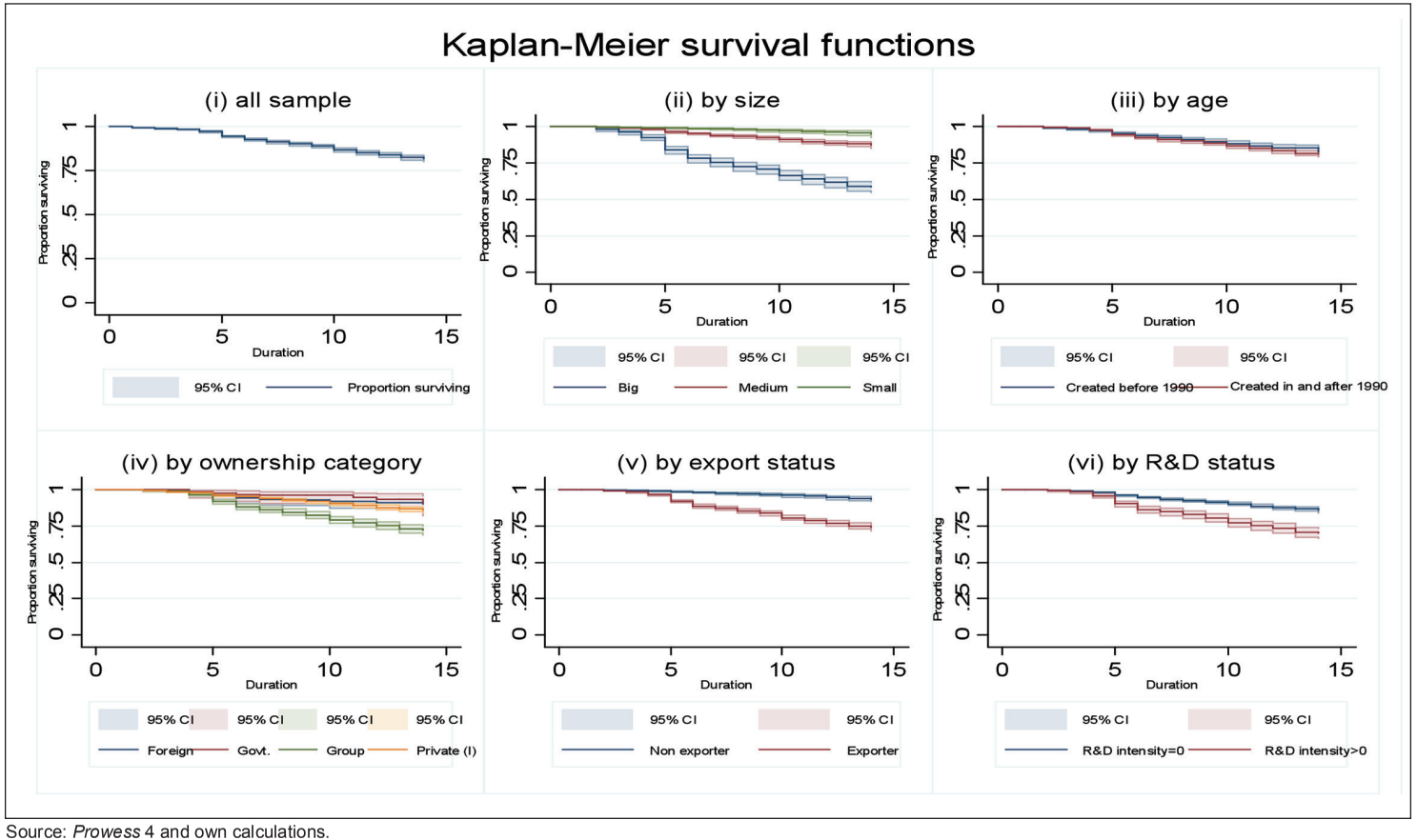
6.1 Nonparametric results

Figure 2.1 (i-vi) presents the estimated KM 'survival' curves and their respective 95% confidence intervals for the entire sample in panel (i) and sub-groups in panels (ii-vi). Based on size, a firm is classified as $Small_t$ if real output< Q1 in year *t*, $Medium_t$ if Q1 ≤ real output <Q3 in year *t*, Big_t if real output ≥ Q3 in year *t*.[59] *Old indicates* if the firm was set up before 1990. Based on ownership structure, firms are divided into private (Indian) standalone, group affiliated, foreign and government firms. A firm that exports in year *t* is classified as an exporter, while a firm that engages in R&D in year *t* is classified as an R&D firm in year *t*.

Each KM survival curve shows, for each value of time *t*, the fraction of firms who 'survive' as non-OFDI firm for at least that length of time, that is, who have not left the initial state at time *t*. Large vertical steps downward indicate a larger number of OFDI entries in a given time interval (horizontal axis). Comparing two KM survival curves, the steeper curve shows a lower probability of 'surviving' as a non-OFDI firm beyond time *t* as against the flatter curve.

[59] Q_1 and Q_3 stand for the lower and upper quartiles of the real output distribution respectively.

Figure 2.1 Kaplan-Meier 'survival' functions



Source: *Prowess* 4 and own calculations.

The KM estimates of the 'survival' functions indicate that firm size is a key determinant of OFDI entry. Panel (ii) shows that the 'survival' curve for the small firms is less steep than the 'survival' curve for large firms. While there is a clear difference between small and medium-sized or large firms, the 'survival' patterns are not very different between medium-size and small firms. Large firms thus seem to have a higher 'failure' rate than small and medium-sized firms. In panel (iii), no clear results are obtained when considering the age effect, but younger firms seem to have a higher 'failure' rate than older firms, suggesting that older firms may have difficulties in OFDI entry. Panel (iv) indicates that business group affiliation has a positive effect on the probability of OFDI entry (suggesting learning effects, better market information from within-business group firms) in comparison to private (Indian), foreign and government firms.

The business group variable, however, also captures a size effect, with larger firms having a higher probability of OFDI entry, whatever the duration. On distinguishing firms according to size category, a large and statistically significant difference is found when considering large firms, while this effect does not show up for medium and smaller firms. Export status (panel v) and R&D status (panel vi) have a clear impact in raising the probability of OFDI entry at any time.

6.2 Semiparametric results

6.2.1 Continuous-time hazard model: Cox PH model

Modeling the time to 'failure'–that is, time to an OFDI entry, the hazard function represents the instantaneous rate at which a firm makes an OFDI entry depending on the observed duration (as a non-OFDI firm) and other explanatory factors. The impact of explanatory variables is specified as shifting the baseline hazard (which depicts duration dependence) in a proportional fashion. By 2010, 599 of the 5,982 firms (10% of the sampled firms) had invested abroad and the remaining 5,383 (90% of the sampled firms) are right-censored. The model is specified as:

'Hazard' of initial OFDI = f(baseline hazard; size, productivity, export orientation, in-house R&D activity, technology imports, product differentiation, financial ability, aging, ownership structure, 'domino effect', policy effects). The dependent variable $h_i(t)$ is the probability that a firm starts investing abroad at time t (Table 2.3).

Table 2.3: Estimation results from modelling the probability of OFDI entry by Indian manufacturing firms, Cox PH regressions, 1995-2010

Determinants	(1)	(2)	(3)	(4)	(5)	(6)
log sales *i,t-1*	2.092***		2.059 ***	2.059***	2.057***	2.058***
	(.000)		(.000)	(.000)	(.000)	(.000)
log productivity index *i,t-1*		2.565 ***	1.415**	1.420**	1.368 **	1.375 **
		(.000)	(.011)	(.010)	(.026)	(.023)
Export to sales % *i,t-1*	1.015 ***	1.015 ***	1.053 ***	1.015***	1.014***	1.014***
	(.000)	(.000)	(.000)	(.000)	(.001)	(.000)
R&D expenses to sales % *i,t-1*	2.469***	1.671 **	2.648***	4.271***		3.286 ***
	(.000)	(.047)	(.000)	(.001)		(.000)
Royalty and technical know-how expenses to sales % *i,t-1*				0.288		
				(.497)		
R&D, royalty and technical know-how expenses to sales % *i,t-1*					1.928***	
					(.001)	
Selling and distribution expenses to sales % *i,t-1*	2.194***	2.654 ***	2.301 ***	2.323 ***	2.500***	2.528***
	(.003)	(.000)	(.001)	(.001)	(.000)	(.000)
Cash flow % *i,t-1*					3.430***	3.439 ***
					(.000)	(.000)
Age (in years) *i,t-1*	0.996	1.003	0.997	0.997	0.997	0.997
	(.195)	(.161)	(.206)	(.201)	(.237)	(.236)
Group affiliation *i,t*	0.928	2.132 ***	0.934	0.934	0.963	0.960
	(.455)	(.000)	(.498)	(.493)	(.710)	(.691)
Foreign ownership *i,t*	0.186***	0.549**	0.179 ***	0.179 ***	0.172 ***	0.171 ***
	(.000)	(.011)	(.000)	(.000)	(.000)	(.000)
Government *i,t*	0.074 ***	0.546*	0.070***	0.070***	0.072***	0.071***
	(.000)	(.088)	(.000)	(.000)	(.000)	(.000)
OFDI by other firms *j,t-1*	1.166	1.082	1.178	1.167	1.192	1.178
	(.774)	(.876)	(.758)	(.771)	(.743)	(.759)
Policy effects	3.183**	1.934	3.206**	3.212**	3.158**	3.125**
2001-2010 = 1,	(.011)	(.167)	(.011)	(.011)	(.012)	(.013)
zero otherwise						
Number of observations	42,139	42,139	42,139	42,139	42,139	42,139
Number of subjects	5,982	5,982	5,982	5,982	5,982	5,982
OFDI entries	599	599	599	599	599	599
Log likelihood	-4361.309	-4616.313	-4358.519	-4358.127	-4290.10	-4289.030
Wald chi2	1017.04	592.48	1023.44	1028.72	1034.44	1039.92
(degrees of freedom)	(36)	(36)	(37)	(38)	(38)	(38)
χ2 test	.000	.000	.000	.000	.000	.000

Notes: Robust p values in parentheses. *p<0.1, **p<0.05, ***p<0.01. i stands for firm and j for industry.

Coefficients are expressed as hazard ratios (exponential linear prediction, or exp *(x'β)*). A hazard ratio (exponentiated coefficient) greater (less) than one implies a higher (lower) hazard rate. For example, the hazard ratio of 1.178 on *OFDI by other firms* $_{j,t-1}$ suggests that with a percentage point increase in outward FDI firms' share in the industry sales, a firm faces 17.8% more 'hazard' of foreign entry. A hazard ratio less than one on a dummy variable implies that changing the dummy from 0 to 1 reduces the 'hazard' rate of OFDI entry (or increases the probability of 'survival' as a non-OFDI firm) by (1-exp *(β)*)*100, *ceteris paribus*.

Source: *Prowess* 4 and own calculations.

Results indicate that among the determinants of the first OFDI decision, firm *size* matters, indicating that crossing a critical 'threshold level' induces OFDI. The result holds whether only *size* is controlled for (column 1) or *size* with *productivity* is controlled for (columns 2-5). The more *productive* a firm is, the more likely it is to undertake OFDI, and the shorter is the duration as a non-OFDI firm. In column (2), *productivity* but not *size* is controlled for, while in columns (3-6), both *size* and *productivity* are controlled for. In each case, despite the positive but moderate correlation between the two (.26), each variable has an influence on the likelihood of OFDI. Firms' *export intensity* also has a positive and significant effect on OFDI. Firms export before they set up foreign production plants (or distribution networks).

Firms with greater *technological effort*, making knowledge investments proxied by R&D intensity are more likely to invest abroad. *Technology imports* against royalty and technical knowhow fees are found to have an insignificant effect on the foreign investment likelihood. *Advertising intensity* has a significant and positive effect on making an OFDI entry. Financial ability/health, measured in terms of *cash flow*, significantly increases firms' probability of entering into OFDI. Firm *age exerts* an insignificant effect on the probability of first OFDI.

Column (1) shows that after controlling for size, *business group* members are not more likely than other firms to start OFDI. As in KM, with no *size* control, column (2) shows that *group* membership raises the likelihood of OFDI. In contrast, *foreign* and government ownership are likely to significantly reduce the likelihood of OFDI entry. Firms with foreign participation or government ownership are thus more likely to continue with their focus on the domestic market.

The presence of other firms within the same industry that made foreign entry in the previous time period (OFDI by other firms) positively affects firms' probability of investing abroad. However, as the peer/spillover effects are not significant, within-industry linkages amongst firms are positive but weak.

The *policy effect* dummy for the post-2001 period shows a sizeable positive effect on OFDI entry. The set of industry-fixed effects (not reported here), (with food, beverages and tobacco (NIC 10,11 and 12) as the base industry group) suggests that firms in coke and refined petroleum products, chemicals (NIC 19, 20), pharmaceuticals (NIC 21), rubber and plastic (NIC 22), computer, electronic and optical (NIC 26), electrical equipment (NIC 27), machinery and equipment n.e.c. (NIC 28), motor vehicles and other transport equipment (NIC 29, 30), and other manufacturing (NIC 32) have a higher propensity to undertake OFDI, after controlling for firm characteristics. Coefficients of year-fixed effects (with 1996-97 as the base year) are positive and significant from 1999-2000 to 2002-03 and again from 2005-06 to 2007-08, being the highest in 2000-01. Year fixed effects capture the effect of changes other than policy changes.

6.2.2 Discrete-time hazard models

If a firm invests abroad in the following year but the exact time (day or week) when the entry occurred is not known, transition times are grouped and discrete-time hazard models are used. The time spell corresponding to the 'survival' of firms (as non-OFDI firms) is evaluated as intervals, measured in years, over the sample period. Asking what factors influence the duration that a firm does not invest abroad is the same as asking what factors influence the probability that a non-OFDI firm invests abroad in a given period of time, given that it has 'survived' as a non-OFDI firm up until that period.

In Table 2.4 with results from the alternative models, the relative importance of unobserved individual heterogeneity is indicated by ρ, which measures the share of individual variation in the hazard rate that is due to variation in the unobserved factors.

Table 2.4: Modelling the probability of OFDI entry: alternative models, 1995-2010

	Models without 'unobserved firm heterogeneity'				Models with 'unobserved firm heterogeneity' (with Gaussian random effects)		
Determinants	**Cox PH**	**complementary log-log**	**logit**	**probit**	**complementary log-log**	**logit**	**probit**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
log salesi, $_{t-1}$	.721***	.735***	0.766 ***	.322 ***	.825***	.807***	.492***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
log productivity	.319 **	.307**	0.335 **	.159 ***	.335**	348**	.185*
index $_{i, t-1}$	(.027)	(.035)	(.030)	(.006)	(.037)	(.031)	(.058)
Export intensity% $_{i, t-1}$	.014***	.015***	.015***	.006***	.016***	.016***	.009***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
R&D intensity% $_{i, t-1}$	1.189 **	1.037 **	1.110**	.548 *	1.118**	1.154**	.735*
	(.017)	(.020)	(.030)	(.055)	(.023)	(.033)	(.068)
Selling and distribution intensity% $_{i, t-1}$	.927**	1.109***	1.181**	.602**	1.166**	1.219**	.773**
	(.013)	(.007)	(.017)	(.024)	(.012)	(.019)	(.035)
Cash flow% $_{i, t-1}$	1.235 ***	1.202***	1.333***	.661***	1.303***	1.384***	.847***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Age $_{i, t-1}$	-.002	-.003	-0.004	-.001*	-.004*	-.004*	-.002
	(.253)	(.113)	(.109)	(.080)	(.083)	(.081)	(.109)
Group $_{i, t}$	-.040	-.035	-0.042	-.009	-.034	-.041	-.002
	(.691)	(.728)	(.684)	(.828)	(.750)	(.698)	(.976)
Foreign $_{i, t}$	-1.763 ***	-1.811***	-1.886***	-.748***	-1.171***	-1.960***	-1.060***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Government $_{i, t}$	-2.631***	-2.698***	-2.806***	-1.114 ***	-2.930***	-2.909***	-1.626 ***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
OFDI by other firms$_{j, t-1}$	0.164	0.085	0.064	-.057	.171	.092	.010
	(.761)	(.874)	(.909)	(.814)	(.758)	(.872)	(.974)
Policy effects dummy	1.139**	3.137***	3.166***	1.192***	3.247***	3.221***	1.626***
2001-10 =1, zero otherwise	(.021)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Constant		-10.533	-10.717	-4.824	-11.317	-11.083	-6.711
		(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Number of observations	42,139	42,139	42,139	42,139	42,139	42,139	42,139

Number of subjects	5,982	5,982	5,982	5,982	5,982	5,982	5,982
OFDI entries	599	599	599	599	599	599	599
Log-likelihood	-4289.030	-2513.398	-2511.986	-2516.633	-2506.112	-2508.790	-2511.736
Wald chi2	1003.53	1193.34	1196.17 (51)	1186.8	845.67	870.65	195.02
(degrees of freedom)	(38)	(51)	(51)	(51)	(51)	(51)	(51)
Pseudo R^2			.192	.190			
ρ					.253	.073	.408
s.e (ρ)					.033	.014	.147
Likelihood ratio test of					14.57	6.39	9.79
***ρ* = 0: chibar 2(01)**					(.000)	(.006)	(.001)

Notes: *p* values in parentheses. *p<0.1, **p<0.05, ***p<0.01. For the Cox PH model, coefficients are reported instead of hazard ratios applying log h(t) = log h_0 (t) + *xi'β*. If the null hypothesis of $\rho = 0$ cannot be rejected, unobserved heterogeneity is unimportant.

Source: *Prowess* 4 and own calculations.

Qualitatively, results from alternative estimation models are similar. However, the age variable that was insignificant in Cox PH regressions, becomes negative and significant in the discrete-time hazard models. Findings suggest that unobserved heterogeneity is important. Accounting for unobserved heterogeneity increases the log-likelihood values. The fraction of individual variation in the hazard rate that is due to variation in the unobserved factors is around 25.3% (cloglog), 07.3% (logit) and 40.8% (probit). None of the coefficients changes signs when unobserved heterogeneity is accounted for. In the probit model with random effects, however, the coefficient of the productivity variable is now significant only at the 10% level.

Of the three models that include unobserved heterogeneity, while the complementary loglog model (with random effects) shows a marginally better fit in terms of log-likelihood, the logit hazard model (with random effects) is the most preferred one as the fraction of individual variation in the hazard rate that is due to variation in the unobserved factors is found to be the lowest.

6.3 Robustness analysis

Robustness checks by shortening the time period under study (by excluding years at the beginning of the sample period) to see if the effects of the covariates vary over time; using alternative measures of TFP; or restricting the sample to only observations with positive exports yield qualitatively similar results.

7 Conclusions

In examining the factors that influence the firm's OFDI entry, parent firm

size contributes significantly towards increasing the probability of OFDI entry. As in the HMY hypothesis, the influence of firm productivity is significant. Ex ante firm productivity advantages (controlling for other firm-characteristics, industry and year effects) thus explain the pecking order between firm productivity and foreign involvement in Chapter 1, suggesting that more productive firms self-select into OFDI.

Findings support the gradual internationalisation process, in which the firm serves the foreign market via exports, before engaging in OFDI.[60] Firms with knowledge-based investments, financial ability and product differentiation also face increased 'risks' of making OFDI entry. Foreign ownership results in lower OFDI probabilities. Controls for within-industry learning spillovers are not found to be significant.

Kaplan-Meier estimates suggest positive effects of the firm's group affiliation on the probability of foreign entry. However, these effects are for large, not medium and small firms. In Cox PH regressions, however, group firms are not predicted to have a higher likelihood of OFDI entry, when firm size is controlled for.

There is some evidence in support of arguments against the Cox PH model as suggested by the large number of ties in the data set and because the PH assumption is rejected for some variables. However, comparing results obtained from discrete-time hazard models (with random effects) and the Cox PH model, differences in the effects of the covariates on the likelihood that a firm starts investing abroad do not seem significant. A few qualitative differences also emerge from the choice of the discrete-time hazard models. Unobserved heterogeneity is found to be important suggesting the need to account for it. None of the coefficients changes signs when unobserved heterogeneity is accounted for.

Empirical support for the self-selection hypothesis as found in this chapter suggests that it is the better performing firms that make the OFDI entry. Policy measures should thus focus on firms in the period prior to undertaking OFDI. To the extent that the more productive firms are the ones that engage in OFDI, policy measures should enable firms to raise their productivity, smoothening firms' transition from D/DX to DXI/DI categories. As shown in Chapter 3, this could also have favourable effects on firms' performance in the post OFDI period.

[60]For instance, *Tata Chemicals* (NIC 20), *Bharat Forge Ltd.* (NIC 30) and *Mahindra and Mahindra Ltd.* (NIC 29), are firms which have followed this route of exporting first and exporting and OFDI next.

Appendix 2.1 Additional tables

Table 2.T1: Definitions of variables used

Variables	Proxy and definition
OFDI entry	Binary variable assuming a value of 1 if a firm has positive OFDI in year *t*, but had no OFDI previously.
Size	*Log of sales* in Rs. crore
Productivity	*Log TFP index:* estimated using the Levinsohn and Petrin (2003) approach using gross output production functions at 2-digit/industry group. Alternately, ln TFP index is estimated through the Woodridge (2009) approach, using the VA specification.
Export orientation	*Export intensity:* ratio of exports to sales (%)
Technological effort	*In-house R&D intensity:* ratio of research and development expenditure to sales (%) *Royalty and technical knowhow intensity:* ratio of royalty and technical know-how fees to sales (%)
Product differentiation	*Selling and distribution intensity:* ratio of selling and distribution expenses to sales (%)
Financial ability	Cash flow: ratio of profit after tax plus depreciation to total income (%)
Ownership (business group)	*Business group* =1 if the firm belongs to a business group, 0 otherwise *Foreign ownership* =1 if the firm has foreign equity holding, 0 otherwise
Ownership (foreign)	*Government* =1 if the firm has government ownership, 0 otherwise
Ownership (government)	*Private (Indian)* standalone firm category is taken as the base group.
Age	*Age* at time t (in years): number of years from year of incorporation to year t
'Domino effect'	*OFDI by other firms* $_{j, t-1}$ *:* share of OFDI firms in industry *j* sales (where *j* is at the 2-digit NIC/ industry group) in *t-1*
Policy effects	2001-10 =1, 0 otherwise
d2-d14	For each of the discrete-time hazard models (i.e., excluding the Cox PH model), the baseline hazard is modeled nonparametrically using duration dummies d2 to d14 (with d1 as base group) for *T* intervals, *T*=1,.., 14.

Table 2.T2: OFDI entries in the sample, over 1997-2010

Year	OFDI entries	Percentage	Cumulative
1997	3	0.50	0.50
1998	7	1.17	1.67
1999	2	0.33	2.00
2000	33	5.51	7.51
2001	109	18.20	25.71
2002	63	10.52	36.23
2003	35	5.84	42.07
2004	32	5.34	47.41
2005	42	7.01	54.42
2006	74	12.35	66.78
2007	64	10.68	77.46
2008	57	9.52	86.98
2009	50	8.35	95.33
2010	28	4.67	100.00
Total	599	100.00	

Notes: As the first year of the sample period is used for taking lagged values of the explanatory variables and the data is organised as spell duration data explains why OFDI entries begin in 1997.

Source: *Prowess* 4 and own calculations.

3. EFFECTS OF OUTWARD FOREIGN DIRECT INVESTMENT ON FIRMS' TOTAL FACTOR PRODUCTIVITY, EXPORT INTENSITY AND SALES

1. Introduction

This chapter evaluates the causal effects of Indian manufacturing firms' significant initiation of OFDI during the sample period 1995-2010 on the instantaneous and subsequent performance of OFDI-switching firms at the domestic location, that is, the *ex-post* (after initiating OFDI) *learning-by-outward investment* hypothesis.[61] Since firms that invest abroad do not arise at random but are high performers ex-ante, OFDI-status becomes endogenous, causing selection bias. Following binary treatment methods (comparing OFDI status with non-OFDI status firms), *propensity-score*[62] *matching* (PSM) techniques (that control for this bias), combined with the d*ifference-in-differences* (DID) approach (that controls for time-invariant, unobservable differences across OFDI-initiating and non-OFDI firms respectively), the PSM-DID estimator is used to assess the performance effects of OFDI. PSM creates the missing counterfactual of the outcome of OFDI firms had they remained non-OFDI by selecting from amongst the firms that do not invest abroad, a group of firms with 'similar' observable characteristics and/or predicted likelihood of initiating OFDI in the pre-OFDI period (matched control group). The PSM-DID approach estimates the *average treatment effect on the treated* (ATT), that infers the causal effects of investing abroad across the OFDI-initiating and the matched control group firms from the average divergence in their outcome paths, starting from the pre-OFDI year, controlling for any initial performance differences.

The PSM-DID estimator applied here follows a matching technique that matches an OFDI-starter firm with a non-OFDI firm within the same sector and year to control for sector specific influences (differences in technology and capital intensity), as well as for

[61]The causal impact of engaging in OFDI on firm-level productivity outcomes, i.e., learning-by-outward investment is closely related to the *learning-by-exporting* (LBE) mechanism. LBE theory argues that the productivity of export starters improves after entering export markets through channels such as exposure to better technology and knowledge flows, intense competition and increase in the scale of operations (as in the *knowledge production function* framework (Criscuolo et al., 2005)).

[62]The propensity score is the conditional probability of receiving treatment given covariates.

any macroeconomic changes. Multiple sources of heterogeneity in treatment effects are allowed: separating out industries where the resource-seeking motive may be of importance; and allowing for industry-level variation (by technology intensity).

Lastly, the chapter examines the causal effects of the treatment *(foreign investment intensity)* on *TFP* and *sales growth* performance. Instead of comparing OFDI and non-OFDI status firms, the continuous treatment approach based on the generalised propensity score (GPS) (that is an extension of the propensity score methodology for binary treatments) and the average *dose-response* function (proposed by Hirano and Imbens, 2004) is applied.

This chapter is organised as follows. Section 2 reviews the literature on the causal impacts of OFDI on firm performance in the home economy. Section 3 outlines the empirical methodology of binary treatment. Section 4 discusses the dataset and sample characteristics. Section 5 presents the results on outcome variables, namely, levels of firm productivity, export intensity and sales based on binary treatment analysis and a set of robustness checks. Section 6 outlines the empirical methodology of continuous treatments. Section 7 presents the results on the outcome variables, namely firms' annual TFP and sales growth, and export intensity following outward investments. Section 8 concludes.

2 Effects of investing abroad: theory and evidence

2.1 *Binary treatment*

2.1.1 Effect on TFP

Barba Navaretti and Venables (2004) identify three channels through which a firm that becomes multinational may raise productivity at home:[63] through the exploitation of firm and plant-level scale economies by accessing new markets,[64] a more efficient relocation of activities within the multinational firm,[65] access to improved intermediate inputs/parts/components and rise in the quality and/or introduction of new products; and improved access to superior technological and managerial knowledge obtained from other firms ('spillovers') and/or foreign affiliates in technology intensive host countries.

However, the effects on productivity are postulated to go in both directions for all three channels, with the home effects of OFDI being an empirical question. Also, as investing in foreign markets is costly, benefits from going abroad may not materialise immediately.

[63]The literature also notes the possibility of industrial 'hollowing-out' induced by OFDI replacing exports and depressing domestic economic activity.
[64]More so for market-driven (horizontal) OFDI.
[65]More likely for resource-seeking (vertical) OFDI motivated towards exploiting cost advantages at the foreign location.

Reported evidence of learning effect from OFDI in the developed country context is mixed (Hayakawa et al., 2012). Also, the motivation for OFDI by developing country firms could differ from that originating in more advanced countries.

2.1.2 Effect on exports

Pradhan (2007) notes that theoretical predictions from the trade-international factor movement literature regarding the effect of OFDI on exports are unclear. While Mundell (1957) demonstrates that in the traditional Heckscher-Ohlin economy, product trade and international factor movements are substitutes, Markusen (1983) shows that under differences in production technology, imperfect competition and returns to scale, factor mobility generated by international factor-price differences increases trade volume.

While the 'proximity-concentration' hypothesis (Brainard, 1993) posits a static displacement of exports by production in host country affiliates, OFDI may raise exports in the dynamic context. Further, while horizontal OFDI is hypothesised to substitute exports of final products, it may also trigger additional exports of intermediate inputs from the home country due to international variations in technology or sector-specific factor endowments.

Vertical OFDI to source raw materials and inputs from abroad could directly result in higher imports into the home country, whereas that designed towards building trade supporting infrastructure (distribution networks and service centres) could boost final product exports from home. Also, Head and Ries (2004) argue that due to vertical specialization and home centralization of certain (e.g. knowledge-intensive) products, export activity of firms in high-technology industries might be more positively affected by the OFDI decision. Given the difficulties in differentiating between horizontal and vertical OFDI and firms following complex integration strategies, with interdependent investments to benefit from complementarities across locations (Yeaple, 2003), it may be hard to predict the causal effects of OFDI on home country exports.[66]

2.1.3 Effect on firm sales

Increased revenues from market expansion and stronger relations with foreign affiliates may strengthen the resource base and production capabilities at home. Resource-seeking (vertical) OFDI might affect home plant output and employment negatively and productivity positively in the short-term, (as some production processes are relocated to exploit cost advantages at the foreign location). In the long-term, however,

[66]For India, see Pradhan (2007) and Singh (2013).

positive backward effects on output and employment based on reducing the cost of production may dominate (Engel and Procher, 2013).

2.2 *Continuous treatment*

Fryges and Wagner (2008) note that several studies that do not necessarily report any learning effects from exports only distinguish between exporting and non-exporting firms (with the firm's export status being a binary treatment variable). It is argued that any positive effects of exporting on firm performance might not just depend on the firm's export status, but also be a function of the *extent* of its export activities (while some firms export only occasionally, others engage actively, generating a high percentage of their total sales in foreign markets).

3 Empirical methodology: discrete (binary) treatment

3.1 *Propensity Score matching-difference-in-differences estimator (PSM-DID)*

This methodology evaluates the static and dynamic causal impacts of engaging in OFDI (treatment) by OFDI-initiating firms (treatment group) on outcome variables (here, log TFP index, export intensity and log sales at the home location), compared to 'similar' firms that do not start OFDI (control group).

Following Heckman et al. (1997) and Dehejia and Wahba (2002), the 'treatment' in this setting is whether or not firm *i* switches into becoming an OFDI firm by investing abroad for the first time at time t=0. The causal effect of starting OFDI for firm i (at time t=0) on firm performance at time $t+s$ is measured by the difference between the post-treatment performance or outcome variable at time $t+s$, s years after OFDI entry, and if the firm does not start OFDI at time t, its performance at time $t+s$.

For a vector of covariates (including firm-specific characteristics), the average effect of the treatment on individuals assigned to the treatment or the average treatment effect on the treated (ATT) is defined as the difference between the observed outcome and what the OFDI entrants would have experienced, on average, had they not invested abroad. While post-treatment performance or outcome variable at time $t+s$ is readily observed for firms that experience OFDI entry, if the firm does not start OFDI at time t, its performance at time $t+s$ is not, causing a missing data problem of the unobserved (hypothetical) counterfactual outcome.

Rosenbaum and Rubin (1983) note that as sample selection into treatment is not random, forming the counterfactual on the basis of the average outcome of non-treatment firms would cause bias in treatment-effect estimates and propose PSM as a counterfactual framework. Further developments by Heckman

et al. (1997) allow for a reduction in selection bias by estimating the counterfactual as the performance of a suitably matched control group from amongst the remaining non-treatment firms where the basis of similarity is the vector of pre-treatment observable characteristics/propensity score.

Although PSM increases the balance between the observable characteristics among the two matched comparison groups, other systematic differences in unobservable characteristics may remain. The *difference-in-differences matching estimator* (PSM-DID estimator) upon observing firms before and after change differences away such time-invariant unobservable characteristics and differs from the standard DID estimator by including only treated firms within the common support.

3.2 Estimating the propensity score

The first step in estimating treatment effects is to estimate the propensity score (the probability of starting OFDI) for all firms in the treatment and control groups through a probability model with the covariates pertaining to the pre-treatment period to address self-selection on which treatment assignment is conditioned.

3.3 Method of matching

Having estimated the propensity score for each firm, each OFDI firm can be paired with one (or more) firms that had a very similar ex-ante predicted probability of becoming an OFDI firm but remained non-OFDI. Here, matching is performed using the 1-to-1 *nearest-neighbour, with replacement, within caliper* matching approach.[67] The quality of matching is checked by applying a set of match balance tests, and performance of firms within pairs of observations matched on the propensity score are compared and estimates of the ATT are obtained.

4 Dataset and sample characteristics

For 6,068 firms from the *Prowess* database, to follow individual firms through time we organise the data around cohorts. Cohorts are defined as four-year windows around year *t [t-1; t+2]* in which domestic firms invest abroad. We impose the condition that within a four-year window the panel should be balanced, and focus on changes in OFDI status of firms between 1996-2007 to have a 3 year post-entry time horizon. Firms with less than five years data are dropped. As in Chapter 2, an OFDI

[67]Bad matches are avoided by imposing a pre-specified tolerance level (e.g. 0.01) on the maximum distance allowed.

firm is defined as one with positive foreign investment intensity and an export firm as one with positive export intensity.

5 Results: discrete (*binary*) treatment

5.1. Propensity score estimation

Within-firm transition from non-OFDI to OFDI is modelled through the Becker and Ichino (2002) pscore procedure, using a probit specification to estimate the propensity score of the treatment on one-year lagged control variables.[68] Based on 51,007 observations over 1996-2010, results show that ex-ante better performers in terms of sales, relative TFP levels, higher R&D ratios, and export intensity are more likely to become engaged in OFDI. High selling and distribution intensity and cash flow affect OFDI entry positively. Older firms are less likely to become OFDI firms. Government and foreign firms are also less likely to invest abroad. The coefficient on the OFDI share variable is statistically insignificant. The period of OFDI policy liberalisation (2004-2010) is associated with an increase in OFDI entries (qualitatively, these results are similar to those obtained in Chapter 2 above).

Based on the estimated propensity scores, PSM-DID estimates of the ATT are obtained with the Arnold and Javorick (2009) matching procedure (implemented in Stata12), a modified version of the Leuven and Sianesi (2003) (psmatch2) procedure that ensures that matched control observations[69] are assigned from within the same 2-digit industry/ industry group and same year as OFDI switchers. For 230 matched pairs, causal effects of investing abroad are inferred from the average divergence in performance paths of OFDI-initiating and matched control firms, starting from the year preceding OFDI entry.

All manufacturing[70]

(a) Log of TFP index

The average difference in relative TFP in the matched pairs, net of the average initial difference in the pre-OFDI period, the ATT is 0.00497 in the year of starting OFDI, i.e., after taking into account the initial difference between the two groups, OFDI firms

[68]While regression analyses performed in Chapter 2 using the 'survival' analysis approaches are conceptually superior as they also include the role of 'time of entry' (with analysis time measured in terms of 'time at risk'), probit regression for the first OFDI entry, based on firm-year observations is performed in this chapter, mainly for computational ease.

[69]Firms that do not serve foreign markets through OFDI but that otherwise share all other forms of access to foreign markets.

[70]Figure 3.F1 in Appendix 3.2 compares trajectories of average values of log TFP index, export intensity and log of sales one year before and after firms start OFDI (in year t0), for treated and matched control group firms. Matching techniques pair firms such that they are nearly similar before t0, and any differences in post-t0 performance can be attributed to treatment effects.

have 0.49 percent higher relative TFP level. In the second year under OFDI, the relative productivity advantage of OFDI firms increases to 1.6 percent. By the third year it reaches 3.5 percent. While the results suggest positive productivity consequences all three effects are statistically insignificant implying that productivity gains at home are limited.

These results are similar to those in Gupta, Patnaik and Shah (2013) on Indian export firms that fails to find evidence for learning-by-exporting in terms of higher productivity growth as a result of exporting, although they do find that new exporters are investing in improving productivity *(learning-to-export)* prior to starting to export (i.e. have ex-ante higher productivity).

Multinational activity by Indian firms, especially horizontal OFDI (generally identified with market-seeking OFDI especially in advanced economies), could increase local headquarter services that the multinational provides to affiliates abroad. As our measure of TFP includes service expenses as inputs, OFDI initiation may not show up as improved TFP. Also, to the extent that the gains from OFDI may take longer to show up, a limited post-entry time dimension may limit the analysis. While Indian firms are widely perceived as investing abroad to stay competitive, with technology transfer as a motivating factor, ATT based effects on TFP are not so indicative. Taking another view, positive impacts of firms' outward investments may not necessarily show up in ATT estimates if post-entry increases in productivity among foreign investors improve productivity of other firms within the same industry and in other industries by increasing competition and providing positive technological and managerial knowledge spillovers. While the chapter does not explicitly focus on firms that do not invest abroad, some positive spillover effects may also flow from the increased export intensity and firm sales of the parent firms that are directly affected.

(b) Export intensity

In the pre-entry year, control firms export a slightly higher share of their output, 20.3 percent compared to 19 percent for the future OFDI firms. While this share goes down slightly for the control firms, new OFDI firms see a steady increase in all the post-change years (22.4 percent two years after the entry and 23.1 percent in the following year). The difference between the two groups is statistically significant in all years. In the second year after switching, the difference in the export share is around 2.6 percentage points between treated and non-treated firms. This difference increases to about 3.3 percentage points in the following year. These findings suggest that exporting and OFDI are complements. This conclusion is consistent with the

theoretical predictions (e.g. Head and Ries, 2004), and previous empirical findings for India. Increasing integration of OFDI firms in the worldwide production and distribution networks of foreign partners could increase the intensity to export home-centred products to foreign markets at lower costs.

(c) Firm sales

Firm sales is defined as the logarithm of sales. OFDI initiating and control group firms show very similar average firm sales levels in the pre-OFDI period. In the OFDI entry year, the outward investing firms have a 7 percentage advantage over the control observations which rises to 10.8 percent in subsequent years. However, it is only by the third year of OFDI entry that the 11.5 percent advantage between the two groups becomes statistically significant (at the one percent level). One reason for the growing advantage in production volumes could be increasing opportunities for restructuring within an enlarged international production network; complementarity between OFDI and exports. Ease in access to foreign financing could also increase firm sales, even if it does not translate into improved productivity.

1. Excluding natural resource-seeking OFDI

As a significant share of OFDI from industries such as coke and refined petroleum products (NIC19) and basic metals (NIC 241) can be associated more with the resource-seeking motive, the impact of starting OFDI is estimated by excluding these two sectors. Even then, initiating foreign investment by the remaining firms is unlikely to boost productivity. Marginal changes from the results for all manufacturing are observed for export intensity and firm sales. For firm sales, however, ATT becomes significant at the 10% level two years after OFDI entry.

2. Heterogeneity based on industry differences (by technology intensity)

Instead of taking learning effects as homogeneous, heterogeneity in the impact of initiating OFDI by the technology intensity of the sectors that the matched pairs belong to is examined. Classification of manufacturing industries, based on NIC codes, follows OECD (2003) classification by technology intensity (categories based on R&D intensities) with four categories, namely high technology, medium-high technology, medium low technology and low technology (Table 3.T2 in Appendix 3.1). For having sufficient number of matched pairs, the medium-high and high technology sectors are combined into one group, and likewise, the medium-low and low technology sectors into another group.

(a) Log of TFP index

For high and medium-high technology industries, a similar picture emerges as with respect to all manufacturing as OFDI entry leads to insignificant effects on log TFP index. Although two years after OFDI entry, the percentage gap in productivity between the treatment and control group seems to rise, the effect is not statistically significant. Gains in productivity in medium-low and low technology industries are insignificant.

(b) Export intensity

OFDI initiating firms in high and medium-high technology industries do not achieve any significant growth in export share relative to non-treated firms. This could indicate a tendency of treated firms to establish foreign affiliates to cater to foreign markets in search of R&D spillovers abroad. In contrast, firms in medium-low and low technology industries start with a relatively high share of export to sales ratio than firms in the high and medium-high technology category and exhibit an increase of over 2.5 percentage points in ATT in the post-switching period compared to matched control firms. This could indicate stronger home-centralisation in serving foreign markets through exports.

(c) Firm sales

High and medium-high technology firms exhibit no significant increase in log sales. Smaller increases in firm sales could signal longer gestation periods for any significant gains to materialise. Firms in low and medium-low technology industries that become engaged in OFDI experience a significant increase in sales in the short and medium-term clearly outperforming non-switching firms. The mechanism for these effects could lie in their increased export intensity.

5.4 Robustness checks

First, considering a longer time horizon (OFDI firms whose outcome variables are observed in each of the 4 years starting from OFDI entry), we discard cases with missing data for the additional year and 2006 is the last year of OFDI entry that can be considered. However, this result is based on a restricted number of matched pairs (116). Some differences are observed with respect to the significance of ATT estimates. The ATT estimate for log TFP index is now significant, two years later, suggesting learning effects from OFDI. ATT estimates for export intensity are now significant only two years later, while log sales is now significant in the year of OFDI entry and in the second year under OFDI but not for the following years. In addition to these results being based on a smaller number of matched pairs, sectors that are dropped to be able to obtain bootstrapped standard errors (in which very few OFDI entries occurred during the sample period)

are predominantly labour-intensive sectors. This may, in part, explain the differences. As an extended time horizon limits the number of matched pairs, our main conclusions from binary treatment analysis focus on the 3 year time horizon considered originally.

Second, results are qualitatively unchanged if we perform only year-wise or only industry-wise matching and results with nearest-neighbour matching *without* caliper.

Finally, it may be argued that firms that make early OFDI entries in the sample period are more productive than those that make later OFDI entries (Chapter 2). The learning effect on productivity is thus expected to be higher for such firms. To exclude later OFDI entries, the OFDI entry period is truncated at sub-period, here taken as 2002, with a two year post-entry period extending up to 2004. Results for *ln*TFP, based on 85 matched pair for the pre 2005 period suggest that while estimates of ATT are numerically higher than when the entire sample period in considered, the estimates are nevertheless insignificant.

6 Empirical methodology: non-discrete (non-binary)/ continuous treatments

Continuous treatments refer to the share of investment outside India in the firm's total assets (foreign investment intensity) over the interval [0, 1].[71] The objective is to study the varying effects of varying treatment levels on the estimated outcome variables (annual TFP, and sales growth rates respectively; and export intensity) in comparison to the outcome estimated at the control (at treatment 0). For this purpose, following (Fryges (2009) and Guardabascio and Ventura (2013, 2014)) a dose-response function that plots the relationship between treatment level changes and outcome variables is estimated. With pre-treatment covariates hypothesised to impact the level of treatment for each firm, with the corresponding outcome being a function of the treatment, the *average* dose-response function represents the average outcome evaluated at any level or dose of the continuous treatment variable.[72]

The dose-response function can be estimated in three steps:

[71]In our sample, the interval of interest is [0, .5], over which the foreign investment intensity is observed to lie.

[72]Hirano and Imbens (2004) define the propensity function as the conditional density of the actual treatment given the covariates. If $r(d, x) = f_{D|X}(d|x)$ is the conditional density function of the treatment given the covariates (where f is the relevant probability distribution function) then the GPS is R = r(D|X) and the dose-response function can be obtained as $\gamma(d,r)=E[Y(d)|r(d,X)=r]=E[Y|D=d,R=r]$ (1); $\varphi(d)=E[\gamma(d,r(d,X))]$ (2).

Step 1: Estimate the score r(d, x) through the Generalized Linear Model (GLM)

In estimating the GPS for continuous variables, Hirano and Imbens (2004) use a normal distribution for the treatment variable. However, in our case, the treatment variable D is a fraction (firms' investment outside India-total assets ratio) with a non-normal, skewed distribution, with many limit observations at the value zero, (representing firms without any international investments). Following the export-performance literature, (e.g., Fryges and Wagner, 2008; and Fryges, 2009) that also consider a non-normal dependent (treatment) variable such as the fraction of overseas sales to total sales, where a large fraction of firms report no exports at all, the estimation of the GPS (the probability of the actual, i.e. the observed, treatment received) is based on estimates of the parameters of the fractional logit model (developed by Papke and Wooldridge, 1996 using GLM (developed by McCullagh and Nelder, 1989).

Step 2: Model the conditional expectation of the outcome as a function of the treatment level and the (estimated) GPS

Using Ordinary Least Squares (OLS), the equation is estimated as a flexible function of the two scalar variables, using polynomial approximations of order not higher than three.

Step 3: Estimate the dose-response function by averaging the estimated conditionl expectation over the GPS at each level of the treatment level of interest

7 Results: continuous treatment

The dose-response function suggests whether the relationship between continuous treatments and outcomes exhibits a maximum, minimum, has turning points or any discontinuities (Flores, 2004). If OFDI is observed to improve TFP growth only within a sub-interval of the treatment variable, whereas it has no effect or even a negative effect within another sub-interval, this can at least partly explain why studies that are confined to OFDI-starter status do not necessarily observe any impact of OFDI on productivity growth. Following the internationalisation-performance literature, it can be argued that for firms with small foreign investment intensity, learning-by-outward investment could be less relevant (limited contact with foreign affiliates, leading to limited knowledge flows). Thus, a firm may have to exceed a minimum treatment level before it can experience any learning effects. Beyond this minimum, TFP growth is expected to increase with the firms' foreign investment intensity. However, when a firm increases its foreign engagement the costs of coordination and control also rise and sometimes begin to

escalate when a critical level of the treatment is exceeded. For instance, Gomes and Ramaswamy (1999) note that entering more distant markets may raise the costs of operations, and increasing international expansion may have a negative impact on a firm's performance that may exceed the benefits due to learning effects. Thus, there might be an optimal value of internationalisation, leading to an inverted *U*-shaped relationship between a firm's international engagement and its productivity growth (the 'threshold of internationalisation', Geringer et al., 1989; Sullivan, 1994).

For the period 1996-2007, given the continuous treatment variable in year *t*, the dose-response functions that depict the expected outcome in the period from year *t* to *t*+3 are estimated using the *doseresponse2* program in Stata 12, developed by Guardabascio and Ventura (2013) (that implements steps 1-3 (given above) and plots the estimated dose-response functions).[73]

7.1 Estimation of the dose-response function

In estimating the conditional distribution of the treatment variable (given the covariates, in addition to the covariates used for the estimation of the propensity score from the probit model (following binary treatment analysis) we now include the squared value of the sales of the firm. The lagged absolute value of TFP is included in the covariates to control for different levels of TFP *prior* to the growth period, and to account for firms' state dependence (likewise, for lagged log of sales, and lagged export intensity respectively).

Estimation results of the fractional logit model suggest that firm *sales* has a positively significant effect on firms' foreign investment intensity, although at a decreasing rate (negative sign of the squared value of firm sales). Results show an inverted *U*-shaped relationship between firm sales and the foreign investment intensity (as in Pradhan, 2004; Kumar, 2007). The foreign investment intensity increases with lagged level of log TFP index, export intensity, R&D intensity, selling and distribution intensity, and cash flow. Firm age has a negative and statistically significant effect. Business group affiliated firms exhibit a higher share of total assets abroad in comparison to private (Indian), foreign and government firms.

The dose-response functions, i.e., the average conditional expectation of the outcome in period t to t+2 and t+3 respectively, given the continuous treatment in t and the estimated GPS evaluated at the observed levels of the continuous treatment in the interval

[73]Annual average growth rate of outcome variables is defined as the difference between the logarithm of outcome variables in any year $t+k$ (with $k \geq 1$) and the switching year t (1996-2007) divided by the number of years between $t+k$ and t: $(logX_{i,t+k} - logX_{i,t})/k$.

[0-.5] are depicted in Figures 3.1a-3.3b.[74]

(a) Causal effects on annual average TFP growth rate

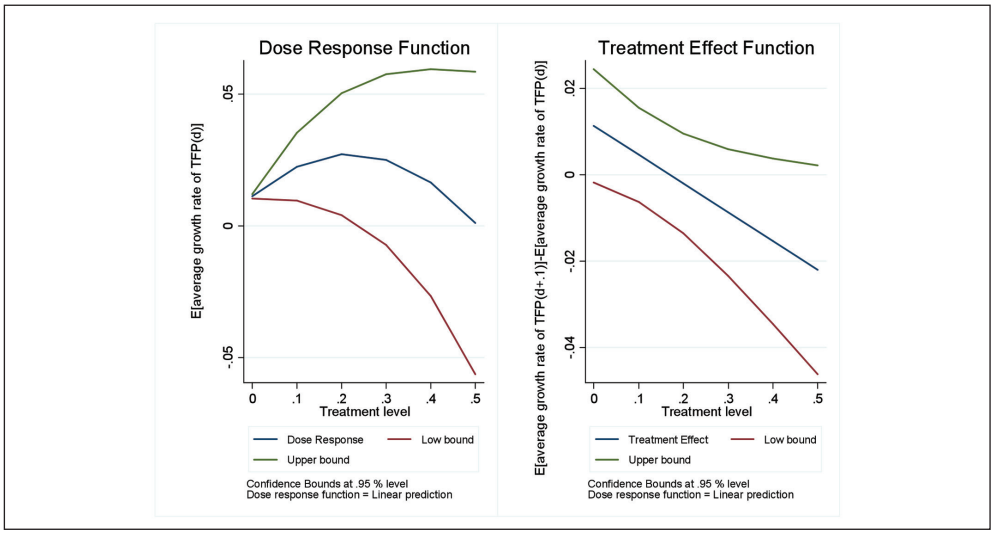
An inverted U-shaped relationship for annual TFP growth (Figure 3.1a) complements previous findings on the relationship between export-sales ratio and labour productivity growth rates (Fryges and Wagner, 2008) to broader internationalisation-performance relationship.

Figure 3.1a reveals that the estimated annual average growth rate of TFP for firms with only domestic and export operations (D and DX with foreign investment intensity of 0) is about 1%. Over the 0-10% interval of the treatment intensity, firms with a higher foreign investment intensity tend to have higher growth rates of TFP than firms that invest a relatively smaller share of assets. This suggests that even though it involves a relatively small degree of foreign involvement, in this interval firms that undertake OFDI benefit from their activities abroad. For the interval between 10 and 19%, TFP growth rate is even higher, though the curve gets flatter. The figure suggests that the treatment level at which the function is maximized is at a foreign investment intensity of 19%, and the maximum value of annual growth of TFP achieved by this function is 2.9%. This suggests that if we eliminate firm-specific differences in the pre-treatment variables (by conditioning on the GPS) a hypothetical switch of a firm from non-OFDI to investing 19% of its total assets abroad causes a 2.9 percentage-point increase in the firm's TFP growth rate. Analytic confidence bands at the 5-percent level suggest that the causal effect of foreign investment intensity on subsequent TFP growth is positive and significant till a foreign investment intensity level of about 24%, beyond which no significant effects can be discerned. Beyond this treatment level, OFDI is observed to have an insignificant impact on TFP growth rate till a foreign investment intensity of about 52%. Thus, we can conclude that OFDI improves TFP growth only within a sub-interval of firms' foreign investment intensity (in our case, less than 24%).

Figure 3.1b shows that results are qualitatively similar even when annual average growth rates are computed over a longer time span. Causal effects are however positive till a treatment intensity of 30%. The maximum TFP growth rate is lower, at just about 2%.

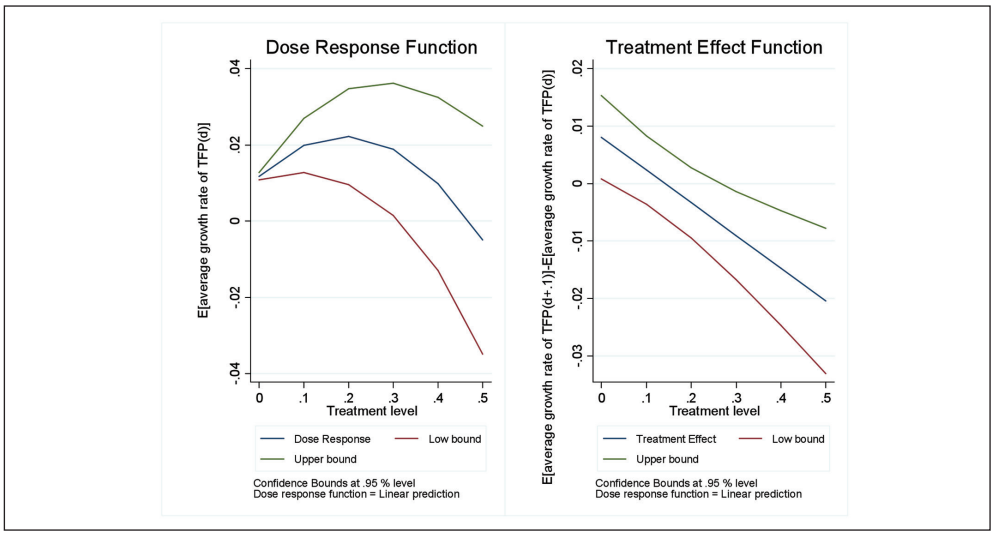
[74]For comparison, Figures3.1a, 3.2a and 3.3a plot the relationship over a 2-year horizon, while Figures 3.1b, 3.2b and 3.2b plot the same over a 3-year horizon. The 3-year horizon however is for a relatively small sample size, being restricted to firms observed over a longer span under OFDI. In the figures, in the left panel, *the middle* line indicates the *dose-response* function that estimates the conditional expectation of outcome given the *share of investment outside India to total assets in t and the estimated GPS*. The outer lines indicate the simulated 95% confidence interval (based on bootstrapping with 100 replications). TFP growth is trimmed by excluding values below the 1st or above the 99th percentiles.

Figure 3.1a: Estimated dose-response functions of the treatment *(investment outside India-total assets ratio)* on the outcome *(average growth rate of TFP (t to t+2))*, estimated derivative, and 95% confidence bands for the fractional logit distributed data, 1995-2010



Source: *Prowess* 4 and own estimations.

Figure 3.1b: Estimated dose-response functions of the treatment *(investment outside India-total assets ratio)* on the outcome *(average growth rate of TFP (t to t+3))*, estimated derivative, and 95% confidence bands for the fractional logit distributed data, 1995-2010

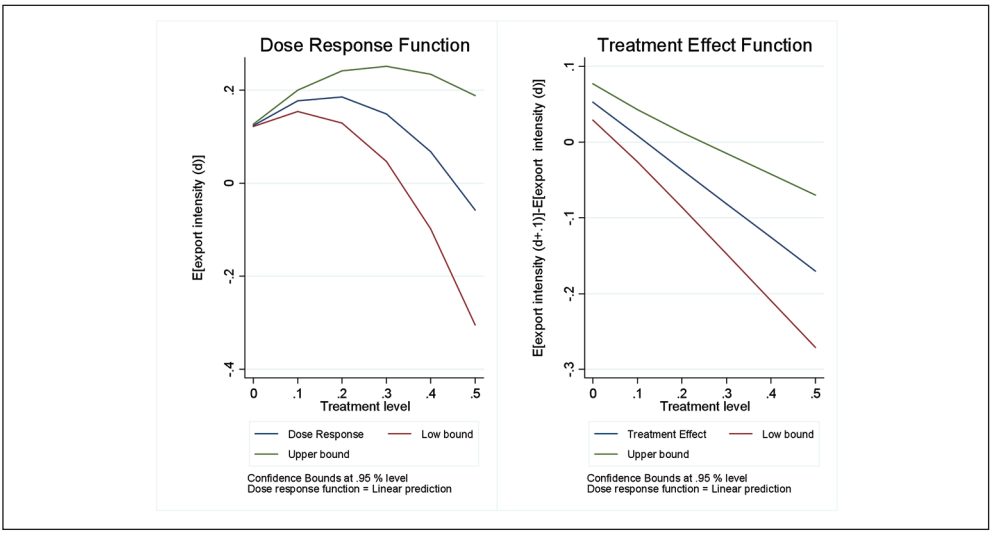


Source: *Prowess* 4 and own estimations.

(b) Causal effects on export intensity

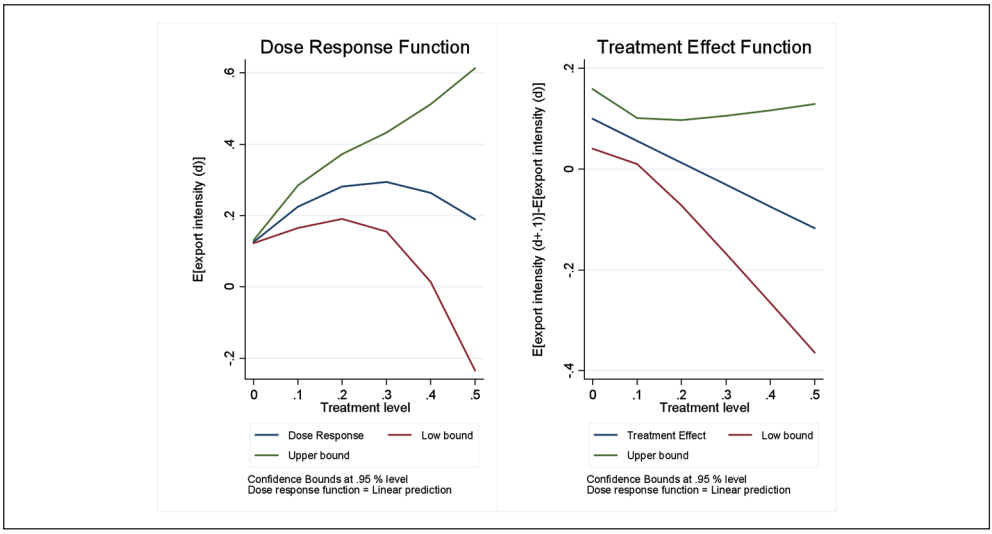
Figure 3.2a depicts the dose-response function that represents the expected export-sales ratio in t+2 conditional on the foreign investment intensity in t and the GPS. The causal impact tends to be positive over a large part of the interval and is statistically significantly different from zero according to the simulated confidence bounds at the 95 percent level over a wide span up to a little above 30 percent of the foreign investment intensity. This impact increases with the intensity of foreign investment at the very beginning of the distribution of the treatment intensity, indicating that some OFDI activity leads to an increase of the export-sales ratio compared to a situation without OFDI activity. The causal impact is a maximum at a point estimate of just below 20 percentage points, corresponding to a treatment intensity of about 20 percent. Further, over an extended time horizon (Figure 3.2b), while the causal effect is positive and statistically significant over a wider span of the treatment intensity, the maximum export intensity is indicated to be even higher, now at a correspondingly higher treatment intensity indicating a strengthening of export activities with prolonged OFDI presence in foreign markets.

Figure 3.2a: Estimated dose-response functions of the treatment *(investment outside India-total assets ratio)* on the outcome *(export intensity (t to t+2))*, estimated derivative, and 95% confidence bands for the fractional logit distributed data, 1995-2010



Source: *Prowess* 4 and own estimations.

Figure 3.2b: Estimated dose-response functions of the treatment *(investment outside India-total assets ratio)* on the outcome *(export intensity (t to t+3))*, estimated derivative, and 95% confidence bands for the fractional logit distributed data, 1995-2010



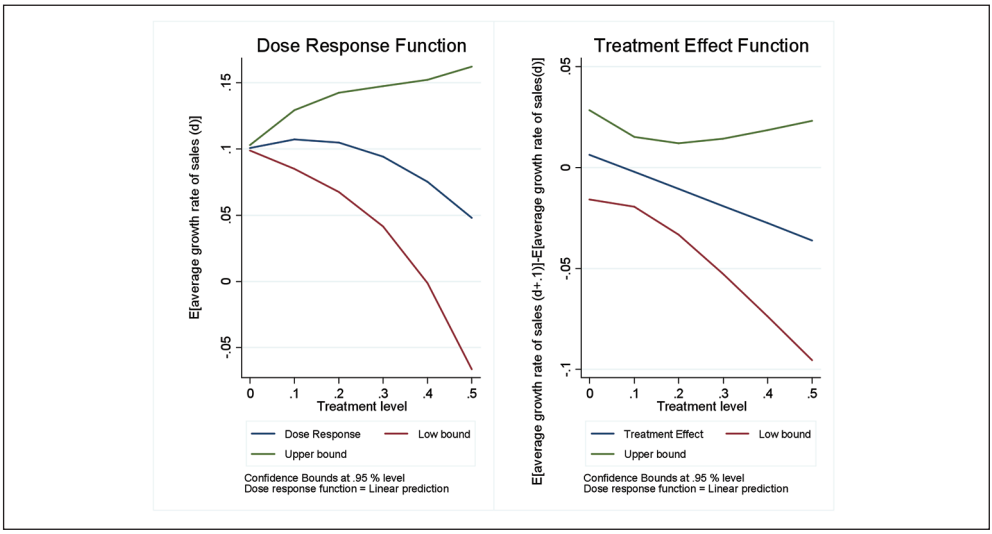
Source: *Prowess* 4 and own estimations.

(c) Causal effects on annual average sales growth rate

The dose-response function for growth of sales (Figure 3.3a) reveals that compared to non-OFDI activity, in the observed interval of the continuous treatment, the causal effect is positive throughout and statistically, significantly different from zero (according to the simulated confidence bands at the 95 % level) over a wide span, up to 40% of foreign assets in total assets. As for TFP growth, the treatment impact increases with the foreign investment intensity at the very beginning of the sample distribution of the treatment variable, indicating that some OFDI activity leads to an increase in subsequent sales growth compared to a situation without OFDI activity, maximum sales growth of about 10.5% is observed at a foreign investment intensity of about 11%. Over the interval (20 - 40% foreign investment intensity), sales growth is observed to be even smaller than the growth rate for non-OFDI firms, and significantly so. However, the sample distribution at higher intensities of the treatment variable is very thin, and this finding may not be of overall consequence.

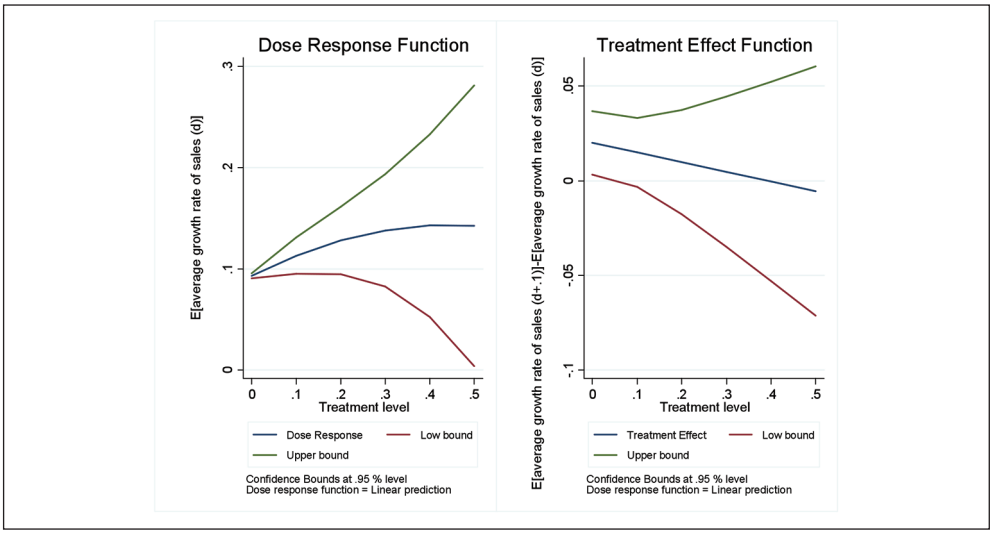
Considering a slightly longer time horizon (Figure 3.3b) shows that the 95% confidence interval suggests a positive and significant impact of the treatment variable over the entire interval of the treatment intensity considered. After growing in the beginning of the sample distribution, the dose-response function tends to be rather flat over a large part of this interval.

Figure 3.3a: Estimate dose-response functions of the treatment *(investment outside India-total assets ratio)* on the outcome *(average growth rate of sales (t to t+2))*, estimated derivative, and 95% confidence bands for the fractional logit distributed data, 1995-2010



Source: *Prowess* 4 and own estimations.

Figure 3.3b: Estimated dose-response functions of the treatment *(investment outside India-total assets ratio)* on the outcome *(average growth rate of sales (t to t+3))*, estimated derivative, and 95% confidence bands for the fractional logit distributed data, 1995-2010



Source: *Prowess* 4 and own estimations.

8 Conclusions

For Indian manufacturing firms over 1995-2010, comparing OFDI starters with non-OFDI firms (binary treatment analysis) this chapter analyses the direct causal effects of initiating OFDI on firm productivity, export intensity and sales over a three-year horizon, after controlling for the Helpman, Melitz and Yeaple (2004) type self-selection of more productive firms into OFDI. Results based on the PSM-DID approach control for observable and time-invariant unobservable differences between the treatment and control group firms. Causal effects are derived from the average divergence in outcome paths between treatment group firms and a set of closely matched non-treated firms, starting from the year preceding OFDI entry.

For aggregate all manufacturing sector, initiating OFDI is observed to have an insignificant effect on the productivity of firms that begin to invest abroad; OFDI is found to complement rather than substitute exports; and firm sales are observed to increase in the third year under OFDI. It is then examined whether the finding of limited effects of investing abroad on firm performance can be explained by the aggregation of heterogeneous effects. Sub-sample analysis based on industrial classification (defined by technology intensity) suggests heterogeneity in treatment effects, implying that the consequences of initiating OFDI for parent firms depend partly on the sector of origin. Initiating OFDI is found to increase export intensity more pronouncedly in low rather than in high technology industries. This may also be associated with scale effects, evidenced by the increase in firm sales, suggesting changes in the organisation of the production process in the parent firm, with higher concentration of production at home. For the productivity variable however, the finding of an insignificant impact at the all manufacturing level does not seem likely due to lack of consideration of heterogeneity.

The finding that firms grow in sales but do not necessarily become more productive could in part result from limitations in analysing the impact of first-time foreign investors that may be very different from the effects of being a foreign investor in time period t on subsequent time periods. Productivity gains may also be realised only after the initial few years. Some of the limitations from binary treatment analysis (based on a relatively small number of matched pairs) can be overcome by adopting the continuous treatment analysis that compares the performance over subsequent time periods of OFDI firms (with varying foreign investment intensity in t), with non-OFDI firms. Results based on the effects of firms' observed foreign investment intensity on annual average TFP, sales growth rates, and export

intensity respectively (over a two-year and three-year horizon), show varying effects of treatment levels, with significantly positive though small causal effects over a certain range of the treatment variable.

This is similar to previous findings on the relationship between export-sales ratio and profitability growth rates, sales growth rates, and labour productivity growth rates. This suggests a broader relationship between internationalisation and performance (namely, between foreign investment intensity and the outcome variables considered).

The finding of limited learning effects from engagement with OFDI suggests that at least some part of the observed cross-sectional productivity advantage of internationally engaged firms could be attributed to the post-entry productivity advantages. To the extent that the evidence on self-selection is strong, it suggests that the better performing firms that make the OFDI entry are the ones that would benefit more from foreign engagement. This finding is also suggestive of policies that increase firms' capacity to undertake OFDI and improve their absorptive capacity in the pre-OFDI period.

Appendix 3.1 Additional tables

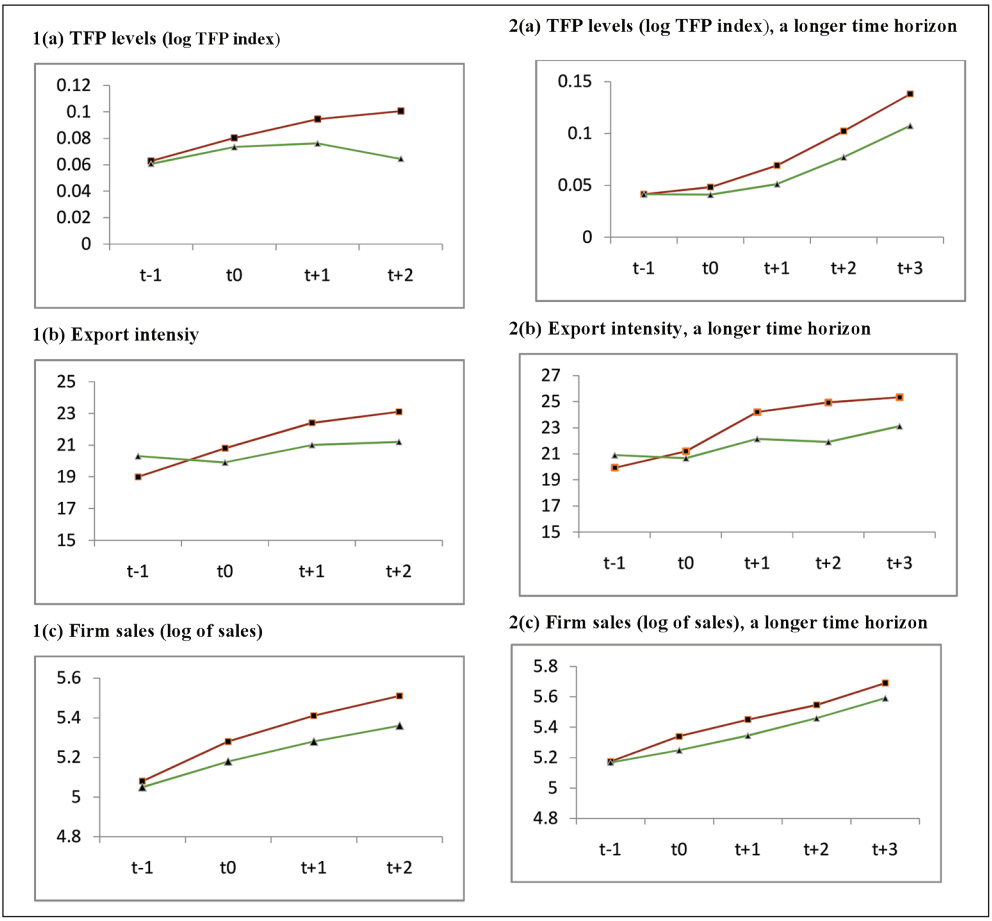
Table 3.T1: Classification of manufacturing industries (based on NIC codes), following the OECD classification of manufacturing by technology intensity (2003)

High and medium-high technology			Medium-low and low technology		
Industry category	**NIC**	**Description of activities**	**Industry category**	**NIC**	**Description of activities**
High technology	21	Pharmaceuticals, medicinal chemical and botanical products	***Medium-low technology***	19	Coke and refined petroleum products
	26	Computer, electronic and optical products		22	Rubber and plastics products
Medium-high technology	20	Chemicals and chemical products		23	Other non-metallic mineral products
	27	Electrical equipment		24	Basic metals
	28	Machinery and equipment n.e.c.		25	Fabricated metal products, except machinery and equipment
	29	Motor vehicles, trailers and semi-trailers	***Low technology***	10	Food products
	30	Other transport equipment		11	Beverages
				12	Tobacco products
				13	Textiles
				14	Wearing apparels
				15	Leather and related products
				16	Wood and products of wood and cork, except furniture
				17	Paper and paper products
				18	Printing and reproduction of recorded media
				32	Other manufacturing

Source: OECD (2011).

Appendix 3.2 Additional figures

Figure 3.F1: Trajectories comparing performance of OFDI initating and control firms over time (all manufacturing)



Notes: The solid line represents the treatment group (OFDI initiating firms).The dashed line represents *the nearest- neighbour, within caliper* propensity-score-matched control group. The horizontal axis plots years before and after OFDI entry (*t0* is the year where firms initiate OFDI), *t*+1 is one year after the OFDI entry, and so on. The vertical axis plots average outcome variables. For the *log TFP* index panel, the vertical axis measures the difference between firm TFP and 2-digit NIC industry mean TFP in the base year.
Source: *Prowess* 4 and own calculations.

REFERENCES

Ackerberg, Daniel, Kevin Caves, and Garth Frazer, "Structural Identification of Production Functions," UCLA working paper (2006). http://www.econ.ucla.edu/ackerber/ACF20withtables.pdf.

Arnold, Jens Matthias, and Beata S. Javorcik, "Gifted Kids or Pushy Parents? Foreign Acquisitions and Firm Performance in Indonesia," *Journal of International Economics* 79 (2009), 42-53.

Balakrishnan, Pulapre, K. Pushpangadan, and M. Suresh Babu, "Trade Liberalisation and Productivity Growth in Manufacturing: Evidence from Firm-Level Panel Data," *Economic and Political Weekly* 35:41(2000), 3679-82.

Baldwin, Richard, "A Domino Theory of Regionalism," NBER working paper 4465 (1993).

Banga, Rashmi, and Bishwanath Goldar, "Contribution of Services to Output Growth and Productivity in Indian Manufacturing: Pre-and Post-Reforms," *Economic and Political Weekly* 42:26 (2007), 2769-2777.

Barba Navaretti, Giorgio, and Anthony J. Venables et al., *Multinational Firms in the World Economy* (Princeton University Press, 2006).

Becker, Sascha. O., and A. Ichino, "Estimation of Average Treatment Effects Based on Propensity Scores," *Stata Journal* 2 (2002), 358-377.

Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott, "Firms in International Trade," *Journal of Economic Perspectives* 21:3 (2007), 105-130.

Bhattacharya, Rudrani, Ila Patnaik, and Ajay Shah, "Exports versus FDI in Services," *The World Economy* 35:1 (2012), 61-78.

Brainard, S. Lael, "An Empirical Assessment of the Factor Proportions Explanation of Multinational Sales," NBER working paper 4583 (1993).

Breinlich, Holger, and Chiara Criscuolo, “International Trade in Services: A Portrait of Importers and Exporters,” *Journal of International Economics* 84:2 (2011), 188-206.

Centre for Monitoring Indian Economy (CMIE) Pvt. Ltd., *Prowess Version 4 (Prowess4)*, Database Dictionary (2011). http://prowess.cmie.com.

Chawla, Isha, “A Note on the Methodology for Measuring Labour Input from Company Databases,” *Economic and Political Weekly* 47:3 (2012), 69-75.

Coe, David, and Elhanan Helpman, “International R&D Spillovers,” *European Economic Review* 39 (1995), 859-887.

Conconi, Paola, André Sapir, and Maurizio Zanardi, “The Internationalization Process of Firms: From Exports to FDI,” CEPR Discussion Paper 9332 (2014). http://www.ecares.org/ecare/personal/conconi$/web/internationalization.pdf.

Cox, David R., “Regression Models and Life-Tables,” *Journal of the Royal Statistical Society. Series B (Methodological)* 34:2 (1972), 187-220. http://www.ida.liu.se/~kawah/Cox2.pdf.

Dehejia, Rajeev, and S. Wahba, “Propensity-Score Matching Methods for Nonexperimental Causal Studies,” *Review of Economics and Statistics* 84:1 (2002), 151-161.

Demirbas, Dilek, Ila Patnaik, and Ajay Shah, “Graduating to Globalisation: A Study of Southern Multinationals,” *Indian Growth and Development Review* 6:2 (2013), 242-259.

Engel, Dirk, and Vivien Procher, “Export, FDI and Firm Productivity,” *Applied Economics* 44:15 (2012), 1931-1940.

_____, “Home Firm Performance after Foreign Investments and Divestitures,” *The World Economy* 36:12 (2013), 1478-1493.

Export Import Bank of India, “Outward Direct Investment from India: Trends, Objectives and Policy Perspectives,” Occasional paper 165 (2014). http://www.eximbankindia.in/sites/default/files/Full%20OP/ODI%20OP.pdf.

Francois, Joseph, and Bernard Hoekman, “Services Trade and Policy,” *Journal of Economic Literature* 48:3 (2010), 642-692.

Fryges, Helmut, “The Export-Growth Relationship: Estimating a Dose-Response Function,” *Applied Economics Letters* 16 (2009), 1855-1859.

Fryges, Helmut, and Joachim Wagner, “Exports and Productivity Growth-First Evidence from a Continuous Treatment Approach,” *Review of World Economics* 144 (2008), 695-722.

____, “Exports and Profitability-First Evidence for German Manufacturing Firms,” *The World Economy* 33 (2010), 399-423.

Gandhi, Amit, Salvador Navarro, and David Rivers, “On the Identification of Production Functions: How Heterogeneous is Productivity?,” CIBC working paper (2013) http://www.ssc.wisc.edu/~agandhi/homepage/Amit_Gandhi_files/production_9_25_13_FULL.pdf.

Geringer, Michael, J., Paul. W. Beamish, and Richard C. DaCosta, “Diversification Strategy and Internationalization: Implications for MNE Performance,” *Strategic Management Journal*, 10:2 (1989), 109-119.

Girma, Sourafel, Holger Görg, and Eric Strobl, “Exports, International Investment, and Plant Performance: Evidence from a Non-Parametric Test,” *Economics Letters* 83 (2004), 317-324.

Goldar, Bishwanath, “Direction of Outward FDI of Indian Manufacturing Firms: Influence of Technology and Firm Productivity,” paper presented at the *VIII Annual International Knowledge Forum Conference*, Indian Institute of Technology Bombay, Mumbai, October 25-27, (2013). http://fgks.in/IndexServer/tifac/article/180.pdf.

Goldar, Bishwanath, V. S. Renganathan, and Rashmi Banga, “Ownership and Efficiency in Engineering Firms: 1990-91 to 1999-2000,” *Economic and Political Weekly* 39:5 (2004), 441-447.

Gomes, Lenn, and Kannan Ramaswamy, “An Empirical Examination of the Form of the Relationship Between Multinationality and Performance,” *Journal of International Business Studies* 30:1 (1999), 173-188.

Guardabascio, Barbara, and Marco Ventura, “Estimating the Dose-response Function Through the GLM Approach,” MPRA paper 45013 (2013). http://mpra.ub.uni-muenchen.de/45013, *published as*: Guardabascio, Barbara, and Marco Ventura, “Estimating the Dose–response Function Through a Generalized Linear Model Approach,” *The Stata Journal* 14:1 (2014), 141-158.

Gupta, Apoorva, Ila Patnaik, and Ajay Shah, “Learning by Exporting: Evidence from India,” ADB working paper series on Regional Economic Integration (2013). http://aric.adb.org/pdf/workingpaper/WP119_Gupta_Patnaik_Ajay_Learning_by_Exporting.pdf.

Hall, Bronwyn H., and Jacques Mairesse, “Exploring the Relationship Between R & D and Productivity in French Manufacturing Firms,” *Journal of Econometrics* 65 (1995), 263-293.

Hayakawa, Kazunobu, Fukunari Kimura, and Tomihiro Macikita, “Globalisation and Productivity: A Survey of Firm-Level Analysis,” *Journal of Economic Surveys* 26:2 (2012), 332-350.

Head, Keith and John Ries, “Heterogeneity and the FDI versus Export Decision of Japanese Manufacturers,” *Journal of The Japanese and International Economies* 17:4 (2003), 448-467. http://www.d.umn.edu/~btadesse/Research/Literature/Heterogeniety%20and%20FDI.pdf.

_____, “Exporting and FDI as Alternative Strategies,” *Oxford Review of Economic Policy*, 20:3 (2004), 409-423.

Heckman, James J., Hidehiko Ichimura, and Petra E. Todd, “Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme,” *Review of Economic Studies* 64:4 (1997), 605-654.

Helpman, Elhanan, *Understanding Global Trade* (2010). http://dems.unimib.it/corsi/678/altro/understanding_global_trade.pdf.

Helpman, Elhanan, Marc J. Melitz, and Stephen R. Yeaple, “Export versus FDI with Heterogeneous Firms,” *American Economic Review* 94:1 (2004), 300-316.

Hess, Wolfgang, and Maria Persson, “Exploring the Duration of EU Imports,” *Review of World Economics* 147 (2011), 665-692.

_____, “The Duration of Trade Revisited: Continuous-Time vs. Discrete-Time Hazards,” *Empirical Economics* 43 (2012) 1083-1107.

Hirano, Keisuke, and Guido W. Imbens, “The Propensity Score with Continuous Treatments,” Working Paper (University of California, Berkeley, 2004). file:///D:/01Chapter%203/Hirano%20&%20Imbens%20-%20GPS.pdf.

International Monetary Fund, *Foreign Direct Investment Trends and Statistics* (2003). http://www.imf.org/external/np/sta/fdi/eng/2003/102803.pdf

India Brand Equity Foundation, “Indian Investment Abroad-Overseas Direct Investment by Indian Companies,” (2014). http://www.ibef.org/economy/indian-investments-abroad.

Kaplan, Edward L., and Paul Meier, “Nonparametric Estimation from Incomplete Observations,” *Journal of the American Statistical Association*, 53:282 (1958), 457-481. http://www.biecek.pl/statystykaMedyczna/2281868.pdf.

Kato, Atsushi, “Product Market Competition and Productivity in Indian Manufacturing Industry,” *Journal of Development Studies* 45:10 (2009), 1579-1593.

Kumar, Nagesh, “Emerging TNCs: Trends, Patterns and Determinants of Outward FDI by Indian Enterprises,” *Transnational Corporations* 16:1 (2007), 1-26.

Lall, Rajiv B., *Multinationals from the Third World: Indian Firms Investing Abroad* (Delhi: Oxford University Press, 1986).

Leuven, Edwin, and Barbara Sianesi, “PSMATCH2: Stata Module to Perform Full Mahalanobis and Propensity Score Matching, Common Support Graphing, and Covariate Imbalance Testing,” Statistical Software Components, Boston College Department of Economics (2003). http://ideas.repec.org/c/boc/bocode/s432001.html.

Levinsohn, James, and Amil Petrin, “Estimating Production Functions Using Inputs to Control for Unobservables,” *Review of Economic Studies* 70 (2003), 317-342.

Markusen, James R., “Factor Movements and Commodity Trade as Complements,” *Journal of International Economics* 14 (1983), 341-356.

McCullagh, Peter and John A. Nelder, *Generalized Linear Models*, 2nd ed., (New York: Chapman and Hall, 1989).

Melitz, Marc J., “The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity,” *Econometrica* 71 (2003), 1695-1725.

Minondo, Asier, “The Link Between Export Status and Productivity in Services: A Firm-Level Analysis for Spain,” Munich Personal RePEc Archive paper 43225 (2012). http://mpra.ub.uni-muenchen.de/43225/1/MPRA_paper_43225.pdf.

Mundell, Robert, “International Trade and Factor Mobility,” *American Economic Review* 47 (1957), 321-335.

Narayanan, Krishnan, and Savita Bhat, “Technological Efforts and Performance of IT MNCs from India,” in Natteri S. Siddharthan and Krishnan Narayanan, eds., *Indian and Chinese Enterprises: Global Trade, Technology and Investment Regimes* (New Delhi: Routledge, 2010).

Nunnenkamp, Peter, Maximiliano Sosa Andrés, Krishna Chaitanya Vadlamannati, and Andreas Waldkirch, "What Drives India's Outward FDI?," *South Asian Journal of Macroeconomics and Public Finance* 1:2 (2012), 245-279.

OECD Directorate for Science, Technology and Industry, ISIC Rev. 3 Technology Intensity Definition, Economic Analysis and Statistics Division, (2011). http://www.oecd.org/sti/ind/48350231.pdf.

Oldenski, Lindsay, "Export Versus FDI and the Communication of Complex Information," *Journal of International Economics* 87:2 (2012), 312-322.

Papke, Leslie E., and Jeffrey M. Wooldridge, "Econometric Methods for Fractional Response Variables with an Application to 401(K) Plan Participation Rates," *Journal of Applied Econometrics* 11:4 (1996), 619-632.

Pavcnik, Nina, "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants," *Review of Economic Studies* 69 (2002), 245-276.

Pradhan, Jaya Prakash, "The Determinants of Outward Foreign Direct Investment: A Firm Level Analysis of Indian Manufacturing," *Oxford Development Studies* 32:4 (2004), 619-639.

_____, "How do Indian Multinationals Affect Exports from the Home Country?," Munich Personal RePEc Archive paper19022 (2007). http://mpra.ub.uni-muenchen.de/19022/.

_____, "Emerging Multinationals: A Comparison of Chinese and Indian Outward Foreign Direct Investment," *International Journal of Institutions and Economies* 3:1 (2011), 113-148.

Raff, Horst, and Michael J. Ryan, "Firm-Specific Characteristics and the Timing of Foreign Direct Investment Projects," *Review of World Economics*144:1 (2008), 1-31.

Rattankumphu, Saowaruj, "Effects of Agglomeration Economies and Learning by Exporting on Firm Efficiency: The Case of Software Services Industry in India," University of Melbourne, Department of Economics working paper (2006).

RBI (Reserve Bank of India), Database on Outward FDI from India, released by the Foreign Exchange Department, Central Office, Overseas Investment Division. http://www.rbi.org.in/scripts/Data_Overses_Investment.aspx.

Report of PricewaterhouseCoopers, *Emerging Multinationals: The rise of new multinational companies from emerging economies* (April, 2010). http://www.pwc.fr/assets/files/pdf/2010/04/pwc_emerging_multinationals.pdf.

Rivers, David A., "Are Exporters More Productive Than Non-Exporters?," CIBC working paper 2 (2013). http://economics.uwo.ca/centres/cibc/.

Rosenbaum, Paul R., and Donald B. Rubin, "The Central Role of the Propensity Score in Observational Studies for Causal Effects," *Biometrika* 70:1 (1983), 41-55.

Siddharthan, Natteri S., and Kaushalesh Lal, "Liberalisation, MNE and Productivity of Indian Enterprises," *Economic and Political Weekly* 39:5 (2004), 448-452.

Singh, Neelam, "Influence of Outward-Foreign Direct Investment and Technological Efforts on Exports: Indian Auto Component Firms," *Innovation and Development* 3:2 (2013), 205-221.

Srivastava, Vivek, *Liberalization, Productivity and Competition: A Panel Study of Indian Manufacturing*, (Delhi: Oxford University Press, 1996).

Sullivan, Daniel, "The "Threshold of Internationalization:" Replication, Extension, and Reinterpretation," *Management International Review* 34:2 (1994), 165-86.

Tan, Benjamin, and Ilan Vertinsky, "Foreign Direct Investment by Japanese Electronics Firms in the United States and Canada: Modelling the Timing of Entry," *Journal of International Business Studies* 4 (1996), 655-681.

Tanaka, Ayumu, "Multinationals in the Services and Manufacturing Sectors: A Firm-Level Analysis Using Japanese Data," REITI discussion paper 11-E-059 (2011). http://www.rieti.go.jp/jp/publications/dp/11e059.pdf.

Thomas, Ronny, and Krishnan, Narayanan, "Outward FDI, Exports and Technological Efforts: A Study of Indian Manufacturing Firms," paper presented at the *VIII Annual International Knowledge Forum Conference*, Indian Institute of Technology Bombay, Mumbai (October 25-27, 2013). http://fgks.in/IndexServer/tifac/article/192.pdf.

Tian, Wei, and Miaojie Yu, "Outward Foreign Direct Investment and Productivity: Firm-Level Evidence from China," (2012). http://dx.doi.org/10.2139/ssrn.1985130.

Topalova, Petia, and Amit K. Khandelwal, "Trade Liberalisation and Firm Productivity: The Case of India," *The Review of Economics and Statistics* 93:3 (2011), 995-1009.

United Nations, “Transnational Corporations from Developing Countries: Impact on their Home Economies,” (New York: United Nations, 1993).

Vernon, Raymond, “International Investment and International Trade in the Product Cycle,” *Quarterly Journal of Economics* 80 (1966), 190-207.

Wooldridge, Jeffrey M., *Econometric Analysis of Cross Section and Panel Data* (Cambridge: The MIT Press, 2002).

_____, “On Estimating Firm-Level Production Functions Using Proxy Variables to Control for Unobservables,” *Economics Letters* 104:3 (2009), 112-114.

Yeaple, Stephen R., “The Complex Integration Strategies of Multinational Firms and Cross-Country Dependencies in the Structure of Foreign Direct Investment,” *Journal of International Economics* 60:2 (2003), 293-314.

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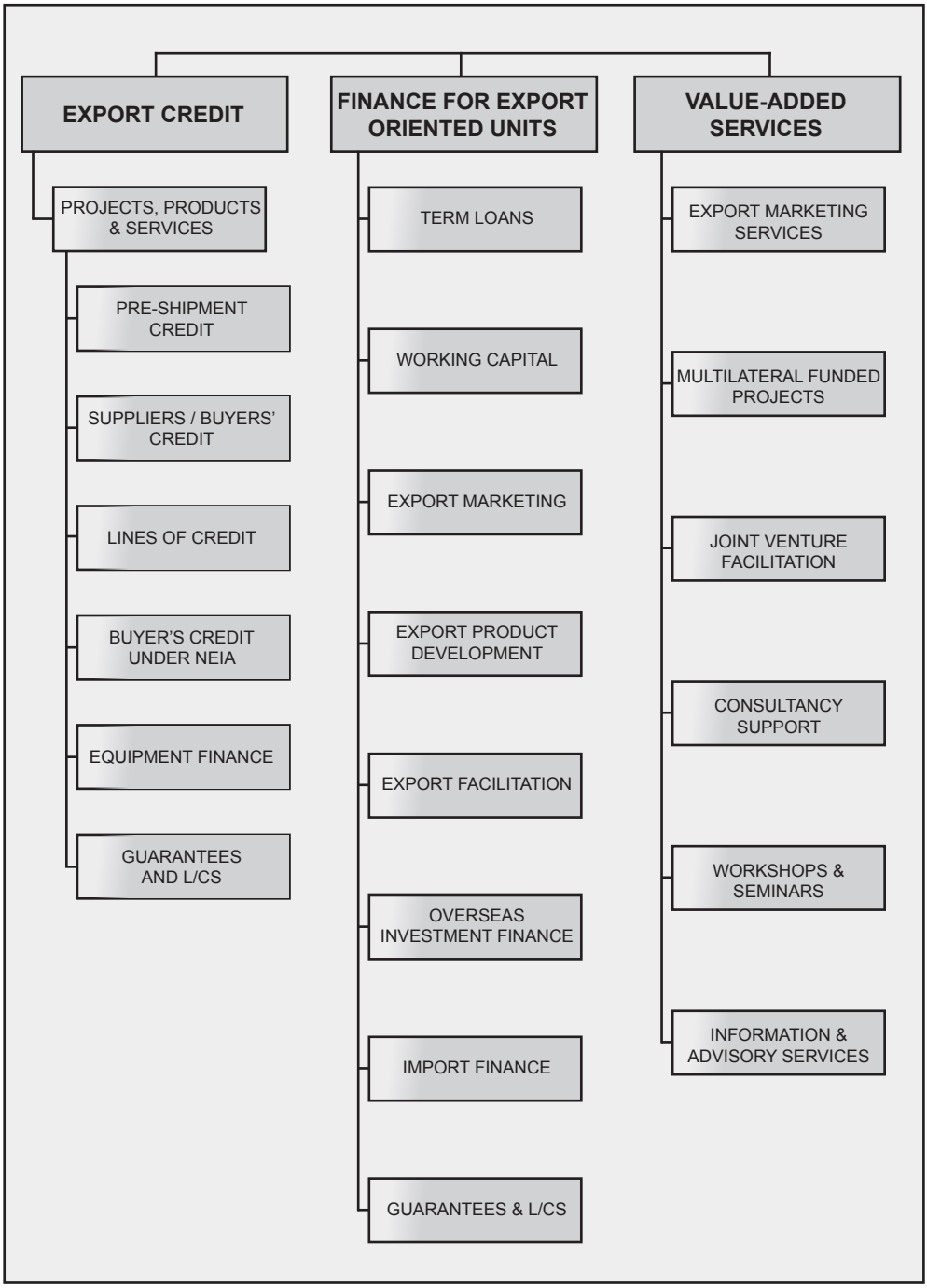

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