Graduating to Globalisation: A Study of Southern Multinationals

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Abstract

The Helpman-Melitz-Yeaple model is a static framework where firms choose whether to serve foreign customers, and whether to do FDI, based on their productivity. We propose an ordered probit model that unifies the analysis of exports and FDI in the spirit of the Helpman-Melitz-Yeaple model. Our empirical findings, for India, are consistent with the predictions of this model. They also suggest that firm characteristics evolve through time, and that there is a ladder of quality where some firms evolve towards exporting and FDI.

JEL Classification: F12, F14, F23, L1, D20.

Keywords: Firm internationalisation, HMY model, productivity, India, outbound FDI.

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1 Introduction

Recent developments in the literature on international trade and foreign direct investment (FDI) emphasise the role of firm characteristics in shaping firm participation in exports and FDI. A key theme of new trade theory is the analysis of the optimisation of the firm, which determines the choice of market of operation – whether domestic versus foreign – and the mode through which a foreign customer is served – whether export or FDI.

The seminal work of Melitz (2003) and Helpman *et al.* (2004) (henceforth, HMY) places heterogeneity in firm productivity at the heart of exporting and FDI. Assuming that firms need to incur certain fixed costs to start exporting and certain variable costs per unit of export, only more productive firms will export. In equilibrium, firms self-select themselves so that more efficient firms export while less efficient firms serve the domestic market. Further, if serving foreign customers through subsidiaries in foreign countries involves a fixed cost then more productive exporting firms will choose FDI as the mode of serving the foreign market.[1]

Considerable empirical research has been done based on the HMY hypothesis, mostly in industrialised economies (Head and Ries, 2003; Helpman *et al.*, 2004; Greenaway and Kneller, 2004; Girma *et al.*, 2005; Tomiura, 2007; Damijan *et al.*, 2007; Greenaway and Kneller, 2007; Aw and Lee, 2008; Gorg and Jabbour, 2009; Bitzer and Holger, 2009). In this paper, a fresh perspective on econometric modelling is brought to the problem, and data from a developing country (India) is examined.

Firms in developing countries have engaged in direct investment abroad at a rapid pace in recent years. Using both stock and flow measures, outbound FDI from developing countries account for about 14 percent of the world total FDI in 2006 UNCTAD (2006), 12 percent in 2007 and 15 percent in 2008 UNCTAD (2009). In the Indian case, while inbound FDI was at USD 22 billion in 2007, outbound FDI for the same time period was as high as USD 13.5 billion. The FDI outflow from India is almost four times in 2007 than in 2005. Moreover, one of the major driving forces in FDI from Asia in 2006 is India (UNCTAD, 2006).

We explore the relationship between trade, FDI and firm productivity in a wider sense by looking at other firm characteristics using firm level data from India for the period 2001-2011. First, as in Helpman *et al.* (2004), we examine differences in firm characteristics between domestic firms, exporting firms and

[1] The HMY paradigm has been extended to various directions depicting various international organisational and integration structure of firms. These include Melitz and Ottaviano (2008) on asymmetries between competing countries and export; Yeaple (2003) and Grossman *et al.* (2006) on cost advantage of intermediate goods production of South and export-platform hypothesis of FDI by Northern firms; Blalock and Gertler (2004); Bernard and Jensen (2004a); Bernard and Jensen (2004b); Alvarez and Lopez (2005); Gorg and Jabbour (2009) on trade liberalisation and export at industry level.

firms engaging with FDI. Our results suggest that the evolution of firms from domestic to exporting to outbound FDI is an integral part of the evolution of the more productive firms in a developing country.

We contribute to the literature in two ways. First, the limited number of studies on developing countries and particularly on India, predate the new trade theory. These involve exploring firm-specific and country-specific characteristics to explain outward FDI. The firm-specific characteristics include endowment of human, knowledge and physical character, marketing capabilities, organisation, finance, export orientation etc. Country or location-specific characteristics include factor endowments, institutional settings and transaction cost in the export market.[2] While these studies attempt to explain the single question that whether the firm decides to serve foreign customers abroad on the basis of the above mentioned characteristics, we unify the firms' choice of markets (domestic versus foreign) and mode of serving foreign markets (export versus FDI) in a single framework in the line of the HMY model. A key innovation of this paper is an ordered-probit model which combines domestic market-oriented, exporting and outward FDI-oriented firms in a quality ladder.

Our findings are that there are strong differences between the characteristics of domestic firms, exporting firms, and firms that invest abroad. The differences between these firms are consistent with the HMY model. The most productive firms appear to walk up this ladder of quality and graduate to globalisation through exporting and then through FDI.

The rest of the paper is organised as follows. Section 2 sets up the background of the HMY framework. Section 3 lays out the related empirical studies while section 4 describes the background of our data set, classification of data set and broad empirical facts. Section 5 discusses our econometric analysis and presents our findings. Section 6 presents our findings using a productivity measure, concluding with section 7.

2 Conceptual framework

In recent decades, the 'new trade theory' has brought fresh insights into aggregative phenomena about trade by analysing *firms* that trade. Firms make conscious choices about undertaking export or FDI; hence the ultimate insights into the exports or FDI measured at the level of a *country* are to be found by understanding the optimisation of individual firms.

The first wave of this literature analysed exports. The pioneering paper Brainard

[2] See Horstmann and Markusen (1992); Brainard (1993); Brainard (1997); Dunning (2000); Markusen and Venables (2000); Bernard *et al.* (2003); Bernard and Jensen (2004a); Bernard and Jensen (2004b); Tybout (2003); Wagner (2007). The studies on developing countries following this approach are; Lall (1986); Narula and Dunning (2000);Blalock and Gertler (2004) Pradhan (2004); Kumar (2007).

(1997) explained the fraction of firms in an industry that export based on trade costs, market size and economies of scale. Building on this, the Helpman–Melitz–Yeaple (HMY) model (Helpman *et al.*, 2004) setup a model with free entry, where firms differ in productivity. Under the assumption of iceberg transportation costs, it is not possible for less productive domestic firms to serve foreign consumers. Hence, there is a selection process where only the most productive firms undertake exports. Similar results are obtained by Melitz (2003) and Bernard *et al.* (2003). A large empirical literature has built up around this model and significantly supported the hypothesis.

The next milestone of this literature lies in the analysis of FDI. The key insight of the HMY model lies in seeing that a firm can choose to serve foreign customers through two modes: exports (which incurs transportation costs) or FDI (which incurs the fixed cost of operations overseas).

A simplified version of their model, by Head and Ries (2003), is illuminating. Consider firm i that produces a differentiated product that must choose whether to export to a foreign market f, and whether to do FDI into it. Suppose marginal cost is constant at w/A_i where A_i is the productivity of firm i and w is the wage. Suppose consumers have a quadratic utility function which yields a linear demand for the product of firm i: $P_i = 1 - Q_i$. That is, each firm is a monopolist facing a linear demand curve.

Exports incur a trade cost of τ per unit, while FDI only requires a fixed cost K. In the simplest static setup, K does not vary with output and there is no distinction between sunk costs and operating costs.

In this model, if the firm chooses to export, it obtains profit π_X and if it chooses to do FDI, it obtains profit π_I:

$$\begin{aligned} \pi_X &= \left(\frac{1-(w/A)-\tau}{2}\right)^2 \\ \pi_I &= \left(\frac{1-(w/A)}{2}\right)^2 - K \end{aligned}$$

This analysis reveals numerous interesting propositions. Unproductive firms, with a low A, find that $\pi_X < 0$ and $\pi_I < 0$ and do not internationalise through either mode.

When $A > w/(1-\tau)$ it is efficient for firms to export as $\pi_X > 0$. But when $A > 2w\tau/(2\tau - 4K - \tau^2)$, $\pi_I > \pi_X$. Hence, firms with heterogeneous levels of productivity A select themselves to fall into three groups. Those with $A < w(1-\tau)$ remain domestic firms. Above this threshold, exporting commences, but for firms with $A > 2w\tau/(2\tau - 4K - \tau^2)$, it is better to serve overseas customers by doing FDI rather than by exporting.

An empirical literature has developed around this proposition from 2003 onwards, with significant success. The HMY model has generated numerous in-

sights in its downstream literature. As an example, the role of costs of transportation in explaining exports and FDI naturally implies that the productivity characteristics of exporters and outbound FDI firms should be different for industries with zero transportation costs (Bhattacharya *et al.*, 2012).

3 Empirical research on firm heterogeneity and internationalisation

The HMY model is a static one. A firm has a fixed productivity A_i and this is immutable. If, in the real world, firm productivity changes over time, then this is a somewhat different environment when compared with the standard model. We adopt the perspective that firm productivity and other characteristics *can* change over time, and that in each time period the firm chooses an optimal strategy on the questions of whether to serve foreign customers and how to do this (by exporting or by FDI).

Most empirical studies on firm heterogeneity and internationalisation modes use firm level data from industrialised economies. Helpman *et al.* (2004) use data on US exporting firms in 1996 and affiliate sales data that cover 52 sectors and 38 countries. They regress the ratio of exports to FDI (measured by sales of overseas affiliates) on unit costs of international trade, plant fixed costs, traditional proximity-concentration variables, and some new industry variables. The study confirms their theoretical prediction on productivity ranking, i.e, only the most productive firms become multinational companies and invest abroad; the less productive ones export, and least productive ones serve domestic markets.

Head and Ries (2003) associate productivity with export and FDI and use different indicators of performance to differentiate firms in a sample of 1070 large Japanese companies classified into 17 two-digit industries in 1989. The paper tests for substitution within industries between FDI and exports looking out for productivity differences using indicators such as sales, value added, and total factor productivity. They show that there exists a hierarchy in performance levels of firms investing abroad, exporting firms and purely domestic firms. Das *et al.* (2007) propose a dynamic structural model of export supply, and in an analysis of Colombian manufacturing firms, identify mechanisms through which firm size and the decision to export are linked. Head and Ries (2003) also find a weak correlation between firm size and productivity. However, Greenaway and Kneller (2007) claim that the results in Head and Ries (2003) cannot be generalised because of a biased sample consisting of only large listed companies.

Using a non-parametric approach based on first-order stochastic dominance, Girma *et al.* (2004a) compare sales, productivity and profitability of domestic firms, domestic exporters and domestic multinationals for Ireland in the year 2000. They find that there is no clear evidence of differences in plant performance between domestic exporters and non-exporters. Girma *et al.* (2005) and

Arnold and Hussinger (2005) apply the same methodology to data from the United Kingdom and Germany respectively, and they find that the productivity distribution of multinational firms dominates that of exporting firms, which in turn dominates non-exporters.[3]

More recently, Damijan *et al.* (2007) also examine the theoretical prediction on heterogeneity and internationalisation modes using micro evidence from Slovenian manufacturing. They find evidence that firms that export and engage with FDI are 20 per cent more productive than firms that serve only domestic markets, but there is no evidence of a productivity advantage of investing firms over exporting firms in data set.

Aw and Lee (2008) focus on the production location decision of Taiwanese electronic multinationals in 2000 and examine their productivity differences. They find that more productive firms engage in outbound FDI, with the most productive ones investing in both China and the USA. Further, they also provide evidence that MNCs investing in the US are more productive than MNCs investing in China.

4 Data and Descriptive Statistics

The dataset that we utilise is based on the firm-level database maintained by the Centre for Monitoring Indian Economy (CMIE)[4]. We create a dataset of the firms were members of the CMIE 'COSPI' stock market index on 31 March 2011,[5] subject to five exclusions:

1. Foreign investment by firms that are controlled by the government might reflect political considerations; hence, firms controlled by the government are ignored.
2. Political considerations may also influence FDI decisions of mining firms; hence we do not consider these.

[3]On the country level study, Kimura and Kiyota (2007) undertake similar study for Japanese firms for the period 1994-2000 and compare mean values on panel data. For that Kimura and Kiyota (2007) investigate the self selection idea of Helpman *et al.* (2004) using the method laid out in Clerides *et al.* (1998). They conclude that firms with foreign presence become more productive than others. On similar lines, Tomiura (2007) uses cross section data of Japanese manufacturing firms in 1998 and sort productivity levels on the basis of foreign activities. Similarly, Ito (2007) also highlights the difference between the service sector and the manufacturing sector regarding panel data on Japanese listed firms from 1980 to 2005. Similarly, Girma *et al.* (2004b) show the positive causality from exporting to productivity growth in UK manufacturing firms in 1998 and 1999.

[4]India has a long tradition of sound accounting standards. Publicly traded corporations face pressures from public shareholders and the securities regulator. Owing to these factors, Indian firm level data is of a high quality by the standards of emerging markets. CMIE has a well developed 'normalisation' methodology which ensures inter-year and inter-firm comparability of accounting data. This database has encouraged an emerging empirical literature, including papers such as Khanna and Palepu (2000); Bertrand M. and Mullainathan (2002); Ghemawat and Khanna (1998).

[5]The rationale for this is based on isolating the firms with the highest data quality.

Table 1 Industry composition of dataset

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Chemicals	327	328	340	348	355	362	355	358	365	363	364
Diversified	29	29	31	34	35	37	37	37	37	36	36
Electricity	12	12	13	15	16	17	17	16	16	17	16
Food	125	131	135	135	136	143	142	144	144	145	146
Machinery	179	183	187	188	188	192	187	188	192	196	191
Metals	135	142	144	152	154	165	165	167	171	171	173
MiscManuf	64	64	70	73	72	73	76	75	76	76	74
NonMetalMin	78	80	81	83	86	89	92	93	93	94	96
Serv.IT	87	89	97	107	111	118	122	127	132	134	129
Serv.Other	238	253	266	264	275	302	311	322	336	349	340
Textiles	139	138	146	148	152	157	158	160	164	163	162
TransportEq	83	79	79	82	82	84	83	87	87	91	92
Sum	1496	1528	1589	1629	1662	1739	1745	1774	1813	1835	1819

3. Export by financial firms is infeasible given India's capital controls. In addition, financial firms present unique difficulties in measurement of accounting data. Hence financial firms are excluded.
4. The concepts of exporting vs. FDI are blurred in the construction industry. Hence, construction firms are excluded.
5. The smallest firms, which may have behavioural characteristics quite unlike the main dataset, were excluded by removing firm-years where either sales or assets were below Rs.10 million (roughly $0.2 million). Capital controls in India substantially interfered with outbound FDI by firms until 2001, when these restrictions were eased. Hence we focus on data from 2001 onwards. We obtain all firm-years for this set of firms available in the CMIE database from 2001 till 2011, covering a period of eleven years. This gives us an unbalanced panel dataset.

This dataset captures a substantial slice of the Indian economy. In the most recent year, 2011, the firms in our dataset had total assets of Rs.29.53 trillion (32% of GDP), and exports of Rs.4.17 trillion (4.5% of GDP). Table 1 shows the number of firms observed in various years and in various industries in this dataset. The total number of firms ranges from 1496 in 2001 to 1819 in 2011.

We draw the following indicators from the CMIE database in order to describe firm-specific characteristics:

1. *Year of incorporation*: The age and birth cohort of a firm is proxied by the year of incorporation.
2. *Total assets*: The balance sheet size of the firm is a measure of the capital employed by the firm and a measure of the size of the firm.
3. *Gross fixed assets*: Some of the total assets of the firm are utilised to own fixed assets. We use the 'gross' measure of fixed assets so as to avoid the tax-induced difficulties of depreciation. Gross fixed assets divided by total assets is a measure of the asset tangibility of the firm.
4. *Sales*: The revenues of the firm are measured by sales.

Table 2 Summary statistics about dataset

	Min	25%	Median	75%	Max	Mean
Incorporatio Year	1863.00	1974.00	1986.00	1992.00	2010.00	1979.43
Total Assets	0.01	0.46	1.48	4.74	2849.00	9.15
Gross Fixed Assets	0.00	0.21	0.71	2.46	2212.53	5.04
Sales	0.01	0.39	1.31	4.23	2586.51	7.79
Gross Value Added	0.00	0.10	0.35	1.12	486.26	2.00
R&D Sales	0.00	0.00	0.00	0.08	5409.86	0.90
Exports	0.00	0.00	0.02	0.34	1405.46	1.15
Foreign Investments	0.00	0.00	0.00	0.00	409.90	0.34

5. *Gross value added*: The value added of the firm measures the output of the firm.
6. *Research and development intensity*: The R&D activity of the firm is measured by summing capital account and current account expenses on R&D and expressing these as a fraction of sales.
7. *Exports*: The direct exports by each firm are observed in the CMIE database.
8. *Foreign investment*: The investments by a firm outside the country are observed in the CMIE database.

Table 2 shows summary statistics about these variables in the pooled dataset. As is typical with firm level data, it shows a small number of very large firms. For example, while the largest value of total assets was Rs. 2849 billion, the mean value was just Rs.9.15 billion.

Along the lines of the analysis in Head and Ries (2003) who investigate similar questions in the context of Japanese firms, we divide firms into four groups:

D A purely domestic firm

DX A firm that produces domestically for both the home country and foreign markets through exports.

DXI A firm that serves foreign customers by exporting and by producing in their country (i.e. through outbound FDI).

DI A firm that serves foreign customers by producing in their country only.

We operationalise these definitions in our dataset by defining a firm as an exporter if exports exceed 1% of sales and as having outward FDI if international assets exceed 1% of total assets.

The DX are firms that produce and export tradeables such as steel or petroleum products. For these firms, India is a production site. While transportation costs from India to markets that are located physically far away are high, it is hypothesised that these firms have sufficiently high productivity to be able to overcome this cost and are exporting.

DXI firms are the firms which export and invest abroad. Production at locations across the world helps avoid the costs of transportation suffered when producing in India and serving foreign customers. While producing abroad involves large

Table 3 Count of firms classified into four categories

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Sum
D	663	664	672	689	673	703	683	678	688	722	708	7543
DI	42	67	75	90	103	104	116	134	141	151	139	1162
DX	743	734	772	769	789	809	798	792	803	778	827	8614
DXI	48	63	70	81	97	123	148	170	181	184	145	1310
Sum	1496	1528	1589	1629	1662	1739	1745	1774	1813	1835	1819	18629

fixed costs, and induces the use of higher-cost labour than is found in India, it is hypothesised that these firms have a large enough edge in productivity to enable them to overcome this.

Finally, there are DI firms. The big firms of this set are engaged in the production of non-tradeables such as electricity or paint, but have embarked on outbound FDI as a way to serve foreign customers. This suggests the firm is a high productivity firm by international standards.

Table 3 shows the number of firms falling into the four categories in all years. The number of DI firms is relatively small in most of the years. This restricted dataset impedes statistical analysis. Hence, in the remaining analysis, we drop this category. We are, then, analysing three groups: the 'D' firms (from 663 firms in 2001 to 708 firms in 2011), the 'DX' firms (from 743 firms in 2001 to 827 firms in 2011) and the 'DXI' firms (from 48 firms in 2001 to 145 firms in 2011).

The data shows that some firms have built up very large positions abroad. As an example, the firm 'Ranbaxy Laboratories' had 23.01% of total assets outside the country in 2011. Other firms have more modest positions. As an example, the firm 'Infosys Technologies' had 1.86% of total assets outside the country in 2011, and this number had actually dropped when compared with the situation in 2002.

Table 4 sums up the foreign assets of all the firms in our dataset. This number went up dramatically from Rs.80.29 billion in 2001 to Rs.1260 billion (roughly USD 23.5 billion) in 2011. The total assets of these firms also rose sharply. The sum of foreign investments of the firms stood at 4.27% of the sum of their total assets in 2011.

Table 5 sums up the exports of all the firms in our dataset. This number went up dramatically from Rs.557.51 billion in 2001 to Rs.4170.08 billion in 2011. Exports as a percentage of sales went up from 7.77% to 18.30% over this period.

While the dataset has many attractive properties, it has several limitations. The firms included in the data set tend to be the larger ones and so we are excluding small exporting firms. It is unbalanced panel data; the set of large firms with good quality disclosure was chosen in the latest year and followed into the past.

Many accounting variables have extreme values. As an example, in this dataset,

Table 4 Foreign assets of Indian firms

Year	For. inv.	Total Assets	FI/TA (%)
2001	80.29	7502.14	1.07
2002	99.55	8298.26	1.20
2003	114.45	9067.10	1.26
2004	113.17	10093.64	1.12
2005	152.16	11882.62	1.28
2006	213.84	14497.00	1.48
2007	340.48	14176.29	2.40
2008	642.59	17772.81	3.62
2009	1554.48	22303.15	6.97
2010	1838.27	25358.30	7.25
2011	1260.50	29539.18	4.27

Table 5 Exports by Indian firms

Year	Export	Sales	X/S (%)
2001	557.51	7172.53	7.77
2002	591.48	7396.22	8.00
2003	721.01	8267.74	8.72
2004	947.84	9577.37	9.90
2005	1398.37	11973.31	11.68
2006	1690.56	14590.27	11.59
2007	2226.26	12358.84	18.01
2008	2753.94	14698.90	18.74
2009	3096.36	17185.21	18.02
2010	3253.88	19037.26	17.09
2011	4170.08	22783.20	18.30

Table 6 Transition probabilities across firm categories

	D	DX	DXI
D	90.36	9.45	0.19
DX	6.67	90.44	2.89
DXI	0.27	12.32	87.41

the return on equity ranges from -205% to 471%. In order to address this, we employ 'winsorisation' for such variables, which involves clipping the distribution to the (.01, .99) quintiles.

5 Results

5.1 Testable Hypotheses

Under the HMY model, the probability of a firm serving domestic market only and both domestic and foreign markets via either export or FDI or both will depend on its productivity level which is an unobserved variable. The higher is the firms productivity level, the higher is the probability of serving foreign market in a sequence of via export only and then via both export and FDI. The unobserved productivity level will (in turn) depend on firm-specific characteristics.

5.2 Transition between categories

What are the chances of the globalisation status of a firm changing from year to year? Table 6 shows the transition probability matrix for firms across the three categories. Each row of this matrix shows transition probabilities from the stated category at time t to all possible categories at time $t + 1$.

There is significant on-diagonal mass. Firms do not seem to fluctuate; there is an 90 /90 /87 percent chance of staying in a given state. When a firm starts out as a D, there is a 9.45% chance of it moving up to exporting. There is only a 0.19% chance of it jumping up to exporting and outbound FDI. This suggests that the transition to DXI generally involves DX as an intermediate stage. Once a firm is an exporter, there is a 6.67% chance of it dropping back to being a domestic firm. There is a 90.84% chance of it staying in the same state, and a 2.89% chance of it jumping up to DXI. Once a firm has exports and outbound FDI, there is a 87.41% chance of it staying there. With a 12.32% probability, the firm drops down to only exports, and with a 0.27% probability, it drops down to being a domestic firm.

This examination of transition probabilities has three key implications. First, internationalisation is relatively 'sticky'; firms tend not to flit around these categories. Second, D firms rarely jump directly to DXI. The process of graduating

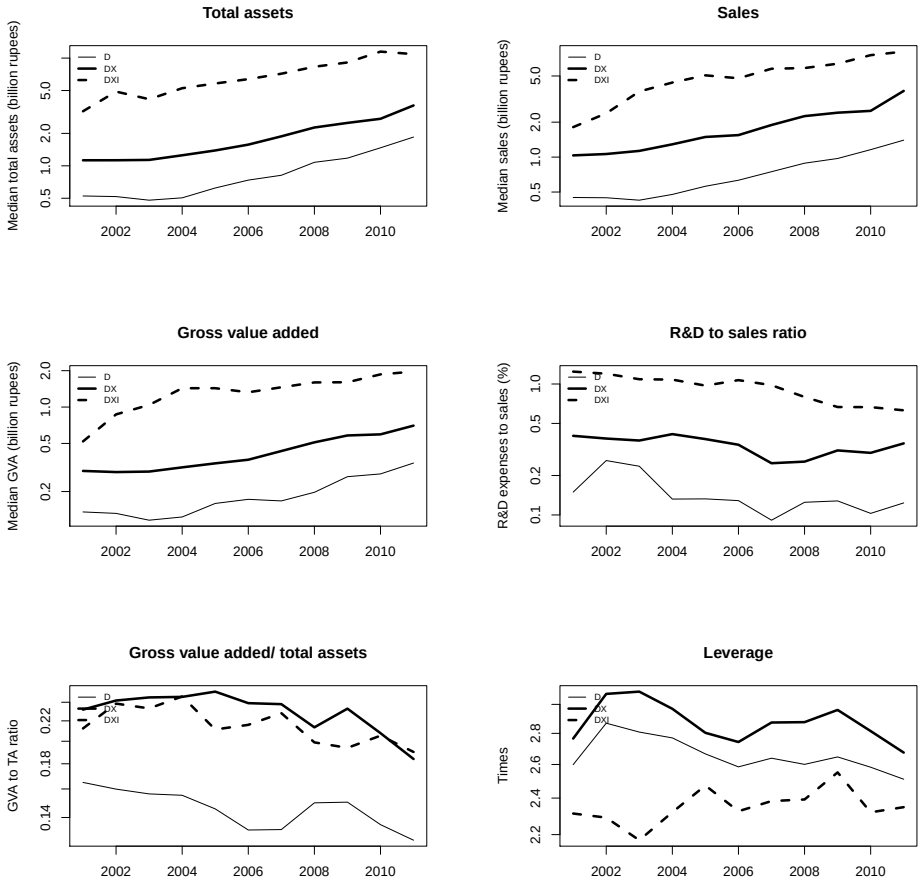
to globalisation generally involves first achieving DX status. Third, the progression towards internationalisation is not inevitable. Many firms do drop down from DXI to DX and from DX to D.

This evidence suggests that firm internationalisation evolves dynamically. This is in contrast with the HMY model which is a static framework. However, it is easy to envision a world where firm characteristics evolve through time, and at each time period, the firm chooses between D and DX and DXI based on the logic of the HMY model. The evidence of this paper suggests there is a ladder of quality where many firms evolve from D to DX to DXI.

5.3 Firm characteristics in three categories

We now embark on a broad understanding of firms characteristics in the three categories D, DX and DXI. Figure 1 shows six graphs where the median value for each year is reported for each of the three categories of firms.

Figure 1 Firm characteristics : comparing D, DX and DXI



Total assets are a measure of firm size. There is a clear hierarchy where the biggest firms are found in DXI, smaller firms are found in DX and the smallest firms in D. Using revenues or value added as a measure of firm size also, the same pattern is found. Thus, whether we measure size by total assets, sales or value added, the identical ordering is found in all years, with the biggest firms being DXI, smaller firms being DX and the smallest firms being D. This may not be inconsistent with the HMY model to the extent that in a competitive market, over time, the most productive firms would tend to become the biggest.

The ratio of R&D expenses to sales is believed to convey investments into technological sophistication which is expected to be linked to productivity. Here also, a clear pattern is seen: firms with the highest R&D to sales ratio are DXI; lower values are DX and the smallest values are D.

Table 7 Probit models for Exporting and Outbound OFDI

	Exports	t	OFDI	t
Industry fixed effects		Present		
Year fixed effects		Present		
Log gross value added	0.1434	11.1003	-0.0068	-0.3411
Log total assets	0.0530	3.6189	0.2973	13.4734
Year of incorporation	-0.0011	-1.7939	0.0037	4.1240
R&D to sales	0.1107	8.3765	0.1745	16.0564
Asset tangibility	-0.3056	-8.1609	-0.7161	-10.9079
Return on equity	-0.0864	-2.6647	-0.1122	-2.0169
LogL	-8474.4465		-3387.2559	
AIC	17004.8931		6830.5119	

The output per total assets is both a measure of asset productivity and a measure of capital intensity. Here, the DX and DXI firms are similar, and have a high value added per unit assets, while the D firms have a low value. This suggests that the D firms are relatively capital intensive.

Finally, DXI firms are seen to have the *lowest* leverage. This may reflect the lack of tangibility of their assets, and the difficulties of the Indian debt market which has emphasised loans against tangible collateral.

5.4 Firm level analysis

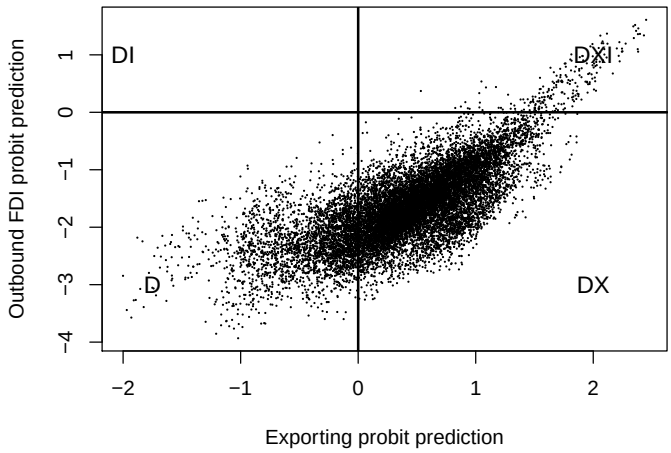
We start by estimating separate probit models for the exporting status and outbound FDI status at firm level (Table 7). For each of these models, we code 0 as a firm which does not export or does not have outbound FDI, and we code 1 as a firm which does.

A set of industry-fixed effects are present in the estimation in order to control for industry effects (the details are omitted in the interest of brevity). A set of year-fixed effects are also present in the estimation in order to control for macroeconomic effects. Size measures, gross value added and total assets deflated by CPI-Industrial Workers, which are likely to be correlated with productivity, appear on the two probit models in different ways. For exporting, value added and total assets are both positive and significant. However, for FDI, only total assets matters. Age also appears to matter differently for the two models. Younger companies are less likely to export but more likely to do FDI.

Firms with greater investments in knowledge, proxied by the ratio of R&D expenses to sales, are more likely to internationalise, with similar coefficients on both models.

Asset tangibility exerts a negative effect on internationalisation for both exporting and FDI, which may suggest that more labour intensive firms internationalise. The return on equity also has a similar effect. This contradicts

Figure 2 Predictions for the latent variables of the two probit models



the prediction of the HMY model to the extent that we might expect more productive firms to have a higher return on equity.

While the two probit models have unique features, in many respects, the relationships are similar. As the transition probability analysis earlier has shown, firms almost always go through DX before they become DXI. This suggests a deeper link between the two choices made by firms, about whether to export and whether to invest abroad.

The two latent variables of the exporting and FDI probit models are computed separately and analysed. Figure 5.4 shows a scatter plot of the values for the two latent variables. The first quartile corresponds to DXI firms. The third quartile corresponds to D firms. The fourth quartile corresponds to DX firms. This graph visually shows that even though the two probit models were estimated separately, the two predictions are positively correlated. The correlation coefficient works out to 0.73.

This suggests unification of the two elements of internationalisation into a single ordered probit model. This is the simplest possible model which expresses the intuition that there is a hierarchy where firm characteristics, that appear to be related to productivity, push firms along from D to DX to DXI.

Hence, we define an ordering (1,2,3) for these three categories and estimate an ordered probit model. In this model, y^* is the unobserved latent variable, and there are cutoffs τ_1 and τ_2 that determine what we observe:

$$y^* = \beta' X + \mu \quad ; \mu \sim N(0, \sigma^2) \quad (1)$$

Table 8 Ordered probit (linear model)

	Value	Std. Error	t value
Industry fixed effects		Present	
Year fixed effects		Present	
Log gross value added	0.1041	0.0116	8.9683
Log total assets	0.1205	0.0130	9.2935
Year of incorporation	0.0007	0.0000	29.0057
R&D to sales	0.1604	0.0089	18.0244
Asset tangibility	-0.4023	0.0275	-14.6322
Return on equity	-0.0835	0.0289	-2.8861
cutoffs_p1	-0.4845	0.0005	-907.0084
cutoffs_p2	1.5208	0.0195	77.9600
LogL	-11756.2497		
AIC	23570.4994		
N	14778.0000		

$$y = \left\{ \begin{array}{ccc} \text{D} & \text{if} & y^* < \tau_1 \\ \text{DX} & \text{if} & \tau_1 \leq y^* < \tau_2 \\ \text{DXI} & \text{if} & \tau_2 \leq y^* \end{array} \right\}$$

Estimation is done by maximum likelihood. The latent variable y^* can be interpreted as a single propensity measure; big values induce exports and bigger values also induce outbound FDI. The ordered probit model forces both exporting and outbound FDI to depend on a single parameter vector β. The single y^* then determines whether a firm falls into exporting or FDI status.

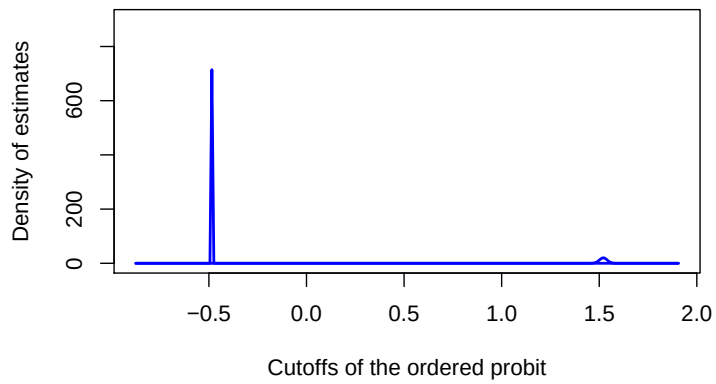
The τ cutoffs, through which y^* is mapped into discrete predictions, are a key facet of the estimation. The data could reject the model by giving τ values which are smeared together. If, on the other hand, we are able to clearly see $\tau_2 > \tau_1$ then it supports our conceptual framework of y^* as being the propensity for firms to export or to do outbound FDI.

Table 8 shows estimated results for this model. Among the industry fixed effects, electricity once again stands out as being a sector with a low propensity for internationalisation after controlling for other firm characteristics. The year-fixed effects (also omitted for brevity) show a rise from 0.04 in 2002 to 0.1 in 2004, and stabilise thereafter.

The year of incorporation has a small positive coefficient: younger firms are more likely to internationalise. Log value added and log total assets, both size metrics, have positive coefficients. To the extent that more productive firms are bigger, this is consistent with the HMY model.

Asset tangibility exerts a negative effect on internationalisation. Firms that spend more on R&D are more likely to internationalise. Finally, higher return on equity exerts a slight negative impact on internationalisation. This contradicts the prediction of the HMY model to the extent that we might expect more productive firms to have a higher return on equity.

Figure 3 Distribution of estimated $\hat{\tau}$



A key claim of the HMY model concerns the ordering: more productive firms export and even more productive firms do FDI. As Table 8 shows, $\hat{\tau}$ = (-0.48, 1.52) and the estimates have t statistics of -907 and 77.96 respectively. Estimates of the ordered probit model could reject the implicit assumption of ordering if the $\hat{\tau}$ estimates are smeared together. Figure 3 shows the distribution of $\hat{\tau}_1$ and $\hat{\tau}_2$. These distributions do not overlap at all. This supports the idea of a hierarchy from D to DX to DXI.

The τ estimates give us a sense of scale for interpreting y^* values. A shift in y^* of 2.00 shifts a firm from the threshold of exporting to the threshold of outbound FDI. This helps us interpret the numerical values for the year-fixed effects: the rise of 0.06 for the year fixed effect (from 0.04 in 2002 to 0.1 in 2004) is a small value compared with the phenomenon of interest. This suggests that the prime factor explaining the increased internationalisation of Indian firms from 2001 to 2011 was changes in firm characteristics, and not changes in the macroeconomic environment or capital controls.

In summary, we find that firm characteristics play a significant role in explaining the decision of a firm to serve a foreign market through exports or FDI; Firm characteristics of Indian firms either exporting or investing abroad show a distinct pattern. The probit models suggest that productivity metrics such as size and R&D intensity positively influence internationalisation. At the same time, there are some unique features of these results: the negative relationship with asset tangibility, the negative relationship with return on equity and the behaviour of young firms. There appears to be a hierarchy where firms go from autarky to exporting to outbound FDI. The ordered probit model represents a unified model of both phenomena.

Table 9 Probit Models (With L-P productivity)

	Exports	t	OFDI	t
Industry fixed effects		Present		
Year fixed effects		Present		
L-P Productivity	0.0656	1.7876	0.0701	1.2474
LogL	-8247.8599		-3795.9065	
AIC	16537.7197		7633.8129	

Table 10 Ordered probit (linear model with L-P Productivity)

	Value	Std. Error	t value
Industry fixed effects		Present	
Year fixed effects		Present	
L-P Productivity	0.0750	0.0298	2.5161
cutoffs_p1	-0.1807	0.0970	-1.8626
cutoffs_p2	1.6794	0.0979	17.1617
LogL	-11727.4389		
AIC	23498.8777		
N	13476.0000		

6 From firm characteristics to firm productivity

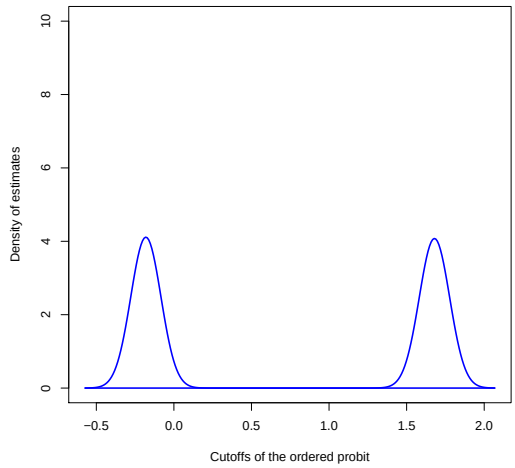
So far, our estimation strategy has explored the role of various firm characteristics. In the spirit of the HMY model, many of these characteristics are expected to be related to productivity. We now turn to estimating these same models, using an explicit measure of productivity as an explanatory variable. In order to do this, we estimate productivity for each firm in each time period using the Levinsohn-Petrin methodology (Levinsohn and Petrin, 2003; Topalova and Khandelwal, 2011). Once productivity is measured, proxies for productivity such as firm size or R&D expenses are no longer required in the estimation.

Table 9 shows separate probit models estimated for exporting and for FDI, using the L-P productivity measure as the only explanatory variable, other than industry and year fixed effects. The results here are not strongly consistent with the HMY model. In both cases, the coefficient of productivity is positive. However, for exporting, the t statistic of L-P productivity is 1.78, and for FDI the t statistic of L-P productivity is only 1.24.

Much cleaner support for the HMY model is obtained using the ordered probit model (Table 10) where the coefficient of L-P productivity is positive and has a t statistic of 2.51.

If the HMY model is correct, the cutoffs τ in the ordered probit model should have clearly separate estimates; the estimated distribution should not be smeared together. Figure 6 shows that this is, indeed, the case.

Figure 4 Distribution of estimated $\hat{\tau}$ (With L-P Productivity)



7 Conclusion

Our analysis of the internationalisation of firms in India shows a process of transition from domestic to exporting to multinational. There are strong differences between the characteristics of domestic firms, exporting firms, and firms that invest abroad. The statistical analysis suggests a unified ordered probit model which predicts that firms with certain characteristics embark on exporting, and an intensification of those very characteristics yields outbound FDI. This can be interpreted as a ladder of quality in graduating to globalisation: some achieve exporting status and others go on to outward FDI. The ordered probit model is consistent with the intuition of the Helpman *et al.* (2004) model, and largely supports it.

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