Technological Efforts and Performance of IT MNCs from India

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Abstract:

During the recent years the information technology (IT) industry has contributed to strengthen the Indian economy through export-led growth and employment generation. Today, many of these Indian IT firms are not only exporting but also investing in other countries. The present paper tries to investigate the factors that determine the export performance of the IT firms in India. Specifically, the study examines the role of technological efforts (in terms of in-house R&D, import of designs and drawings against royalty payments, import of capital goods, and intra-firm transfer of technology through foreign equity participation) in explaining the inter-firm variation in export behavior of IT multinationals from India. The analysis shows that Indian IT MNCs differ from the rest of the IT firms in their intrinsic characteristics including export behavior. During the period of study, the IT MNCs on an average are found to have higher export intensity than rest of the sample. They are also the ones who are technologically more active compared to others, with many of the IT MNCs investing simultaneously on multiple technological activities. However, the result of the double specification model (Probit + Truncation) suggests that import of embodied technology is the most important technological factor for the IT MNCs that positively influence their decision to export as well as their export intensity. Foreign equity although important for the export intensity of the IT sample as a whole, is not statistically significant in explaining the export behavior of the MNCs. Among the non-technology variables larger size, higher capital and skill intensity, and higher profit margins are important for better export performance of the IT MNCs.

The study reveals the need for proactive measures by the government to bridge the gap between India and other countries on both infrastructure and technology front. In particular, the government needs to help the young IT firms in setting up offices or information centres abroad so as to facilitate acquisition of latest technologies as well as information on prospective clients' requirements.

Keywords: Technological Efforts, Competitiveness, IT Industry, Developing Countries, India

JEL Classification: F14, F23, L1, L63, L86.

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1. Introduction

India is considered to be one of the most successful developing countries in Information Technology (IT) exports, especially in the software and IT-enabled services sectors (IBEF, 2006). In this era of globalization, India is also emerging as one of the favorite destinations for foreign direct investments from developed countries such as the United States (Henley 2006). At the same time, with the relaxation in the controls over outward investments by the Indian government, many of the Indian companies, including those in the IT sector, have been investing abroad.

With special reference to India, Pradhan (2007a) notes that outward investments not only helps companies to acquire new technologies and managerial practices but also helps them to strengthen the trade-supporting infrastructure. Consequently, Pradhan (2007b) attempts to understand how the differences in the percentage of outward foreign direct investments affects exports of firms for the Indian manufacturing industry.

The present study is different from earlier studies on IT industry in India (Patibandla and Peterson, 2002; Siddharthan and Nollen, 2004; Bhaduri and Ray, 2004; Narayanan 2006b) in the sense that we examine how Indian multinationals differ from others in their intrinsic characteristics, including export behavior. In particular, the study looks into the factors, especially the technological ones, explaining the inter-firm differences in the export behavior for the Indian IT multinationals sub-sample. Here, Indian multinationals are defined as those firms with head quarters in India that have majority Indian holding in their equity, and that have also invested abroad on any of offices, development centers, subsidiaries, or joint ventures.

Unlike the earlier studies in India that followed the Tobit specification model (Bhaduri and Ray, 2004; Siddharthan and Nollen, 2004; Narayanan, 2006a, 2006b; Pradhan, 2007b) for dealing with censored sample data, the present study follows the methodology suggested by Wakelin (1998), Sterlacchini (1999), and Basile (2001). Thus, in this study export behavior of the firms in this industry is defined in two forms, namely, the decision made by the firm to export, and the export intensity of the exporter firm. Using the likelihood ratio test, the Tobit model is compared to the double specification model (Probit + Truncation) and the double specification model is found to be more appropriate and robust for the present study.

The paper is divided into seven sections. The following section would give an overview of the literature dealing with determinants of export competitiveness. Section 3 would give a general idea about the IT industry in India. Section 4 would describe the sample and the variables. Section 5 would deal with the methodology and the model followed in this study. Sections 6 would present the results of the empirical analyses and the final section would give the summary and conclusions of the study.

2. Literature Review

The literature on international trade recognizes the importance of technological factors in determining the direction of trade. The proponents of technology gap (Posner, 1961) and product cycle approach to trade (Vernon, 1966) assert that it is due to the differences in the technological capabilities that a country producing a novel product is able to export it to other countries. Further, the country has the comparative advantage in exporting the product if it keeps improvising on the product through technological efforts. The empirical evidences (Hufbauer, 1966; Pavitt and Soete, 1980; Fagerberg, 1987; Fagerberg, 1988) based on these theories confirm that technological differences are important in determining trade.

The new trade theories too acknowledge the importance of technology factor in determining trade by incorporating innovative activities within imperfect competition models of trade and growth (Grossman and Helpman, 1991). However, it is the proponents of evolutionary theoretical approach (Nelson and Winter, 1982; Dosi, Pavitt and Soete, 1992) who assert that these differences emanate from micro or firm level due to acquisition of differential technological capabilities by the firm over time that ultimately reflect into differences at macro-level.

A number of studies in developing countries' context have incorporated technological variables at micro level to test the importance of technological efforts in determining competitiveness of the firms. In Indian context studies dealing with competitiveness in the IT sector include Patibandla and Peterson (2002), Siddharthan and Nollen, (2004), Bhaduri and Ray (2004), and Narayanan (2006b).

One of the technological variables that has been most commonly used in various studies on firm competitiveness is in-house R&D. In-house R&D can be aimed at either improving the existing process of production or developing a new product. The empirical evidences show

differing effects of R&D on export competitiveness. Aggarwal (2001) for medium-high technology industry in India, Basile (2001) for Italian manufacturing industry, and Ozcelik and Taymaz (2004) for Turkish manufacturing industry found a positive relationship between R&D and exports. In case of Chinese manufacturing industry Zhao and Zou (2002) did find a positive relationship between R&D and probability to export, however the export intensity of the exporters was negatively affected by R&D activities. In case of Indian high technology industries Kumar and Siddharthan (1994) did not find R&D to be important in determining the export competitiveness. However, in a recent study on Electronics/Electrical industry of India, Bhaduri and Ray (2004) found that large firms investing higher amounts on R&D exported at higher intensities.

In studies on export competitiveness, foreign equity participation has been considered as a mode of intra-firm transfer of superior technological and managerial knowledge. Most of these papers have found foreign equity participation to have a favorable influence on exports (Kumar and Siddharthan, 1994; Aggarwal, 2001; Wignaraja, 2002; Bhaduri and Ray, 2004; Ozcelik and Taymaz, 2004; Siddharthan and Nollen, 2004; Narayanan, 2006a, 2006b). Patibandla and Peterson (2002) find the role of transnational corporations (TNCs), especially the tacit knowledge transfer, to be important in the competitive evolution of the software segment in India.

Firms can acquire technology in disembodied form by importing designs, drawings, and blueprints against lump sum, technical fees, and royalty payments. They can then produce products of export quality based on these imported designs, drawings, and blueprints. Kumar and Siddharthan (1994) in case of Indian high technology industry, Sterlacchini (1999) in case of non-R&D performing small firms of Italian supplier dominated industries, and Siddharthan and Nollen (2004) in case of MNE affiliates of Indian Information Technology industry have found the effect of disembodied technology imports to be positive on export competitiveness.

Use of up-to-date machines and equipments helps in improving the services and products offered by firms. The firms can also use reverse engineering technique to learn from the imported capital goods or machines and equipments. Thus, these technology imports in embodied form can help a firm in producing higher quality products that are acceptable at world standards. Sterlacchini (1999) for non-R&D performing small firms in Italy, and Basile (2001) for manufacturing firms in Italy have reported positive effects of import of capital goods on

exports. However, studies on Indian IT industry (Siddharthan and Nollen, 2004; Narayanan, 2006b) have not obtained statistically significant positive relationship between import of capital goods and exports.

In studies on competitiveness, a frequently used non-technology variable is size of the firm. The argument in favor of better export performance of large size firms is availability of resources for investments. Also, the firm is able to reap the benefits of economies of scale by increasing its size of operation. Large size also gives risk bearing capacity and advantages with respect to brand loyalties and price-setting power (Krugman, 1979). However, empirical evidences on the effect of size on exports have been inconclusive (see Aggarwal, 2001; Basile, 2001; Zhao and Zou, 2002; Siddharthan and Nollen, 2004; Narayanan, 2006a).

Age of the firm determines a firm's learning curve and thus the capabilities that the firm has accumulated over time. It is also a factor that can affect the cost of capital. However, it should be noted that in India, as part of the liberalization process, software and services firms have been given a lot of incentives to become export-oriented. Therefore many of the firms incorporated in the late 1980s and later are exporting from beginning itself. In other words, younger firms might be more export oriented in the Indian IT industry. This is supported by the findings of Bhaduri and Ray (2004) for Indian Electronics/Electrical industry where younger firms are more export oriented than older firms.

Export is a risky activity requiring substantial investments on client search and marketing of new products. Since getting venture capital finance for new product development is difficult in India, it has been observed that software firms use services exports to get funds to invest on product development (Arora et al, 2001). Thus, firm profits become an important source of finance for new product developers in IT industry.

A major problem in Indian IT industry is attrition (Arora et al, 2001; Arora and Athreye, 2002). Therefore a company giving high remunerations to its employees or a company employing a large number of semi-skilled employees (especially in services sector) would be able to retain the skilled workers in the company and maintain its capability to produce export quality products and services.

In the context of Indian IT industry, Siddharthan and Nollen (2004) note that although India is capital-poor country however within the dynamic IT industry it is very much likely that firms having higher capital intensity are investing on latest machines. Therefore the firms are

likely to be able to meet the requirements of the export market more effectively than the lesser capital-intensive firms. In case of domestic and licensees sub-samples from Indian IT industry, Siddharthan and Nollen (2004) did find capital intensity to be an important determinant of exports.

Chakraborty and Jayachandran (2001) note that, for the overseas clients, most of the Indian software firms carry out work onsite rather than offsite. This is especially so because many of the overseas clients are afraid to undertake the risk of sending work offshore to India due to problems such as lack of efficient telecommunication network, attrition, and poor enforcement of copyright protection laws in India. In such cases, firms that have development centres and subsidiaries abroad would be in a better position to gain confidence of their prospective foreign clients. Also, as Pradhan (2007a) notes outward investments can be one of the ways to acquire new and efficient technologies and managerial practices from abroad.

3. IT Industry in India

The IT industry in India started in 1960s. Initially IBM (International Business Machines) and ICL (International Computers Limited) were the two giants in Indian IT industry. The policy of the Indian government at that time was towards achieving self-sufficiency in various industries including computers and electronics. At the same time, government was willing to promote software exports. Therefore, in 1973 the Santa Cruz Electronics Export Processing Zone (SEEPZ) was established in Bombay (Parthasarathy, 2004). In 1975, Tatas with Burroughs as partner established a unit in SEEPZ. Money from the exports was used for paying for the imports of technology. Due to equity restrictions put forth by the Indian government, IBM left India in June 1978. Soon after Indian firms, such as Hindustan Computers Limited (HCL), DCM Data products and Operations Research Group (ORG) that designed and assembled systems, and International Data Machines (IDM) that marketed and serviced Microsystems, entered the IT industry.

In 1984, with the new hardware policy, microcomputers became more easily available in India. Further, the Computer Software Export, Development and Training Policy of 1986 helped in increasing software production for both domestic and export market (Parthasarathy, 2004). However, the kind of projects that the Indian firms got from overseas clients were mainly low-end routine ones such as maintenance or integration of systems after mergers and acquisitions, or

solving Y2K problems (Henley, 2006). Need for constant client-provider interaction, but lack of data communication facilities accentuated the need for on-site services or "body-shopping".

Table 1: IT industry Production and Exports[a] during 2000-01 to 2005-06 (In US$ Millions)

Sector			2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
ELECTRONICS	Consumer Electronics	Production	2597.83	2662.47	2851.24	3304.35	3741.65	4178.90
		Exports	134.78	146.75	154.96	179.35	256.12	451.77
	Comm. & Broadcasting Equip.	Production	978.26	943.40	991.74	1163.04	1024.50	1219.79
		Exports	126.09	31.45	103.31	35.87	77.95	112.94
	Instrumentation & Strategic EC	Production	1250.00	1320.75	1663.22	1923.91	2394.21	2823.58
		Exports	121.74	199.16	289.26	329.35	334.08	519.54
	Electronic Components	Production	1195.65	1194.97	1363.64	1652.17	1959.91	2055.57
		Exports	397.39	461.22	495.87	816.30	846.33	858.37
	Computer Hardware	Production	739.13	744.23	878.10	1478.26	1959.91	2371.81
		Exports	260.87	377.36	113.64	313.04	267.26	231.53
	Total Electronics	Production	6760.87	6865.83	7747.93	9521.74	11080.18	12649.65
		Export	1040.87	1215.93	1157.02	1673.91	1781.74	2174.16
		Exports as a Percentage of Production	15.40	17.71	14.93	17.58	16.08	17.19
SOFTWARE		Production	8021.74	9931.66	12376.03	16141.30	21587.97	29695.05
		Exports	5978.26	7651.99	9607.44	12608.70	17216.04	23718.09
		Exports as a Percentage of Production	74.53	77.05	77.63	78.11	79.75	79.87
Total IT Production		Production	14782.61	16797.48	20123.97	25663.04	32668.15	42344.70
		Exports	7019.13	8867.92	10764.45	14282.61	18997.77	25892.25

[a] *Table adapted from the one provided by Statistical Year Book 2005-06 accessed on October 5, 2007 from http://www.escindia.in/export_statistics.pdf*

With devaluation of the Rupee in 1991, Indian software became cheaper for global market. In 1990s, Software Technology Parks were set up to provide duty free imports of capital goods, high-speed data communication links and tax holidays for 10 years. This encouraged more offshore development of software and services. The time difference between US, which was the major importer of Indian IT products and services, and India was also an advantage for offshore Indian software and services development. However, as Heeks (2007) notes most of the

exports is still at the lower end of the technological ladder. Further, R&D and product development efforts are also limited.

Still, over the last few years India has witnessed tremendous growth in the IT sector. Table 1 shows the value of production in India for various constituents of electronics and software during 2000-01 to 2005-06. As is clear from Table 1, a large portion of the electronic production consists of consumer electronics. However, in terms of value, electronic components are exported more than other sub-sectors of electronics.

Figure 1a depicts in graphical form the distribution of IT production during 2000-01 to 2005-06. In India, IT production has been increasing over time. However, within IT, software sub-sector is growing at a faster rate than electronics sub-sector. As is clear from Figure 1b, even the export intensity of the software sub-sector is higher than the electronics one. While the export intensity for the electronics sub-sector has been fluctuating, the export intensity of the software sub-sector has been showing a continuous increasing trend.

Figure 1a: Production Distribution in the IT industry in India

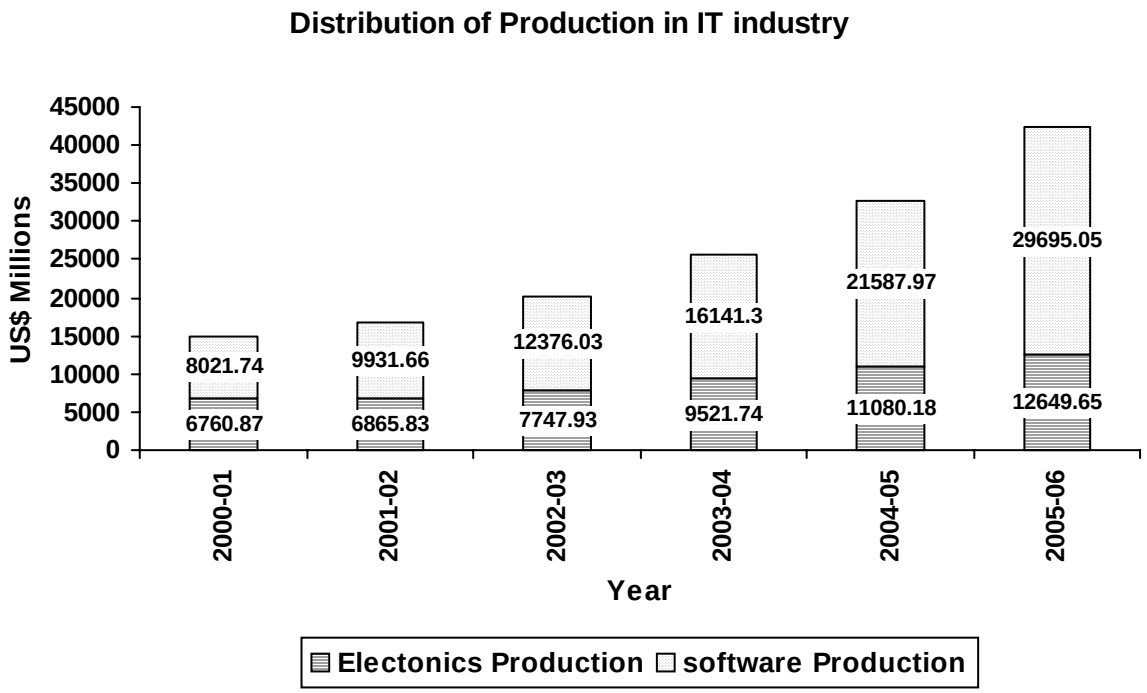
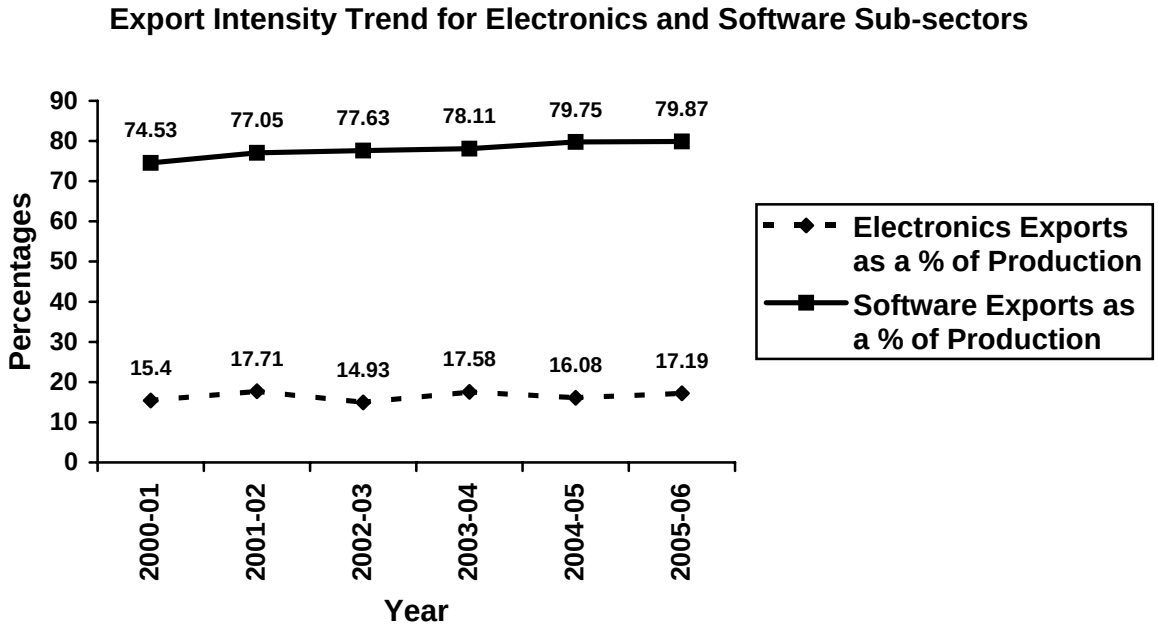


Figure 1b: Export Intensity Trends in IT industry in India



4. Data and Methodology

The sample used in the present study is a balanced panel consisting of 130 firms for a period of 6 years, from 2000 to 2005. It consists of 19 hardware, 105 software, and 6 services firms according to the classification by Center for Monitoring Indian Economy, which is the source of data for the analysis. Further, on the basis of various data sources[3], the firms in the sample that have invested abroad on offices, development centers, subsidiaries, and joint ventures have been identified.

For the purpose of the present study Indian Multinational Company (Indian MNC) was defined to be those firms, having head quarters in India with majority Indian holding in the equity, that have also invested abroad during the period of study. Following this definition, the present sample consists of 73 Indian MNCs. Of these, 10 are hardware, 60 are software, and 3 are service providers.

Table 2 gives the variables and their definitions used in the present study. Export intensity (EXPI) is the explained variable. Four variables representing the technological efforts

[3] Data sources include the company web-sites, information provided by the CapitalinePlus database provided by Capital Market, various articles in the Internet version of Business Line provided by THE HINDU group of publications, and Pradhan (2007c)

of the firm are R&D intensity (RDI), import of capital goods intensity (MKI), intensity of import of technology in the form of designs, drawings, and blueprints against royalty payments (RI), and foreign equity participation (FE). As indicated in the literature review section, size of the firm (SIZE), age of the firm (AGE), profit margin of the firm (PROFIT), skill intensity of the firm (SKILL) and capital intensity of the firm (CAPI) are some of the potential non-technological determinants of exports. Since the Indian IT industry can be divided into three sub-sectors, two dummy variables $D_{software}$ and $D_{services}$ representing the software and the services sub-sectors respectively have been included in the analysis to differentiate from the third, that is, hardware sector.

Table 2: Definition of Variables

Sl.	Variable	Symbol	Definition Used in the Study
1	Export Intensity	EXPI	[Exports / Sales Turnover] * 100
2	R&D Intensity	RDI	[R&D expenses / Sales Turnover] * 100
3	Import of Capital Goods Intensity	MKI	[Foreign Expenditure on Capital Goods / Sales] * 100
4	Royalty Intensity	RI	[Royalty Expenses in Forex / Sales Turnover] * 100
5	Foreign Equity Participation	FE	[Equity held by Foreign collaborators and promoters / Total Equity] * 100
6	Firm Size	SIZE	Sales Turnover in Crores of Rupees
7	Age of the firm	AGE	Relevant Year – Year of Incorporation of the concerned firm
8	Profit Margin of the firm	PROFIT	[Gross Profits / Sales Turnover] * 100
9	Skill Intensity	SKILL	[Salaries and Wages / Sales Turnover] * 100
10	Capital Intensity	CAPI	[Gross Fixed Assets / Sales Turnover] * 100
11	Software Firm	$D_{software}$	D_{soft} = 1 when the firm is a software producing firm D_{soft} = 0 otherwise
12	Services Firm	$D_{services}$	$D_{service}$ = 1 when the firm is a service providing firm $D_{service}$ = 0 otherwise
13	Indian MNC Firm	$D_{indianMNC}$	$D_{indianMNC}$ = 1 when a majority Indian holding firm with head quarters in India invests abroad on any of offices, development centers, subsidiaries, or joint ventures $D_{indianMNC}$ = 0 otherwise

The data set consists of both exporters and non-exporters. For such a sample, where the dependent variable takes a zero value for many observations, models that use maximum

likelihood estimation technique are considered to be more appropriate than ordinary least square (OLS) estimation technique (Greene, 2002; Gujarati, 2003; Siddharthan and Nollen, 2004; Narayanan, 2006a).

In most of the Indian studies, Tobit model is one such econometric model that has been used for censored data (see Kumar and Siddharthan, 1994; Bhaduri and Ray, 2004; Siddharthan and Nollen, 2004; and Narayanan, 2006a). According to these studies the advantage of using Tobit model instead of a Probit model is that information on the continuous values of explained variable are not lost in Tobit models, whereas after converting the variable into binary form (as is the case in Probit model) valuable information is lost. Statistically, a general Tobit model can be expressed as:

$$Y_i^* = \alpha_0 + \alpha_1 X_{1i} + ... + \alpha_n X_{ni} + u_i,$$
$$Y_i = 0 \quad \text{if } Y_i^* \leq 0,$$
$$= Y_i^* \quad \text{if } Y_i^* > 0 \qquad \text{-----(1)}$$

where subscript i stands for the particular observation, Y_i^* is the unobserved regressand or the latent variable (also called as index variable), Y_i is the actual observed variable, and X_{1i} to X_{ni} are the n regressors.

However, in their respective studies on Italian manufacturing industry, Wakelin (1998), Sterlacchini (1999), and Basile (2001) note that Tobit technique intrinsically assumes the explanatory variables to have similar effect on the decision to export and the export intensity, an assumption which may not always be a correct. In other words, the effect of the explanatory variables on decision to export may differ from that on export intensity of exporters. Therefore the three authors in their studies compared the Tobit model to the double specification model where the effect of the explanatory variables on decision to export is first analyzed for the complete sample using Probit technique followed by a truncation model fitted to analyze the effect of the explanatory variables on the export intensity of the exporters. This double specification model thus nests the Tobit model as a special case. The authors also note that a test, that is, likelihood ratio test (also mentioned in Greene, 2002, p. 915), is available to determine which of the two models, that is, Tobit or double specification (Probit + Truncation) is more suitable for the data.

A general Probit model can be specified as:

$$DY_i = \alpha_0 + \alpha_1 X_{1i} + ... + \alpha_n X_{ni} + u_i,$$

$$DY_i = 0 \quad \text{if } Y_i^* \leq 0,$$

$$= 1 \quad \text{if } Y_i^* > 0 \qquad \text{-----(2)}$$

where subscript i stands for the particular observation, Y_i^* is the latent variable under study, and DY_i is a binary variable that takes a value of 1 whenever Y_i^* is greater than zero else DY_i is zero.

A general truncated model can be specified as:

$$Y_i = \alpha_0 + \alpha_1 X_{1i} + ... + \alpha_n X_{ni} + u_i \quad \text{if } DY_i = 1 \qquad \text{-----(3)}$$

where Y_i is the intensity of the variable under consideration and is defined only for cases where the dummy variable DY_i is 1.

In the present study the Tobit model for export competitiveness of a firm for the complete sample can be specified as:

$$EXPI^* = \alpha_0 + \alpha_1 RDI + \alpha_2 MKI + \alpha_3 RI + \alpha_4 FE + \alpha_5 AGE + \alpha_6 SKILL + \alpha_7 LnCAPI + \alpha_8 LnSIZE + \alpha_9 PROFIT + \alpha_{10} D_{software} + \alpha_{11} D_{services} + \alpha_{12} D_{indianMNC} + u_1$$

$$EXPI = 0 \quad \text{if } EXPI^* \leq 0$$

$$= EXPI^* \quad \text{if } EXPI^* > 0 \qquad \text{-----(4)}$$

where $EXPI^*$ is the latent (index) variable and EXPI is the corresponding observed export intensity.

The double specification model would estimate separate models for decision to export (DX) and intensity of export (EXPI) for a firm. Here the decision to export (DX) for a firm can be specified as:

$$DX = \alpha_0 + \alpha_1 RDI + \alpha_2 MKI + \alpha_3 RI + \alpha_4 FE + \alpha_5 AGE + \alpha_6 SKILL + \alpha_7 LnCAPI + \alpha_8 LnSIZE + \alpha_9 PROFIT + \alpha_{10} D_{software} + \alpha_{11} D_{services} + \alpha_{12} D_{indianMNC} + u_2$$

and $DX = 0$ if firm does not export

$= 1$ if firm exports -----(5)

The truncated model for the export intensity of exporter (EXPI) can be specified as:

$$EXPI = \alpha_0 + \alpha_1 RDI + \alpha_2 MKI + \alpha_3 RI + \alpha_4 FE + \alpha_5 AGE + \alpha_6 SKILL + \alpha_7 LnCAPI + \alpha_8 LnSIZE + \alpha_9 PROFIT + \alpha_{10} D_{software} + \alpha_{11} D_{services} + \alpha_{12} D_{indianMNC} + u_3 \quad \text{if } DX = 1 \qquad \text{-----(6)}$$

where EXPI is the observed export intensity for a firm which is defined only when the firm is an exporter, that is DX takes a value of 1. In the present sample the probability distributions of size

and capital intensity variables were highly positively skewed. Since one of the reasons sited for heteroscedasticity is skewness in the distribution of one or more regressors (Gujarati, 2003, p.391), to avoid the likely problem of heteroscedasticity the variables were introduced after transforming them using logarithmic function.

5. Empirical Analysis

This section deals with the empirical analysis of the sample. Sub-section 5.1 gives some analysis of the data. Sub-sections 5.2 and 5.3 discuss the determinants of decision to export and export intensity respectively.

5.1 Data Analysis

Table 3 gives the comparison of the mean values of various variables for the Indian-MNC sub-sample to others where others include the Indian majority holding firms that have not invested abroad and the entire foreign majority holding firms. As is clear from Table 3, the Indian-MNC sub-sample differs from rest of the sample on the mean values of most of the firm characteristics. The Indian-MNCs on an average have higher export intensity and technological investments such as R&D and import of capital goods. An average Indian-MNCs is also larger and with higher skill content compared to others.

Table 3: Mean values of the variables for the sub-samples (Total NOBS = 780)

Sl.	Variables	Indian-MNCs	Others
1	RDI [a]	1.20	0.35
2	MKI [a]	2.04	0.81
3	RI	0.78	0.33
4	FE [a]	1.59	3.91
5	AGE [a]	12.95	11.27
6	LABI [a]	30.60	21.32
7	CAPI	96.73	166.96
8	SIZE [a]	254.32	60.70
9	PROFIT	7.83	3.42
10	EXPI [a]	54.33	21.26
	NOBS	438	342

[a] Difference between mean values of the variable for Non-Indian-MNC and Indian-MNC sub-samples is different from zero at statistical significance of 10%

Table 4 gives the mean and standard deviation of various variables when Indian- MNC sub-sample is divided in terms of average degree of foreign equity holdings during the time

period. As is clear from Table 4, most of the Indian-MNCs in the sample have no equity participation from foreign firms. These are also on an average the largest firms in the sample. By and large, with increase in equity participation the average size of the Indian-MNC firm decreases. In contrast, the average capital intensity of the firms in general increases with increase in degree of foreign equity participation. The firms with moderate amount of foreign equity seem to be investing more on in-house R&D efforts whereas firms in the extreme ranges of equity participation, that is, no equity and greater than 25, seem to prefer import of capital goods to other technological investment modes. Except for the firms with more than 25 percent of foreign equity participation, by and large, the average export intensity doesn't differ much according to the degree of foreign presence in the equity of the Indian-MNCs.

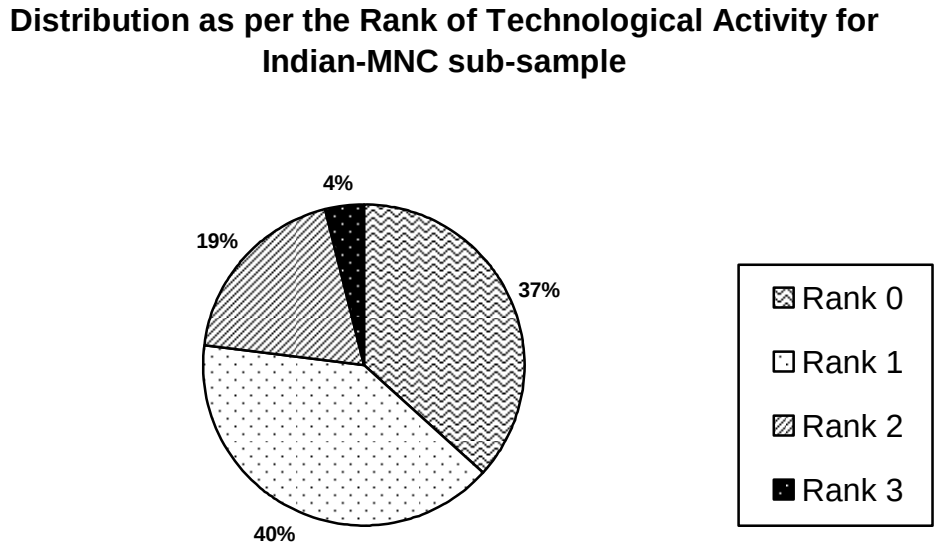
Table 4: Mean with Standard Deviation in parenthesis for the Indian-MNC sub-sample

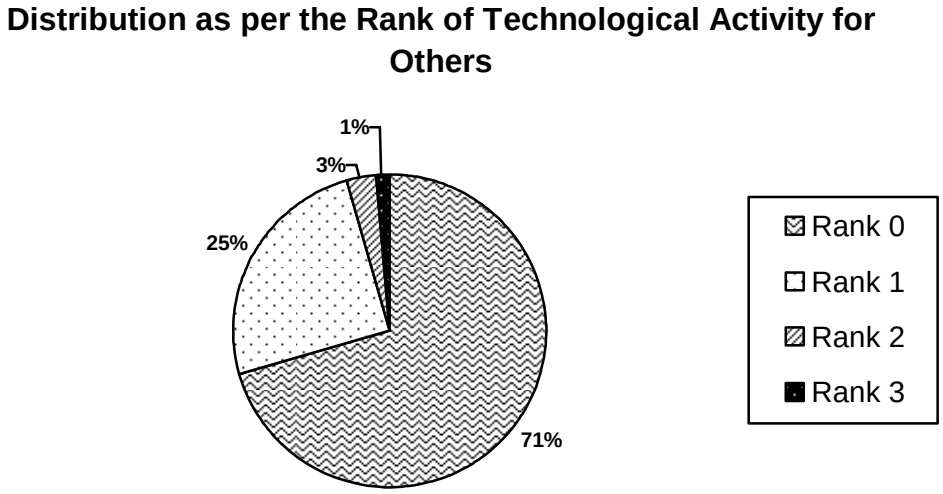
Sl.	Symbols	Indian-MNCs			
		Average FE = 0	0 < Average FE <= 10	10 < Average FE <= 25	Average FE > 25
1	PROFIT	10.1 (29.7)	-7.9 (79.1)	12.9 (14.6)	2.0 (19.8)
2	SIZE	267.7 (832.5)	176.4 (247.4)	55.4 (44.7)	34.5 (35.1)
3	AGE	13 (8.0)	11.3 (4.9)	15.3 (4.0)	15 (12.1)
4	RDI	0.8 (3.1)	3.1 (9.0)	3 (5)	0
5	MKI	2 (6.2)	2.1 (4.7)	1.7 (3.2)	3.8 (10.6)
6	RI	0.5 (4)	0.6 (2.8)	6 (13.8)	0.01 (0.04)
7	CAPI	85.8 (127.5)	112.1 (240.9)	100.3 (94.6)	336.6 (739.1)
8	LABI	30.0 (23.7)	29.3 (23.4)	28.8 (21.2)	56.6 (12.5)
9	EXPI	54.4 (39.0)	46.4 (36.2)	55.3 (41.3)	84.6 (10.3)
	Number of Hardware /Software /Services Firms	Hard = 7 Soft = 48 Services = 3	Hard = 2 Soft = 7 Services = 0	Hard = 1 Soft = 3 Services = 0	Hard = 0 Soft = 2 Services = 0
	NOBS	58*6 = 348	9*6 = 54	4*6 = 24	2*6 = 12

Figure 2, compares the technological activity of Indian MNC sub-sample to the rest of the sample by giving ranks to simultaneous investments on multiple technological efforts. The ranks are defined as follows:

Rank 0 = Not investing on any of RDI, MKI or RI
Rank 1 = Investing simultaneously on only one of RDI, MKI or RI
Rank 2 = Investing simultaneously on only two of RDI, MKI or RI
Rank 3 = Investing simultaneously on all of RDI, MKI or RI

Figure 2: Pie Charts depicting Percentages of Observations undertaking Technological Activity of Different Ranks





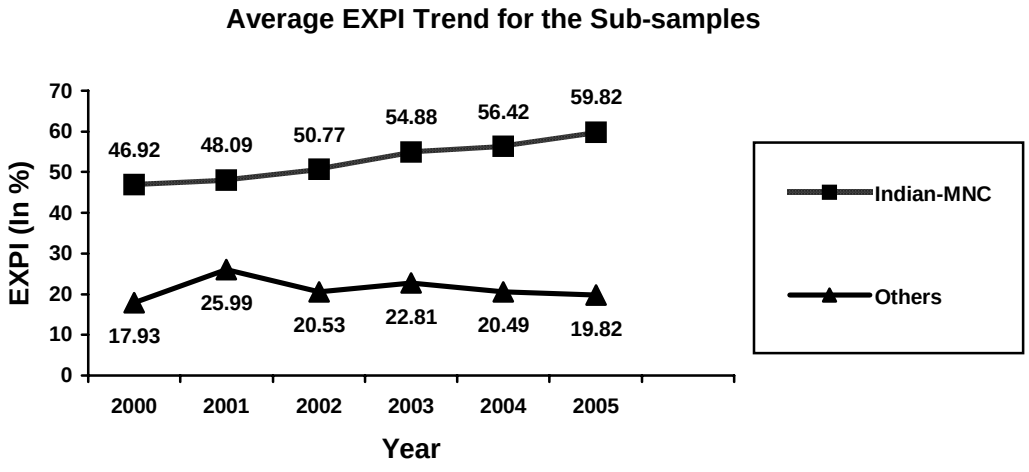
As is clear from Figure 2, more than 70 percent of the observations that are not Indian-MNC do not invest on any of the three technological activities. In contrast, majority of the Indian-MNCs are technologically active. Further, higher percentages of Indian-MNCs invest on higher ranked technological activities as compared to the not Indian-MNCs. This clearly shows the preference of the Indian-MNCs to go for investments on multiple technological strategies at a time.

Table 5 further indicates the trend in export intensity (EXPI) for the Indian-MNC and the rest of the sample. Figure 3 depicts the trend in graphical form. As is noticeable, there is a clear difference in the trends. For the Indian-MNC sub-sample the average export intensity has been at a higher level than the not Indian-MNC sub-sample. Also, the export intensity for the Indian-MNC sub-sample has been steadily increasing during the period where as for others it is more or less decreasing.

Table 5: Trend in average EXPI for the 6 years for the sub-samples

Year	Average EXPI		
	Full Sample	Indian-MNC	Others
2000	33.63	46.92	17.93
2001	38.41	48.09	25.99
2002	39.26	50.77	20.53
2003	42.25	54.88	22.81
2004	42.00	56.42	20.49
2005	43.45	59.82	19.82
No. of Firms in Each Year	130	73	57

Figure 3: Graphical Representation of the Trend in average EXPI for the 6 years for the sub-samples



Tables 6 and 7 denote the correlation matrix between the variables for the full sample and the Indian-MNC sub-samples respectively. The correlation coefficients between all the variables are low. Therefore, there are less chances of multicollinearity among the variables. Also, there

are differences among the correlation coefficients for the Indian-MNC sub-sample and the full sample. For example, correlation coefficient between R&D intensity and export intensity takes a positive but statistically insignificant sign where as for the Indian-MNC sub-sample it takes a negative, statistically significant sign.

Table 6: Correlation Matrix for Full Sample (NOBS = 780)

Variables	EXPI	RDI	MKI	RI	FE	AGE	LABI	LnCAPI	LnSIZE	PROFIT
EXPI	1.00									
RDI	0.03	1.00								
MKI	0.27[c]	0.0003	1.00							
RI	-0.04	-0.03	-0.04	1.00						
FE	0.17[c]	0.10[c]	0.05	0.05	1.00					
AGE	0.08[c]	-0.01	-0.04	0.05	0.004	1.00				
LABI	0.37[c]	0.20[c]	0.18[c]	-0.06	0.15[c]	-0.008	1.00			
LnCAPI	0.005	0.08[c]	0.12[c]	-0.07[c]	0.03	-0.07[c]	0.24[c]	1.00		
LnSIZE	0.37[c]	0.06[c]	-0.009	0.03	0.14[c]	0.30[c]	-0.02	-0.47[c]	1.00	
PROFIT	0.21[c]	-0.09[c]	0.03	-0.001	0.03	0.003	-0.13[c]	-0.20[c]	0.25[c]	1.00

[c] *denotes statistical significance at 10 percent*

Table 7: Correlation Matrix for Indian-MNC Sub-Sample (NOBS = 438)

Variables	EXPI	RDI	MKI	MTI	FE	AGE	LABI	LnCAPI	LnSIZE	PROFIT
EXPI	1.00									
RDI	-0.11[c]	1.00								
MKI	0.21[c]	-0.05	1.00							
RI	-0.10[c]	-0.04	-0.05	1.00						
FE	0.07	0.06	0.04	0.15[c]	1.00					
AGE	0.08[c]	-0.04	-0.08	0.08	-0.03	1.00				
LABI	0.25[c]	0.21[c]	0.18[c]	-0.09[c]	0.08[c]	-0.03	1.00			
LnCAPI	0.05	0.12[c]	0.17[c]	-0.03	0.16[c]	-0.12[c]	0.17[c]	1.00		
LnSIZE	0.21[c]	-0.01	-0.11[c]	-0.01	-0.12[c]	0.47[c]	-0.07	-0.52[c]	1.00	
PROFIT	0.20[c]	-0.17[c]	-0.02	-0.04	-0.01	0.05	-0.17[c]	-0.27[c]	0.22[c]	1.00

[c] *denotes statistical significance at 10 percent*

In the present study, all the technology variables are hypothesized to have a positive effect on export decision as well as performance. In the light of the high technological activities taking place in the Indian-MNC sub-sample, the technological variables are likely to be more relevant for the Indian-MNC sub-sample; although the correlation matrix doesn't clearly support

this view. Also, larger size of the firm can be a clear advantage in this industry since it can give them definite scale economies as compared to others.

In the model suggested in the previous section, if the sign on the coefficient of the dummy variable $D_{indianMNC}$ is positive then it would confirm that Indian MNC firms are better export performers than those who are not Indian-MNCs. At the same time one should note that this form of equation assumes no difference in the effects of the explanatory variables on exports for Indian MNC sub-sample and the others. However, in actuality there can be differences even in the effects of the explanatory factors on exports for the Indian MNC sub-samples. Therefore, to explore this possibility, separate regressions have been carried out exclusively for the Indian-MNC sub-sample.

A likelihood ratio test similar to the one suggested by Sterlacchini (1999) rejected the Tobit specification model in favor of double specification model for both the cases of full sample and Indian-MNC subsample. Nevertheless, in the present study the authors have reported the Tobit results for the purpose of comparison with double specification results. Table 8 presents the maximum likelihood estimation results for the full sample and the Indian MNC sub-sample. A comparison of Tobit and Double Specification results reveals that the Tobit results are similar in sign to the Truncation one for both the cases. As is clear from Table 8, the factors affecting the decision to export and the export intensity of the exports do differ for the present sample.

The following sub-section would describe the results of Probit model, that is, the factors affecting the decision to export for the IT firms. Sub-section 5.3 would deal with factors determining the export intensity of the firms as revealed by the results of the Truncation model. In both the sub-sections, differences in the determinants of export competitiveness for the Indian MNC sub-sample as against the full sample would be highlighted.

5.2 Factors affecting the Decision to Export

In the Probit results for full sample the Indian-MNC dummy is statistically significant. This confirms that Indian IT MNCs are relatively different from rest of the firms in terms of decision to export. Of the four technology variables only import of capital goods seems to be positively affecting the decision to export for the full sample as well as the Indian-MNCs. This implies that the firms in this industry, including the Indian MNCs are importing latest technology in the form of machines to provide up-to-date products and services to the clients abroad.

Table 8: Results of **EXPI** as explained variable

Sl (1)	Regressand (2)	Full Sample			Indian MNC sub-sample		
			Double Specification			Double Specification	
		Tobit (3)	Probit (Robust) (4)	Truncation (Robust) (5)	Tobit (6)	Probit (Robust) (7)	Truncation (Robust) (8)
1	Constant	-75 (-8.7)[a]	-2.4 (-6.9)[a]	-104.4 (-5)[a]	-36.4 (-3.4)[a]	-1.1 (-1.9)[c]	-50.7 (-2.7)[a]
2	RDI	-0.8 (-2.0)[b]	0.06 (1.1)	-2.1 (-3.7)[a]	-1.2 (-3.1)[a]	0.03 (0.9)	-2.4 (-4.3)[a]
3	MKI	1.5 (5.4)[a]	0.3 (2.8)[a]	0.9 (3.0)[a]	1 (3.4)[a]	3.3 (2.4)[b]	0.6 (2.1)[b]
4	RI	0.3 (1)	0.02 (1.2)	0.1 (0.1)	0.1 (0.4)	-0.003 (-0.2)	0.5 (0.6)
5	FE	0.4 (3.1)[a]	-0.002 (-0.4)	0.4 (3.7)[a]	0.4 (1.5)	0.01 (1.0)	0.3 (1.4)
6	AGE	-0.6 (-2.6)[a]	-0.003 (-0.3)	-0.5 (-2.2)[b]	-0.1 (-0.5)	0.02 (1.0)	-0.2 (-0.9)
7	SKILL	0.5 (7.6)[a]	0.01 (3.0)[a]	0.6 (6.1)[a]	0.3 (4.3)[a]	0.003 (0.7)	0.4 (3.8)[a]
8	LnCAPI	4.0 (2.5)[b]	0.2 (2.7)[a]	3.8 (1.5)	5.6 (2.7)[a]	0.2 (1.7)[c]	4.3 (1.6)[c]
9	LnSIZE	10.4 (10.5)[a]	0.4 (8.1)[a]	5.7 (4.1)[a]	7.1 (6)[a]	0.3 (3.5)[a]	4.2 (3.1)[a]
10	PROFIT	0.2 (4.7)[a]	0.003 (1.6)	0.3 (2.3)[b]	0.2 (3.1)[a]	0.002 (0.75)	0.2 (1.7)[c]
11	$D_{software}$	31.5 (6.7)[a]	0.5 (2.9)[a]	87.6 (5.1)[a]	31.9 (5.6)[a]	0.2 (0.7)	67.1 (4.5)[a]
12	$D_{services}$	44.6 (5.3)[a]	0.7 (2.1)[b]	95.6 (5.1)[a]	56.0 (5.5)[a]	0.2 (0.4)	93.6 (6.2)[a]
13	$D_{indianMNC}$	31.3 (9.5)[a]	0.9 (7.6)[a]	22.3 (4.1)[a]	---	---	---
	NOBS	780	780	549	438	438	390
	Chi^2	527.26[a]	207.83[a]	182.07[a]	157.16	33.21	130.62
	Log L.	-2919.27	-279.81	-2569.377	-1993.2784	-109.96501	-1838.1705

Values in parenthesis are t-statistic for Tobit and z-statistic for Probit and Truncation Regressions
[a], [b], [c] represent statistical significance at 1%, 5%, and 10% respectively

Again, in both the cases large size of the firms and high capital intensity increases the probability of the firms to export. It confirms that the firms in this industry are able to take advantage of economies of scale. Also, as Siddharthan and Nollen (2004) note, the firms that invest more on latest equipments and facilities (reflected in their high capital intensity) are more likely to be chosen as suppliers by the foreign clients.

Further, in the present sample the software and service firms are more likely to export when compared to the hardware firms. This seems to be mainly due to the continuous support given by the Indian government to the software and services sector.

The difference in the factors affecting decision to export for the Indian-MNC sub-sample as compared to the IT industry as a whole lies mainly in the skill factor. For the sample as a whole skill content of the firms is important for making a decision to export. The capability of the employees of the firm gets reflected in the salaries that they receive. Firms with higher capabilities would be better able to perceive the requirements of the international clients and

therefore they are more likely to export. At the same time, for the Indian-MNC sub-sample the coefficient of skill variable is not statistically significant in determining the probability to export. The firms that have invested abroad are likely to be making use of their marketing skills for attracting foreign clients, thereby making the skill factor less important in influencing their decision to export.

5.3 Factors affecting the Export Intensity

Among the technological variables, import of capital goods again turns out to be favorably affecting the export intensity of the firms for the full sample as well as the Indian-MNC sub-sample. This is unlike the results obtained by Narayanan (2006b) for Indian IT industry. At the same time, one should note that the sample in the earlier study was an unbalanced one that included even those firms that were established during the period of analysis. It is likely that the export oriented new firms already had the latest capital equipments and so, for the sample as a whole, factors other than capital goods imports became more relevant in determining export competitiveness.

For the Indian-MNC sub-sample as well as the IT industry as a whole, in-house R&D investments do not seem to be favoring export intensity. Zhao and Zou (2002) too in case of Chinese manufacturing industry had found export intensity of the exporters to be negatively affected by R&D activities. The authors had suggested that import-substituting R&D undertaken by the Chinese firms, which was aimed at capturing domestic markets, rather than export market, was the possible reason for this unexpected result. In the present case too it is possible that the R&D undertaken by the firms are mainly for solving problems posed by the domestic clients.

For the sample as a whole, intra-firm transfer of technology and managerial skills through foreign direct investments seems to be favorable in determining export intensity. The finding is in line with that of Siddharthan and Nollen (2004) for an earlier sample period from IT industry in India. This means that in the new millennium too the firms in this industry are able to take advantage of intra-firm transfer of technological, managerial, and marketing capabilities from the foreign equity participants for better performance in the foreign markets. However, for the Indian-MNCs, foreign equity is not important for export decision as well as performance. This could be because the overseas offices, development centers, and subsidiaries of the Indian-MNCs

can acquire the required tacit knowledge and transfer it through intra-firm means to the parent company in India.

In this industry, size of the firm is important not only for the decision to export but also for the export intensity of the exporters. The finding is consistent with that of an earlier study (Narayanan, 2006b). The large sized firms are able to reap cost benefits due to existence of economies of scale in this industry. As Heeks (2007) too notes, during the IT recession period of 2001-03 cost- cutting was one of the strategies adopted by Indian firms to compete with IT firms from Russia and Vietnam.

Profit margins are important in determining the export intensity of the exporter firms although they were not important for making the decision to export. It seems that although current profits of the firm are not important for getting foreign clients, however higher profit earnings, that suggest higher efficiency and capabilities of the firm, is important for determining the size of the projects obtained from the overseas clients.

Skill intensity is also important in determining export intensity for this industry. As was suggested in the literature review any company that spends on high remunerations for its existing employees or employs a large number of semi-skilled workers would be in a better position to retain its employees and thus be more efficient in handling larger projects from overseas clients.

For the sample as a whole, younger firms have higher export intensity. This is in line with the findings of Bhaduri and Ray (2004) for Indian Electronics/Electrical industry. Foreign clients are likely to give their projects to those exporters that have the more efficient infrastructure and facilities (more likely in a younger firm). However, for the Indian MNC sub-sample, age of the firm is not important in determining export intensity. This could be because the firms that have invested abroad are generally closer to their prospective clients and so are in a better position to identify and fulfill the requirements of their prospective clients beforehand.

For the sample as a whole, capital intensity is only important for taking the decision to export; whereas for the Indian MNC sub-sample capital intensity is important for better export performance as well. This could be because the Indian IT MNCs that are continuously expanding and up-grading their facilities are able to garner larger projects from the overseas clients.

For the full sample as well as for the Indian-MNC sub-sample, the software firms and the services firms are having higher export intensity compared to the hardware firms. With the large amount of encouragement and incentives for the software and services sector from the Indian

government the software and services firms are expected to perform better in the export sector as against the hardware firms that mainly rely on their foreign collaborators' network for exports.

6. Summary and Conclusions

The present study analyzes the determinants of export performance of the firms derived from the IT industry in India. In particular, the study examines the effects of various factors, especially technological factors, in determining exports of the Indian-MNC sub-sample as compared to the complete sample. Here, Indian multinationals are defined as those firms, with head quarters in India, that have majority Indian holding in their equity, and that have also invested abroad on any of offices, development centers, subsidiaries, or joint ventures.

Unlike the earlier studies on IT industry in India that followed the Tobit specification model (Bhaduri and Ray, 2004; Siddharthan and Nollen, 2004; Narayanan, 2006b; Pradhan, 2007b) for dealing with censored sample data, the present study follows the methodology suggested by Wakelin (1998), Sterlacchini (1999), and Basile (2001). Thus, export performance is considered in terms of decision to export and export intensity of the exporters.

In the present study that dealt with export performance of the Indian IT industry in general, and Indian IT MNCs in particular, the following points are noteworthy as concluding observations:

1. The Indian IT MNCs are generally more export oriented than the others. In line with the arguments of Pradhan (2007a) we can say that outward investments help companies to strengthen the trade-supporting infrastructure. The development centres and the subsidiaries abroad are able to understand the needs of the clients better and thus serve them better.

2. The Indian IT MNCs are by and large technologically more active than others as they are investing on multiple technological strategies at a given time. However, when it comes to the effect of technological efforts on export performance, only import of disembodied technology in the form of import of capital goods emerged statistically significant for both- the sample as a whole and the Indian-MNC sub-sample. Indian IT firms that import more hardware and other IT equipments are able to meet the

requirements of the foreign clients more effectively and thereby able to obtain larger projects.

At the same time, degree of foreign equity participation is important for determining export intensity for the sample as a whole but not for the Indian MNCs. In general, it is likely that higher the share of foreign collaborator in the equity the greater would be the willingness of the foreign collaborator to transfer its tacit technology and managerial skills to the Indian firm using intra-firm mode. This tacit knowledge would in turn help the firm to obtain larger projects from foreign clients. However, in the case of the Indian MNCs, the overseas development centres and the subsidiaries of the Indian MNCs can gather the tacit knowledge and transfer it to their parent firms in India thereby making foreign equity participation unimportant in explaining exports of Indian IT MNCs.

Unlike what was expected for the dynamic IT industry, in-house R&D efforts do not seem to be oriented towards enhancing export competitiveness. It seems that most of the R&D is undertaken for adaptation or for solving problems of the domestic clients. However, in case of the Indian MNCs, it is possible that the R&D undertaken by the parent firms in India is actually for the use of their development centres and subsidiaries abroad. In such a case, the R&D efforts could be enhancing the capabilities of the parent firm, which in turn can help the firms to produce higher value added products and services in future. Nevertheless, further study is needed to understand the nature of R&D undertaken by Indian IT firms, and Indian IT MNCs in particular.

3. Skill content of the firm is an important factor for determining the decision to export and export intensity for the industry as a whole. At the same time, for the Indian-MNC sub-sample skill content is only important for export intensity of the firm. Thus, minimum amount of technological and managerial capabilities are required for capturing foreign clients. These skills are likely to be already present in the Indian MNCs. Once an IT firm starts exporting, workforce with higher technological and

managerial capabilities becomes more critical for successfully completing larger projects. As the attrition rate in the industry is also high, firms need to pay higher wages to keep their employees. Stock options to supplement salaries can solve the problem of attrition to some extent (Arora and Athreye, 2002).

4. Large size of the firm is important for both, the decision to export and export intensity of the exporters. In the IT industry economies of scale exists due to ease in duplication of standard products. Thus, the larger firms are able to produce more product and/or services at lower costs compared to the smaller counterparts. Therefore, to ensure that lack of resources and information doesn't hinder the export performance of the small firms, the government needs to encourage networking within the IT industry.

5. In this industry, capital intensity is an important factor in determining the decision to export by the firms. The firms that have the latest facilities in terms of infrastructure and equipments are more likely to be chosen by the foreign firms for off shoring their work. For the Indian MNCs, higher capital intensity is also essential for higher export intensity. This implies that Indian IT MNCs that are continuously expanding and up-grading their facilities are able to more efficiently serve the overseas clients. Therefore, the government should try to build more special economic zones and technology parks with latest network technology for enhancing the competitiveness of the firms.

6. Although profit margins are not important for deciding to export however they are important in determining the export intensity of the exporter firms. Firms that earn higher profits are better able to invest on capability building through suitable investments. High current profits can also be considered as an indicator of the efficiency level of the firm. High current profits can thus attract larger projects from the overseas clients. Therefore it is essential that government continue supporting the smaller and younger firms financially.

7. For the industry as a whole, younger firms are better export performers than older firms. Due to the tax-related and other incentives provided by the government for the export oriented software and services firms, the new firms consider the export market from the very beginning. Yet, it is very likely that the young firms are at the lower end of the technological ladder. As Heeks (2007, p.22) too notes in the context of Indian software industry- "… for every large firm that upgrades from a factor-driven to an investment-driven model, five new small firms enter the industry using the low-barrier bodyshopping approach".

8. The software and services firms are better performers than the hardware sector in the export scenario. This is essentially due to the favorable environment created by the government for the software and services industry. The government should continue with these facilities for at least the younger and smaller software and services firms so that they are able to compete effectively in the export market.

Thus, the present study throws light on the factors determining export performance of the Indian IT industry in general, and Indian IT MNCs in particular. The study reveals that outward investments on offices, development centres, and subsidiaries do enhance the export competitiveness of firms in this industry. It seems that proximity to their prospective clients enables the Indian firms to gauge their requirements more effectively and thus capture larger projects.

From the findings of the present study one can conclude that apart from outward investments, skill content, capital intensity, and profits are also essential for better export performance of IT firms. However, the younger and smaller firms are unlikely to have sufficient resources for the same, and so they may not be able to perform at par with their larger and older counterparts. Therefore, government needs to continue giving financial and infrastructure support to such firms.

The government needs to bridge the gap between India and the client countries on both infrastructure and technology front so that the Indian IT firms are able to climb higher up the technology ladder. One of the ways of bridging this gap is by forming networks and forums where information about the up-coming areas of IT as well as information about skill

development can be shared. Further, the government can help the young firms in setting up offices or information centres abroad that would enable them to acquire information on the latest IT technologies and the requirements of their prospective clients. Thus, with better knowledge, the new firms that generally start with lower end projects would be able to quickly switch over to producing complex product and services.

References

Aggarwal, A. (2001), 'Liberalisation, Multinational Enterprises and Export Performance: Evidence from Indian Manufacturing', *Indian Council for Research on International Economic Relations (ICRIER) Working Paper No. 69*.

Arora, A., Arunachalam, V.S., Asundi, J. & R. Fernandes (2001), 'The Indian Software Services Industry', *Research Policy*, 30, 1267-1287.

Arora, A., & S. Athreye (2002), 'The Software Industry and India's Economic Development', *Information Economics and Policy*, 14, 253-273.

Basile, R. (2001), 'Export behaviour of Italian manufacturing firms over the nineties: the role of innovation', *Research Policy*, 30, 1185-1201.

Bhaduri, S., & A.S. Ray (2004), 'Exporting Through Technological Capability: Econometric Evidence from India's Pharmaceutical and Electrical/Electronics Firms', *Oxford Development Studies*, 32 (1), 87-100.

Chakraborty, C., & C. Jayachandran (2001), 'Indian Software Industry: Structure, Trends and Constraints', *Journal of Services Research*, 1(2), 73-94.

Dosi, G., Pavitt, K., & L. Soete (1992), *The Economics of Technical Change and International Trade*. Brighton: Harvester-Wheatsheaf.

Fagerberg, J. (1987), 'A Technology Gap Approach to Why Growth Rates Differ', *Research Policy*, 16, 87-99.

Fagerberg, J. (1988), 'International Competitiveness', *Economic Journal*, 98, 355-374.

Greene, W.H. (2002), *Econometric Analysis*. Delhi: Pearson Education Asia.

Grossman, G.M., & E. Helpman (1991), *Innovation and Growth in the Global Economy*, Mass, MIT press.

Gujarati, D.N. (2003), *Basic Econometrics*, fourth ed. New Delhi: MacGraw-Hill.

Hufbauer, G.C. (1966), *Synthetic Materials and the Theory of International Trade*, London, Gerald Duckworth.

Heeks, R. (2007), 'Using Competitive Advantage Theory to Analyze IT Sectors in Developing Countries: A Software Industry Case Analysis', *Information Technologies & International Development*, 3 (3), 5-34.

Henley, J. (2006), 'Outsourcing the Provision of Software and IT-Enabled Services to India: Emerging Strategies', *International Studies of Management and Organization*, 36 (4), 111-131.

IBEF (2006), 'Information Technology', a report by KPMG for India Brand Equity Foundation (IBEF*)*, [accessed 28th September, 2007] from *http://ibef.org/download/IT_sectoral.pdf*

Krugman, P. (1979), 'A Model of Innovation, Technology Transfer and the World Distribution of Income', *Journal of Political Economy*, 87, 253-266.

Kumar, N., & N.S. Siddharthan (1994), 'Technology, Firm Size and Export Behaviour in Developing Countries: The Case of Indian Enterprises', *The Journal of Development Studies*, 31 (2), 289-309.

Narayanan, K. (2006a), 'Technology Acquisition and Export Competitiveness: Evidence from Indian Automobile Industry', in Tendulkar, S.D., Mitra, A., Narayanan, K., Das, D.K. (Eds.), *India: Industrialization in a Reforming Economy* (pp. 439-470), New Delhi, Academic Foundation.

Narayanan, K. (2006b), 'Technology Acquisition and Competitiveness: Evidence from Indian IT industry', paper presented at *International Seminar on 'Knowledge-Based Industries, Employment and Global Competitiveness'* organized by the Forum for Global Knowledge Sharing during October 6-7, 2006, Delhi, India.

Nelson, R.R., & S.G. Winter (1982), *An Evolutionary Theory of Economic Change*. Cambridge: Harvard University Press.

Ozcelik, E., & E. Taymaz (2004), 'Does innovativeness matter for international competitiveness in developing countries? The case of Turkish manufacturing industries', *Research Policy*, 33, 409–424.

Parthasarathy, B. (2004), 'Globalizing Information Technology: The Domestic Policy Context for India's Software Production and Exports', *Iterations: An Interdisciplinary Journal of Software History*, 3, [Accessed 28th September, 2007] from http://www.cbi.umn.edu/iterations/parthasarathy.pdf

Patibandla, M., & B. Petersen (2002), 'Role of Transnational Corporations in the Evolution of a High-Tech Industry: The Case of India's Software Industry', *World Development*, 30 (9), 1561-1577.

Pavitt, K., & L. Soete (1980), 'Innovative Activities and Export Shares: Some Comparisons between Industries and Countries', in Pavitt, K. (Ed.), *Technical Innovation and British Economic Performance* (pp. 38-66), London, The MacMillan Press Ltd.

Pradhan, J.P. (2007a), 'Growth of Indian Multinationals in the World Economy: Implications for Development', ISID working paper No. 2007/04, Institute for Studies in Industrial Development.

Pradhan, J.P. (2007b), 'How do Indian Multinationals Affect Exports from Home Country?', ISID working paper No. 2007/07, Institute for Studies in Industrial Development.

Pradhan, J.P. (2007c), 'National Innovation System and the Emergence of Indian Information and Software Technology Multinationals', ISID working paper No. 2007/09, Institute for Studies in Industrial Development.

Posner, M.V. (1961), 'International Trade and Technical Change', *Oxford Economic Papers*, 13, 11-37.

Siddharthan, N.S., & S. Nollen (2004), 'MNE Affiliation, Firm Size and Exports Revisited: A Study of Information Technology Firms in India', *The Journal of Development Studies*, 40 (6), 146 – 168.

Sterlacchini, A. (1999), 'Do innovative activities matter to small firms in non-R&D-intensive industries? An application to export performance', *Research Policy*, 28, 819–832.

Vernon, R. (1966), 'International Investment and International Trade in the Product Life Cycle', *Quarterly Journal of Economics*, 80, 190-207.

Wakelin, K. (1998), 'Innovation and export behaviour at the firm level', *Research Policy*, 26, 829–841.

Wignaraja, G. (2002), 'Firm Size, Technological Capabilities and Market-oriented Policies in Mauritius', *Oxford Development Studies*, 30(1), 87-104.

Zhao, H., & S. Zou, (2002), 'The Impact of Industry Concentration and Firm Location on Export Propensity and Intensity: An Empirical Analysis of Chinese Manufacturing Firms', *Journal of International Marketing*, 10(1), 52-71.