Comparative Performance of Foreign Affiliates of Multinational Enterprises and Domestic Firms in the Indian Non-Electrical Machinery Industry: Applications of Linear Discriminant Analysis *versus* Probabilistic Models

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Introduction

The issue of divergence in the conducts and performance of Foreign Affiliates of Multinational Enterprises (FAs) and Domestic Firms (DFs) has considerable importance for the policy and decision makers in the host developing countries and for the researchers interested in the study of Multinational Enterprises (MNEs) as a separate field of enquiry. One of the major reasons for the recent interest in this topic is that the world over governments in their respective countries are undertaking substantial effort and devoting large amounts of resources in the promotion of inward foreign direct investment (FDI) through its major vehicle the MNEs. This is based on the belief that FAs are superior to DFs in terms of their holding of firm-specific assets (FSAs) and several measures of performance such as efficiency and exports (Kobrin 2005). Therefore, locating more FAs in the host developing economies may lead to direct benefits on account of increased number of better performing firms with superior FSAs. Besides, the presence of FAs in the host developing economies may indirectly cause benefits to DFs through horizontal and vertical linkages and by improving their efficiency level and export performance through increased competition and knowledge spillovers (Smeet 2008 and Görg and Greenaway).

In view of the above, it is important to understand the origin, nature and the direction of the differences between FAs and DFs and the effects foreign ownership of the firms have on a host developing economy, particularly to its domestic sector. The extant literature suggests that the differences in the characteristics of FAs and DFs and the impacts of the presence of FAs in terms of generating linkages and knowledge spillovers are contextual, i.e., country or industry specific [Dunning (2000), Lall and Narula (2004), Jungnickel (2002) and Bellak (2004)].

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In view of substantially increased attractiveness India for FDI and paucity of firm-level and industry-specific studies, this study attempts to identify various firms' characteristics, conducts and performance, which could enable a firm to fall in one of the ownership categories, FAs or DFs, in an industry. Specifically, the objectives of this study are to empirically examine: a) the differences in FAs and DFs in terms of the major aspects of characteristics, conducts and performance of a firm which are captured by the several variables: firm size (SZ), age (AGE), financial leverage (LEV), advertisement and marketing intensity (AMI), capital intensity (CAPI), research and development intensity (RDI), intensity of import of disembodied technology (MTI), intensity of import of intermediate goods used for production (MI), export intensity (XI), technical efficiency (TE) and gross profit margin (GPM).

b) The determinants of probability of the firms to appear as FAs in terms of the above firm-level variables, while controlling for the sub-industry level influences so as to know if MNE affiliations make significant difference between the two ownership groups of firms.

The plan for the rest of the chapter is as follows. In section-2, we briefly discuss about scope including the industry and period selected for the study. Section-3 reviews the relevant literature and formulates various hypotheses on individual aspects of discriminating characteristics of DFs and FAs and probability of a firm to fall in the category of FAs (or DFs). Section-4 identifies major characteristics of the data and sample drawn for the study. Section-5 explains the statistical methods and econometric procedures used for the study. Section-6 analyses, discuses and compares the results obtained from the use of group mean t-test, Linear Discriminant Analysis (LDA) and the estimation of binary outcome probabilistic (probit and logit) models. Section-7 presents the summary and conclusions of the study.

2. Scope of the Study

2.1 Indian Non-electrical Machinery Industry-The Focus

Keeping in view the contextual nature of the benefits of FDI, we selected only one industry that is the Indian Non-electrical Machinery Industry (NEMI) - a medium/high technology industry of an emerging economy- for this study. Selection of only one industry enabled us to reduce heterogeneity across industries arising out of differing product profiles, levels of product differentiation, industry specific

policies, tax and tariff rates, levels of backward and forward integration, capital intensity, levels of technological capabilities, export orientations, etc. Focusing on only one industry also reduces heterogeneity in FDI, including the types and motives of FDI.

Indian NEMI represents *manufacture of machinery and equipment n.e.c*. that is the division 28 in National Industrial Classification: All Economic Activities-2008 (NIC-2008). The division-28 comprises two types of machinery producing industries, namely, general-purpose machinery (or group 281) and special purpose machinery (or group 282) at three digit level of classification. We thus define Indian NEMI as the amalgamation of these two groups of industries.

The major reasons for the selection of Indian NEMI *inter alia* were the following: a) Being a major part of the capital goods industry, it can be the important source of innovations and higher value addition. It generally has higher margins and growth prospects as compared to the mature low-technology industries, in which intense competition has shrunk margins and lowered growth prospects. Being a technology and skill intensive industry, it could also generate significant intra-industry and inter-industry externalities and linkages.

b) Indian NEMI is relatively under-studied, especially in terms of micro level impact of FDI on its performance. Besides, there exists no firm-level study to the best of my knowledge that employs common sample of panel data for the recent period and uses sophisticated econometric methods for simultaneous examination of several important aspects of comparative behaviour and performance of DFs and FAs and the efficiency and export spillovers to the former arising from the presence of the latter in the Indian NEMI.

c) NEMI produces higher value-added products, acts as an important source of innovation and creates strong forward and backward linkages, therefore, the growth of this industry was considered important by the Indian policy makers.

d) Along with the adoption of outward oriented growth strategy and economic reform measures implemented since the year 1991, Indian NEMI has been exhibiting certain problems including inadequate technological capability, lack of international competitiveness, global marketing and customer orientations, management and operational inefficiencies, higher propensity to import than the domestic production, etc.

e) Indian NEMI has been receiving lower level of FDI compared to the other closely related medium/high-tech industries (viz. electrical machinery and transport equipment) in the post-reform period. As a consequence, during the period of study, FAs as a group constituted only about 20 per cent in the aggregate sales of this industry whereas FAs' shares are quite high in the other closely related industries, 41 per cent in the automobile and auto ancillaries and 42 per cent in the electrical machinery

f) Since NEMI is categorised as the medium/ high technology industry, the MNEs could contribute in this industry in a better way either by setting up Greenfield ventures or by offering latest technology, management and marketing expertise, international business contacts and market intelligence.

g) Traditionally, USA, Germany and Japan have been the largest suppliers of NEMI. Of late, Asian countries such as China, South Korea and Taiwan are also emerging as the important players in the production and export of NEMI. Consumption of NEMI has also increased substantially in the developing Asian countries due to their thrust on the value-added manufacturing. The shifting base of machinery and equipment production from the developed to developing countries is also providing major opportunities of production and exports from technologically advanced countries of the developing economies like China, India, South Korea, etc. However, India's share in world's total production NEMI is still insignificant 1.4 per cent, indicating ample scope for expansion in its market share. On the other hand, the countries like China and South Korea respectively share 7 per cent and 4 per cent in the world’s total production of NEMI.

2.2 Period

The specific time period of our study covers seven financial years (FY) 2000/01 to 2006/2007. During this period India has become one of the most attractive destinations for FDI. There has been no major change in policies affecting the Indian NEMI. Yet, the first 4 years of this period were characterized by slow growth in the Indian NEMI and the remaining period was marked by a significantly higher growth compared to the first period. Empirically, this suggests that we should control for time effect in the proposed econometric analysis. The period of study is also important from the point of view of Indian companies adopting better accounting standards, which has made the presentations and descriptions of financial statements

more detailed, transparent, accurate and uniform across the firms. As our study uses firm-level data originally sourced from the annual reports of the companies, these developments add additional feature to our study over the studies that have used data pertaining to the period prior to the year 2000.

3. **The Literature, Hypotheses and Variables**

The eclectic theory of FDI suggests that FAs and DFs may differ in terms of their competitive advantages based on the ownership or access to *monopolistic advantages*, possession of a bundle of scarce, unique and sustainable *resources and capabilities* and *competence* to identify, evaluate, and harness resources and capabilities from throughout the world and to integrate them with their existing resources and capabilities (Dunning 2000). This literature also points out that the competitive advantages of FAs over DFs are partly generic but partly context specific (Ibid).

More specifically, the recent literature suggests the following factors to be generally important in creating the overall differences in the characteristics of FAs and DFs. First, FAs generally have privileged access to two types of superior FSA of MNE. The first category of assets is named as *technology type assets* including machinery and equipments and skilled labour who operate them. The technology-type assets can easily spillover to DFs from FAs and the latter may lose competitive advantage derived from these assets in a short span of time. However, the FAs can maintain their competitive advantage based on *transaction-type* FSA for much longer period or until the DFs also become multinational in their reach (Lall and Narula 2004).

Second, FAs may be more flexible and aggressive in utilising the FSAs, not being hindered by the inertia that derives from being integrated into the local system, and associated path dependent political and social obligations (Wang and Yu 2007).

Third, FAs may specialize in a narrow range of activities and operate at a higher end of industry requiring better technology, skills and OMPs. Thus, the characteristics of the industry segments may be important in determining their presence.

Fourth, MNEs may have acquired indigenous firms having better FSAs and displaying better performance (than the average DFs in the industry) in terms of R&D, exports, productivity and profitability performance (Bellak 2004a). This implies that the FAs' superiority in their average performance may partly stem from the superiority of the acquired DFs.

Fifth, to the extent positive gaps exist between developed and developing countries in terms of corporate culture, level of technology, factor endowments and productivity, these gaps may also reflect in the conducts and performance of FAs with headquarters in the developed countries and DFs based in the developing economies (Bellak 2004a).

Sixth, by combining location-specific advantages and working in the institutional set up and policy environment applicable to a host country, FAs may develop their unique set of advantages by enhancing and modifying the FSAs received from the MNEs. The institutional perspective of business strategy emphasizes that the resource endowment of the host economy and its institutional framework moderate the characteristics of FAs, facilitates the development of their resources and capabilities and even generate new capabilities and new markets opportunities, especially in the emerging economies (Meyer et al. 2009). Rugman and Verbeke (2001), for example, argue that export from a particular FA may arise from affiliate specific regional advantages that are grounded in FSA acquired from both the parent and location-bound advantages.

During the decades of 1990s and 2000s, there has been a growth in empirical literature on relative performance of FAs and DFs in the manufacturing sector of developed and developing economies. These studies have mostly used firm-level data and econometric methods. In the case of developed countries, there have been a few important studies surveying relatively recent literature on the subject. We focus here on the findings of two important surveys. The first one, Jungnickel's (2002) edited volume of studies, compares the behaviour of FAs and DFs in a number of European countries. Second one, Bellak's (2004) survey, based on the 54 studies mainly using firm-level data in panel framework, compares the various aspects of performance chiefly for the industries based in the developed. The research papers in Jungnickel's (2002) edited volume (e.g. Bellak and Pfaffermayr 2002) predominately address both

the theoretical and methodological issues associated with comparison between FAs and DFs. They also empirically tests the differences between FAs and DFs in terms of selected indicators, such as productivity, wages and R&D. Jungnickel (2002) arrives at two major conclusions: First, the real difference in behaviour and performance lies between FAs and uni-national DFs and not between FAs and multinational DFs. Second, the comparison between FAs and DFs is inherently context specific, and hence there are different finding in different countries, industries, etc.

Bellak (2004) reports that: a) the superior economic performance of FAs over DFs is observed in the areas of productivity, technology, wages, skills and growth rates but mixed results in case of profitability; b) the performance gap, however, disappears when firm and industry characteristics are controlled; c) the gap is more perceptible between FAs and uni-national DFs than between the FAs and multinational DFs in a host country. Despite the availability of plenty of studies, we find that the most of the scholars focus on one or a few aspects of firms' characteristics and performance at a time in a study. There are of course few studies that have tried to examine the differences between FAs and DFs in terms of the several aspects of firms' characteristics in a single framework. We now turn towards these studies.

Two noteworthy Indian studies, Kumar (1991) and Ray and Rahman (2006), have examined the differences in many aspects of firms' behaviour and performance by using the statistical technique of linear discriminant analysis (LDA). Kumar (1991) empirically examines the issue of differences in the relative conducts and performance of FAs and DFs in the 43 Indian industries for the early 1980s. The finding of this study reveals that the FAs are more vertically integrated; have higher access to fund; operate at larger scales; employ more skilled personnel; earn higher profit margin; and have product differentiation advantage over their domestic rivals. Based on these results, Kumar (1991) concludes that the FAs' possession of significantly higher amount of intangible assets (compared to DFs) enables them to pursue *non-price mode of rivalry* including product differentiation strategies for maximising the revenues from these assets. This study, however, is dated and uses aggregated firm-level data for an ownership category in an industry. In such types of studies, the use of firm-level (or sometimes plant level) data is considered appropriate (Bellak and Pfaffermayr 2002).

In a relatively recent firm-level study, Ray and Rahman (2006) evaluate the discriminating conducts of foreign and local enterprises mainly in terms of innovative activities and in establishing linkages with the domestic (or foreign sector) sector.[i] The study uses a stratified random sample of 338 firms, each one with at least Rs. 40 crore of annual sales turnovers for the year 1997/98, belonging to the Indian chemical, electronics and transport equipment industries. The findings of this study suggest that: a) FAs spend more on import of disembodied technologies than DFs; b) they however do not significantly differ in terms of R&D intensity, indicating that FAs do not make efforts to adapt their technologies to the Indian condition; b) FAs foster backward horizontal linkages with local suppliers of final goods but make less efforts to develop backward vertical linkages. Although Ray and Rahman's (2006) study uses firm-level data, it excludes performance aspects and does not include Indian NEMI in the scope of their study. Moreover, they are unable to control industry or sub-industry level influences on the categorical dependent variable capturing the foreign or domestic ownership, probably due to the limitation of LDA.

Based on the above discussions, we can formulate the following hypothesis constituting the core of the analysis.

FAs and DFs differ in terms of certain aspects of their conducts and performance due to the ownership of or access to firm specific assets and their effective utilisation in the context of Indian NEMI.

and/or

The firms with certain characteristics are more likely to appear as FAs than DFs

However, the individual aspects of firm characteristics, conducts and performance between FAs and DFs are equally important. Therefore, we need to have sub-hypotheses on likely differences on the individual aspects. Further, we predict that the likelihood of a firm to appear as FAs (or DFs) also depends on the relative characteristics of various sub-industries of the Indian NEMI. Hence, the following sub-sections summarises the theoretical arguments and the findings of empirical literature pertaining to the individual aspects of relative conducts and performance of FAs and DFs and accordingly forwards testable hypothesis for this study.

***Capital Structure* or *Financial Leverage* (LEV)**

Capital structure determines a firm's value and refers to the way a company finances its assets through some combination of debt and owned fund. Therefore, capital structure of a firm is represented by various measures of financial leverage (e.g. long-term debt to networth or long-term debt to total assets). Since the seminal work of Modigliani and Miller (1958), alternative theories of capital structure have been developed which include trade-off theory, the pecking order theory and the agency theory. Besides, a plethora of empirical research has been done to identify the determinants of corporate capital structure and financial leverage. These researchers have identified firm size, age, growth prospects, profitability and retained earnings, volatility in earning, tangibility of assets (proportions of fixed assets in total assets), non-debt tax shield (NDTS)[ii], asymmetry in information and agency cost, bankruptcy, business and foreign exchange risks, as the major determinants of corporate capital structure and financial leverage (Akhtar and Barry 2009).

As the FAs and DFs may differ in respect of some of these determinants of capital structure (or financial leverages), we expect FAs and DFs to differ in terms of financial leverage. In comparison to DFs, FAs being part of MNE system are expected to have lower volatility in their earnings and increased access to international capital market, both of which, in turn, would enable FAs to sustain a higher level of debt without increasing their default risk (Shapiro 1996; Eiteman et al. 1998, pp. 583-606).

In contrast to the above, the following arguments suggest financial leverage in FAs to be lower than that in DFs: First of all, as per the Myers's (1984) *pecking order theory* of capital structure, if a firm is more profitable, it is more likely that it would finance its assets more from the internal sources (e.g. retained earnings which is part of networth or owned fund of a firm), which is easier, readily available and more cost effective than the external sources. As FAs are expected to be more profitable than the DFs, the former may retain lower financial leverage. Secondly, the financial and fiscal expertise coupled with multinationalisation enables better utilization of taxation regulations across countries and reduction in tax liabilities in MNEs, implying FAs can have higher NDTS than the DFs (Singh and Hodder 2000). As the tax benefits of maintaining higher leverage are relatively less valuable for firms with higher NDTS, the FAs (i.e. firms with higher NDTS) are expected to have lower financial leverage than DFs. Finally, firms with higher *agency costs* of debt are

expected to have lower debt levels (Jensen and Meckling 1976; Doukas and Pantzalis 2003). FAs' agency costs are expected to be higher relative to DFs due to higher auditing costs, language differences, and varying legal and accounting systems (Burgman 1996). In sum, since the some determinants of capital structure vary between FAs and DFs, the former may have different capital structure than the latter.

There exist several empirical studies comparing capital structure of MNCs and DFs but all of them are based on the experience of the developed countries. These studies [e.g. Akhtar and Barry (2009) for Japan; Lee and Kwok (1988), Burgman (1996), Homaifer et al. (1998), Chen et al. (1997), Chkir and Cosset (2001) and Doukas and Pantzalis (2003) for USA] report that FAs are less leveraged than the DFs. Mittoo and Zhang (2008), however, find that the Canadian MNEs have higher financial leverage relative to their domestic counterparts. A study by Akhtar (2005) did not find significant difference in level of leverage between Australian MNCs and Astralian DFs. Hence, the majority of the studies report FAs to be less leveraged than DFs.

In view of the above reasoning and findings, we hypothesize in the context of Indian NEMI that: i) FAs, as compared to DFs, will be less financially leveraged, and ii) firms with lower value of financial leverage shall have the higher probability to appear as the FAs.

***Firm's Size* (SZ)**

The size of a firm is a complex variable and may reflect the influence of several factors, including the amount of resources owned by a firm. Firm size is an indicator of managerial and financial resources available in the firm, and to the extent that excess resources are available, a firm will look for opportunities for expansion (Penrose 1959). Besides capturing amount of resources owned by a firm, the large size acts as an advantage in attracting bigger clients, gathering and processing of information, achieving economies of scale and scope in production and marketing, exerting political pressure and winning favours from the government (Mueller 1986, p.139). As substantial resources and sunk cost are involved in establishing and operating in a foreign location, FAs are likely to be larger than DFs. Some studies in East Asian countries have found that FAs tend to be relatively large in comparison to DFs (see Ramstetter 1999a; Takii and Ramstetter 2003).

We hypothesise that i) the average size of FAs would be greater than that of DFs, and ii) firms with greater size have probability to appear as FAs.

Firm's Age **(AGE)**

The oldest and biggest firms in the Indian NEMI are a few public sector enterprises set up by the GoI (see Chapter-3 of this thesis). Yet, a major portion of the industry, being part of the high priority and high technology sector, has been open to foreign participation with minority equity holding of up to 40 per cent even before 1991 under the old industrial policy regime; and at least for 51 per cent foreign equity participation on automatic basis since July 1991 under the new industrial policy (Kapila 2001, Chapter 19).[iii] Private including foreign participation in this industry has been increasing after the year 1991 at the cost of public sector participation.

Hence, we may not find any significant difference in the average age of FAs and DFs. We also predict that the probability of a firm to appear as FA may not be significantly affected by the age of the firm.

Choice of Technique **(CAPI)**

The choice of technique (or technology) of production used by a firm in an industry is generally captured by its capital intensity. Theoretically, all the firms belonging to an industry, by reasons of common technology, are expected to operate with the same level of capital intensity. However, the capital intensity of FAs may be higher than that of DFs for the following reasons. First, DFs economize on use of capital (than labour) in developing countries because they generally face higher cost in raising capital (than FAs) in the external market. The opportunity for accessing capital for DFs based in a developing country is mostly limited to the domestic market, while FAs have better capabilities and opportunities to raise capital and spread risk globally. However, capital is normally expensive in the domestic market of the developing countries. Therefore, DFs have to rely more on expensive capital being available in the domestic market. Even if DFs of a developing country can access capital from the international market, they have to normally pay higher rate of interest or service charges than that paid by the FAs. Due to the better corporate image of MNE system, DFs are sometimes crowded out by FAs even in their own domestic market. Hence, cost of raising capital domestically or internationally is generally higher for DFs in relation to FAs. Besides, FAs can also access cheaper

internal sources of credit (e.g. the cash flow of the MNE-network) without paying a risk premium (Oulton 1998).

Secondly, the MNEs originating in the developed countries have comparative advantage in producing capital-intensive goods. Therefore, their FAs may have affinity towards more capital-intensive industries or more capital-intensive segments of an industry. MNE critics often allege that FAs do not adapt their capital-intensive technique of production to the labour abundant conditions of developing countries (Jenkins 1990). The reasons being that: i) FAs are able to pass on the higher cost of inappropriate technology to the customers due to their market power, ii) there may not be adequate demand for the product so as to justify the FA's investment in adjusting the product to the comparative advantage of the host developing country (Jenkins 1990).

Earlier empirical researches have focused maximum on the choice of technique aspect of the comparative behaviour of foreign and local firms in the developing countries. Based on a survey of a large number of empirical studies pertaining to the developing countries, Jenkins (1990) report mixed results but find considerable evidence about FAs to be more capital intensive than DFs in the manufacturing sector of Latin American countries, India, Pakistan, South Korea and Kenya. He concludes that when local and foreign firms are often in direct competition, producing similar products at similar scale of output, both ownership groups tend to employ equally capital-intensive techniques. There are not many studies examining the issue of choice of techniques for the period of 1990s and 2000s. However, the studies by Ramstetter (1994, 1999a) for Thailand and other East Asian countries and Ngoc and Ramstetter (2004) for Vietnam suggests FAs to be relatively more capital intensity than DFs.

We hypothesise that the capital intensity of FAs would be higher than that of DFs and more capital-intensive firms will have greater probability to appear as FAs in the Indian NEMI.

Research and Development Intensity **(RDI)**

MNEs are well suited for technological innovations and commercialization of technology generated by other agencies (e.g. research laboratories, universities, etc.) because they have easier and larger access to financial resources and firm-specific assets, the ability to tap the global market for scientific and technical personnel, and

to organize R&D and to utilise technological assets worldwide (Dunning 2000). Overwhelming literature on the internationalization of innovative activities suggests that the MNEs tend to conduct little R&D outside their home base. The MNE literature (see e.g. Castellani and Zanfei 2006, Chapter-1 and Dachs et al. 2008) offers the following explanations for the centralization of the major part of R&D activities at the headquarters of MNEs and for conducting only a minor part of R&D activities by FAs in the host countries.

First of all, R&D generated products and firm-specific assets, including new products or processes, are mostly created and tested at the respective headquarter locations of MNEs due to: a) the person embodied nature of knowledge, b) the high level of uncertainty associated with the development and testing of new products/processes, c) the strong complementarities between the knowledge base of MNEs and the technological competency of the home-based innovation system, d) the economies of scale and scope in knowledge production.

Secondly, FAs have privileged access to the stock of technology and R&D laboratories located at their respective headquarters. Therefore, FAs need to undertake only *asset exploiting* kind of R&D activities, involving minor expenditure for absorbing the technology and adapting intermediate goods obtained from the MNE systems and for customisation of final products to the peculiarities of local demand, regulations and standards of the host countries.

Thirdly, since technology is a main source of competitive advantages of MNE system, centralisation of R&D activities at home location enables maintenance of secrecy and avoidance of leakages to their competitors. Fourthly, MNEs by centralization of R&D avoid coordination costs and principal-agent problem, which would result if R&D activities are located in different countries. Finally, there could be a lack of scientific infrastructure and highly skilled manpower, particularly in the developing countries, required for the R&D activities.

Since the 1990s, however, MNEs have been shifting R&D activities from their respective headquarters to the locations of their FAs in select developing countries, including India and China (UNCTAD 2005 and Siddharthan 2009).[iv] It is also reported that the FAs are complementing the traditional *asset exploiting* R&D activities with *asset augmenting* R&D activities (Castellani and Zanfei 2006 and Siddharthan 2009). The *asset augmenting* R&D activities require decentralization of

R&D functions of MNE system for exploiting the technological advantages (e.g. R&D infrastructure and unique accumulated knowledge and inexpensive and high quality skilled workers) available in the high-tech laboratories and industries of the host countries (Kuemmerle 1999). Thus, the *asset augmenting* strategies require FAs to spend more on R&D in their respective host countries in addition to what is required for the *asset exploiting* R&D strategies.

Despite the recent trend in the decentralization of R&D activities a large number of empiric0al studies, relating to both the developed as well as developing countries, reveal that FAs are not more R&D intensive than DFs. In most of the OECD countries FAs are characterized by lower R&D intensities as compared to the DFs (OECD 2005). In a study of five small European countries (Austria, Denmark, Finland, Norway and Sweden), Dachs et al. (2008) find no difference in R&D intensity of FAs and DFs. In a study on major developing countries of East Asia and Latin America, Amsden (2001) found that more the foreign ownership less the depth and breadth of R&D. In the case of Indian manufacturing sector, overwhelming evidences suggest that the R&D intensity of FAs is not more than that of DFs [viz. Kumar and Saqib (1996), Ray and Bhaduri (2001), Pradhan (2002b), Kumar and Agarwal (2005), Ray and Rahman (2006), Ray and Venaik (2008), Kathuria (2008), Rasiah and Kumar (2008)].

In view of the above arguments and findings, we predict that the R&D intensity of FAs would not be greater than that of DFs and R&D intensity may not be significantly related to the firms' probability to appear as FAs in the Indian NEMI.

Intensity of imported Disembodied Technology **(MTI)**

Foreign technological collaborations agreements provide a firm foreign technology in disembodied form, which may include the right to use patents, drawings and designs, technical services, etc. on payment of royalty and technical fee to foreign technology suppliers. In many cases, foreign technologies are transferred with supporting documents and know why. Therefore, these technologies can be assimilated, absorbed and used for production purpose with some amount of in-house technological efforts on the part of firm.

It is normally expected on the basis of FDI theories that FAs should spend less or minimum amount on import of technology, since they have access to technologies generated within the MNE system at free or marginal cost. On the other hand, DFs

should have higher propensity to import disembodied technology than FAs. The reason is that the DFs with their limited resources and expertise are generally incapable of generating new technologies on their own on account of high investment and sunk cost involved in R&D and risk of failure and appropriation associated with the development of new technologies. Therefore, DFs generally prefer to import the foreign technologies often available with MNE system, even if the latter do not sell the latest technologies and put several conditions and restrictions on the use and absorption of technology.

A firm in the Indian NEMI generally uses complex technologies for manufacturing machineries and equipments. Technological capability of a firm in this industry is determined by product design and development capabilities and advanced engineering skills. As the DFs in this industry could not develop these capabilities through in-house R&D, they have depended extensively on import of capital goods and disembodied technologies for building their technological capabilities. On account of automatic approval of foreign technological collaboration agreements and lifting of restrictions on terms of payments and conditions for import of technology in the aftermath of reforms, the firms in Indian NEMI have been heavily depending on import of disembodied technology via foreign technological collaboration agreements (refer to Chapter-3 of this thesis). In fact, Indian NEMI received highest number of approvals for the foreign technological collaboration agreements during August 1991-July 2007 (Ibid).

The empirical literature on transfer of technology in developing countries suggests that FAs tend to spend more on import of disembodied technology than DFs [Ray and Rahman (2006), Kumari (2007), Ray and Venaik (2001 & 2008)]. This may happen for the following reasons: a) MNEs may transfer technologies free of cost only to those subsidiaries in which they have controlling or hundred per cent stake and they may supply technology to other affiliates at higher price; b) the sales of disembodied technologies may boost profit of MNE system as intra-firm trade at transfer prices offers good opportunity to inflate price of the technology and intermediate goods to be supplied to the foreign affiliates; c) MNE system normally allows FAs to undertake only minor kinds of R&D activities, therefore, they obtain free or/and purchase disembodied technologies developed at the headquarters of their respective MNE systems.

It is thus hypothesized that FAs spend greater amount on import disembodied technologies than that of DFs and firms with higher intensity to import disembodied technology will have greater probability to appear as FAs in Indian NEMI.

Advertising and Marketing Intensity **(AMI)**

Advertising and marketing tactics and R&D are considered as the two major elements of non-price strategies followed by MNEs for differentiating their products and competing with their rivals. FAs are expected to follow more intensive advertising and marketing strategies to promote sales of their products than what is followed by DFs. Against this logic, one may also expect FAs to be pursuing less intensive advertising and marketing strategies than those adopted by DFs in the Indian NEMI for the following reasons: i) In the international as well as Indian market, brand equity of products sold by FAs and corporate image of MNE system may have already been established and thereby MNE system to which FAs belong may be well known as a reputed supplier of producer goods. Therefore, it may not be necessary for FAs to spend substantial amount on current advertising and marketing; ii) FAs may be concentrated in segments of NEMI, which may not require substantial advertising and marketing campaign for the enhancement of sales. Instead, these segments may depend more on increased efforts towards R&D for product differentiation and adaptation.

Only a small number of empirical studies have compared advertising intensity of FAs and DFs in the industrial sector and findings of these studies are not conclusive (Jenkins 1990; Kumar and Siddharthan 1997). However, most of these studies do not control for other firm or industry-specific characteristics while comparing the advertising intensity of DFs and FAs (Jenkins 1990). Advertising and marketing, a phenomenon associated with imperfectly competitive market, are used as a means to reduce the scope and effectiveness of price competition by creating product differentiation and strong goodwill for the firm. Advertising and marketing are widely accepted as the most effective methods of product differentiation among firms in consumer goods industry. In a producer goods industry like NEMI, advertising and marketing expenses related to selling of goods may be less important in creating product differentiation. We, therefore, capture product differentiation advantage of a firm in NEMI partly by its advertising and marketing intensity (AMI) and rest by R&D intensity.

In view of the above arguments, we feel that the AMI of DFs and FAs may not differ significantly in the Indian NEMI.

***Export Intensity* (XI)**

FAs have the following advantages over DFs in undertaking exports (Greenaway and Kneller 2007, Kneller and Pisu 2007): First, FAs' access to superior technology and organisational and management practices leads to higher productivity[v], cost competitiveness, better quality and quick delivery of their products and after sale services. Secondly, production and marketing network of the MNE system itself provides an outlet for the intermediate and final products of FAs. Thirdly, entry in third country export market requires incurring sunk cost. Since MNEs are better placed than DFs in terms of financial resources and have already incurred major part of sunk cost by virtue of multinational scope of their operation, FAs may find it easier (than DFs) to penetrate in the international market, particularly in the markets with high barriers to entry or of highly differentiated and technologically sophisticated products. Fourthly, FAs are better equipped to resist protectionist pressures in their home countries in such a way as to favour imports from their affiliates (Helleiner 1988).

Against the above arguments, there are the following reasons to believe that the export intensity of FAs may not be more than that of DFs. First of all, a MNE operates with the help of its worldwide network so as to maximise the global profits but not necessarily the profits of its individual subsidiaries (Hymer 1976). Thus, a parent MNE, which has control over its FAs, may not allow them individually to maximise exports and profits resulting from exports, if these are expected to reduce the MNE's global profitability. This is sometimes accomplished by under pricing the exports from MNE affiliates to parent firm or to other affiliates in the MNE's network.

Secondly, technology transfer and financial agreements between the MNEs and their FAs often include restrictive clauses controlling the export behaviour of the latter. A RBI (1985) study on Indian manufacturing sector has pointed out high incident of restrictive clauses either totally prohibiting or strongly limiting the latter's exports. Thirdly, if the nature of FDI is market seeking, export intensity of FAs and DFs may not differ significantly (Nayyar 1978). Fourthly, if FAs suffer from higher cost of production relative to their parents and others affiliates in the parents network,

their ability to export would be limited (Abdel-Malek 1974). This may happen if FAs are greatly affected by *liability of foreignness* and FAs are unable to develop FAs specific advantage.

Most of the older empirical studies examining the export performance of FAs *vis á vis* DFs in the manufacturing sector of developing countries have shown mixed results and used divergent and unsatisfactory methodologies of comparing FAs and DFs (refer to Casson and Pearce 1987 and Jenkins 1990 the surveys of literature). The recent studies on developing countries which mostly use firm-level data and econometric techniques indicate FAs to be more export oriented than DFs. These studies include Ramstetter (1999a and 1999b) on selected East and South East Asian Countries; Sun (2009), Du and Girma (2007) and Fung et al. (2008) for Chinese manufacturing; Lutz and Talavera (2004) on Ukraine; Jensen (2002) on Poland; Rasiah (2005) for textiles and garments, food and beverages and metal engineering firms in Kenya; Rasiah (2004) for electronics exporting firms in Malaysia, Phillipines and Thailand; Chudnovsky and Lopez (2004) for MERCOSUR countries; Ngoc and Ramstetter (2004) for Vietnam; Rasiah and Malakolunthu (2009) for electronics exporting firms in Malaysia; Wignaraja (2008a) for a sample of clothing firms in Sri Lanka; Correa et al. (2007) for Ecuador. Kumar's (2005) literature survey on Indian studies reveals statistically insignificant difference in the export performance of FAs and DFs during pre-reform period in majority of the cases.[vi]

Indian studies pertaining to post-reform period report mixed results. Employing a cross-section spline regression method, Chhibber and Majumdar (2005) concludes when property rights devolves unequivocally to foreign owners (i.e. with majority ownership of equity) the Indian firms display higher export orientation. In the case of Indian information technology sector, Siddharthan and Nollen (2004) report that the export intensity of FAs is greater than that of DFs. Bhaduri and Ray's (2004) firm-level study provides *weak evidence* on FAs to be more successful in exporting than the DFs in Indian pharmaceutical industry but find no difference in export intensity of FAs and DFs in the case of electrical/electronic industry. Using OLS method, Rasiah and Kumar (2008) report FAs to be better than DFs in terms of export intensity in automotive parts industry. Ray and Rahman (2006) and Ray and Venaik (2008), however, came to the conclusion that FAs are less export intensive

than the DFs belonging to the chemicals, electronics and transport equipment industries.

In view of the above discussions, we hypothesize that: i) FAs are more export intensive than DFs, and ii) more export intensive firms shall have greater probability to appear as FAs.

***Intensity of imported Intermediate Goods* (MI)**

A firm can procure capital goods, raw material, components and spare parts locally or import the same. In the former case, the firm creates backward linkages, which helps in building additional capacities for production of raw material, components and other intermediate inputs, etc. in the host economy. It is said that the FAs have fewer linkages with the host economy than the DFs as the former on the average maintains the higher intensity of imported intermediate goods (MI) than the latter based in the same industry. Based on the literature on FDI and import of MNEs, the following explanations for higher import orientation of FAs over DFs can be offered.

First of all, FAs normally perceive the reliability and quality of supply in the host developing country to be inferior. Therefore, they prefer to source their input requirements including machinery, raw material and components from the MNEs system including parent and its affiliates (Rugman 1981, Hennart 1986). The use of imported and superior raw materials and capital equipments ensures better quality of products leading to barriers to entry (or mobility) through differentiation advantage (Ray and Venaik 2001). The importance of quality factors may be more important in the context of NEMI, since the efficiency of the user industries of NEMI largely depends on the quality, reliability, durability, precision and overall efficiency of machineries and equipments supplied by the NEMI.

Secondly, even if cost, quality and reliability of supplies are the same, a MNE affiliate may prefer to obtain inputs from its parent or parent's network so that the parent can capture supplier's profits and utilize economies of scale in production and distribution. Besides, continuing to import intermediate inputs provides opportunities for transfer pricing which may be lost with local sourcing (Jenkins 1990).

Thirdly, it is possible that the MNE may have preferential access to relevant raw material and machinery used for the production and may be operating in a product segment, which has less vertical linkages in the host's market. Finally, MNEs

may have interest in maintaining high import content to please home country trade unions and the governments respectively worried about jobs and about trade deficits or loss of production and employment to a foreign country (Natke and Newfarmer 1985; Natke 1987).

In the high technology industry such as non-electrical machinery, DFs may also depend on imports for sophisticated machinery, capital goods and other critical inputs but they are less likely to be tied to the overseas supplier. They will attempt to indigenise the imported items as soon as possible so that they can capture the suppliers' profits. In case the inputs are available in the local market, DFs may procure the inputs from the local producers to ensure the timely supply rather than bothering too much about quality of the supply. Further, the DFs may not prefer importing because they may not be well equipped to bear or tackle the uncertainty of exchange rate fluctuations and hassles of importing from the international market about which they obviously have less information than a MNE. Furthermore, DFs normally operate on the lower end of the industry that may not require such sophisticated technologies, capital goods and raw materials, etc. for which they have to depend heavily on import.

The majority of the earlier studies in developing countries reveal that the FAs are more import intensive than DFs (Jenkins 1990 and Siddharthan and Kumar 1997). The latest studies on Indian manufacturing sector and the literature survey therein [viz. Ray and Venaik (2001) and Ray and Rahman (2006)] report that FAs are more import intensive than DFs. In view of the above arguments and the findings of the empirical literature, we hypothesize that FAs may have higher MI than DFs and firms with more import orientation have probability to appear as FAs in the Indian NEMI.

Technical Efficiency **(TE)**

Internalisation approach asserts that, "horizontal MNEs will exist only if the plants they own and operate attain lower costs or higher revenue productivity than the same plants under separate management" (Caves 1996, Chapter 1). Based on this prediction and further developments in literature on comparative performance of foreign and domestic firms, we argue that FAs achieve higher level of productivity/efficiency in comparison to DFs in the same industry. Bellak and Pfaffermayr (2002), Bellak (2004) and others identify the following major reasons for higher productivity/efficiency performance of FAs as compared to DFs: First and

foremost, FAs, being part of MNE system, have access to firm-specific assets[vii] (e.g. newer and superior technology, organisational and management practices) at marginal cost and to the internal market of the MNE systems. Therefore, FAs benefit from the productivity/efficiency spillovers of the system and multi-plant economies of scale. FAs may also develop their unique sets of productivity enhancing FSAs while applying the FSAs accessed from their respective MNE systems to the locational conditions of the host countries.

Second, FAs specialize in narrow spectrum of activities due to strategy of MNEs to fragment the production stages internationally according to the locational advantages of the host countries. FAs normally exist in higher end of an industry requiring intensive use of superior FSA, whereas DFs may exist in lower end of production involving standard technology and lower skill levels. For instances, on account of the availability of cheaper skilled workers in India, FAs may undertake highly technical or core activities with automated production facilities in a sub-industry of NEMI requiring highly trained staff with above average efficiency. As most of the DFs in our sample do not have transnational presence, they are unable to fragment the production stages internationally.

Third, DFs may select and adopt inferior technology while FAs may use frontier technology. For example, import of second hand machinery has increased substantially in India after its liberalisation (refer to Chapter-3 of this thesis). Compared to FAs, DFs may have higher propensity to use inferior machineries for the lack of adequate information about the frontier technology and lack of financial resources needed for acquiring the frontier technology, price sensitivity of their customer, inadequate market size or clientele for the quality products and unavailability of best practice technology due to strategies of the MNEs.

Fourth, MNEs would have formed FAs by acquiring more productive plants or firms possessing unique strategic FSA in Indian NEMI. Therefore, FAs may enjoy higher productivity than DFs.

Fifth, MNEs follow superior corporate governance practices as compared to DFs. Therefore, the top managements in FAs may be under higher pressure to perform and show better efficiency than the management of DFs, especially after MNE's takeover of a local firm through a strategic investment.

Sixth, FAs have access to financial capital of MNE system, which makes financing of the business of FAs easier and cheaper compared to that of DFs.

Seventh, as compared to DFs, FAs generally employ and retain highly skilled workers by paying them higher wages and by constantly upgrading their skills through regular trainings and exposure to best-practices in the industry.

Eighth, since the MNEs have global outlook, they are able to respond quickly to the changes in the policy environment, emerging opportunities and locational advantages of a country. For instances, they may invest and divest plants frequently, achieve better match between locational advantages and FSAs, cherry pick plants/firms with above average productivity in an industry. This is almost impossible by uni national DFs and possible to a much lesser extent by newer MNEs headquartered in a developing country.

Ninth, the gap in the productivity/efficiency between the home country of a FA and the host country may be reflected in the gap in productivity/efficiency of FAs and DFs. Thus, the TE of FAs may also be higher than DFs because FAs are linked to MNEs headquartered in the developed home country and DFs are based in a developing host country like India. It may be noted that the average labour productivity of Indian manufacturing firms are lower compared to the other countries of emerging market economies (Lakshmanan, et al. 2007).

Several studies pertaining to the period 1990s and 2000s for the developing countries report FAs to be more productive than DFs [e.g. Blomström and Wolff (1994) for Mexico; Okamoto and Sjöholm (1999) and Sjöholm (1999a), Takii (2004), Takii and Ramstetter (2003) for Indonesia; Haddad and Harrison (1993) for Morocco; Kokko et al. (2001) for Uruguay; Ramstetter (1999a) for East Asian countries; Chuang and Lin (1999) for Taiwan; Hallward-Driemeier et al. (2002) for various East Asian Countries[viii]; Ngoc and Ramstetter (2004) for Vietnam; Sinha (1993), Kathuria (2001), Ray (2004), Goldar et al. (2004), Sasidharan and Ramnathan (2007) for Indian manufacturing sector].

On the contrary, some studies [e.g. Patibandala and Sanyal (2005) for Indian manufacturing sector; Ito (2002), Ramstetter (1994, 2002b, 2003), Tambunlertchai and Ramstetter (1991) for Thailand; Menon (1998) and Oguchi (2002) for Malaysia; Konings (2001) for Bulgaria and Rumania] suggest that FA are not more productive than DFs.

Gross Profit Margin **(GPM)**

The reasons for higher profitability in case of FAs compared to DFs may be the following (Jenkins 1989). First of all, as discussed in the last sub-section, FAs may enjoy higher technical efficiency/productivity. Secondly, FAs may face favourable demand conditions for their products in developing countries whether they enter into an existing industry (either through Greenfield venture or acquisition) or an entirely new industry. In the case of an existing industry, FAs may set price initially in line with the higher average costs generally prevailing in the industry. Since FAs have cost advantage over existing DFs, the former enjoy surplus profits. In the case of a new industry, where the demand conditions are quite favourable in relation to supply, FAs would be able to charge a high price and thereby earn higher rate of profit.

Thirdly, customers of developing countries may also perceive products of MNEs as superior in terms of non-price attributes such as quality, technological sophistication, reliability, durability, just-in-time delivery and after-sales service even if they may not mind paying higher than market price for the same. Finally, as explained by Kumar (1990), FAs and DFs constitute two different strategic groups in Indian manufacturing sector. Further, the group of FAs enjoys greater protection from "mobility barriers"[ix] and thereby attain greater profitability on account of market power, notably in the knowledge-based industries.

Empirical evidence concerning the existence of profitability differential between DFs and FAs is mixed but in majority of the cases FAs outperform the DFs in terms of profit performance. Jenkins (1989) in his survey concluded that FAs do enjoy higher profitability (than the DFs) based in the manufacturing sector of the developing countries, mainly on account of their productivity advantages and higher demand for their products. However, these studies are quite dated and use rudimentary methods of comparisons. Bellak's (2004) survey includes more recent studies which employ econometric methods for comparing the profit performance of FAs and DFs. However, he too finds mixed results. He explains the reasons for mixed results in terms of differences in the quality of data used across the studies and rent shifting through the use of transfer pricing mechanism adopted by the MNEs.

Some studies in the context of East Asian countries [e.g. Wiwattanakantang (2001) for Thailand, Ramstetter (1999a), Ramstetter and Matsuoka (2001) for other

ASEAN countries] suggest that FAs enjoy higher profitability than DFs. Similarly, Anastassopoulos (2004) in the case of Greek food industry finds that the profitability of FAs to be higher than that of DFs even after controlling for other determinants of profitability. A recent study by Aydin et al. (2007) on all the quoted firms on Istanbul Stock Exchange, Turkey and literature survey therein reveals that the FAs perform better than local firms. In contrast, a study by Barbosa and Louri (2005), employing a quantile regression analysis suggests that foreign ownership ties in general do not make a significant difference with respect to performance of firms operating in Portugal and Greece.

In the context of Indian manufacturing sector, several authors including Kumar (1990), Chhibber and Majumdar (1999) and Douma et al. (2006) reveal significant association between foreign ownership and firm's performance, measured by various indicators of profitability including gross profit margins. Based on the regression analysis of industry level data covering 43 Indian manufacturing industries, Kumar (1990) found that the profits before taxes as a proportion of sales was higher for FAs than for DFs even after controlling for other influences on profitability. He explained the reason for superior profitability of FAs in terms of greater protection enjoyed by FAs from 'entry and mobility barriers' leading to greater market power rather than the higher ability (or efficiency) of FAs.

Chhibber and Majumdar (1999) show that, after controlling for a variety of firm and environment-specific factors, only when property rights devolve to foreign owners, at ownership levels providing unambiguous control at 51 percent, foreign owned firms display relatively superior performance as compared to domestic firms in the Indian corporate sector. Controlling for firm size, age, business group affiliation and industry specific effect, Douma et al. (2006) tested the impact of foreign ownership on performance of 1005 Indian manufacturing firms in 1999 and 2000 by applying OLS multiple regression method. They observed that foreign ownership positively affects the firms profitability measured by return on assets.

Based on the above arguments and on the review of empirical literature, we put forward the following hypotheses. First, FAs may show greater performance than DFs in terms of two important firm-level performance variables, namely, TE and GPM. Second, firms with higher TE and GPM may have greater probability to appear in the group of FAs than in the group of DFs.

***Index of Market Concentration* (IMC)**

Hymer (1976) stresses that the MNEs are prevalent in concentrated markets where the few firms command major share of the sales (Caves 1996, chapter 4). In such markets, sellers are not price takers; and the best response of each seller is conditional upon the actions of other sellers. Lall (1978 & 1979) and others suggest that the operations of FAs are likely to increase the industrial concentration in the long-run and thereby they may be found mostly in the concentrated industries. The following factors are considered chiefly responsible for this phenomenon: (i) inefficient small firms may exit or merge in the face of increased competition from FAs having competitive advantage over DFs; (ii) FAs may use their privileged access to financial resources to outlast their rival by resorting to price and non-price warfare, and predatory practices. The distortions in market for firms considerably favour MNEs in buying out of local companies (Newfarmer 1983); (iii) the conducts of FAs may have an indirect effect on concentration by stimulating defensive amalgamations among DFs and raising barriers to entry for new entrants.

The TCI approach of FDI, however, seems to suggest that entry of MNEs creates more competition and breakdowns the existing oligopolistic structure, particularly in the developing countries. Therefore, it is more likely that FAs are present in less concentrated and more efficient industries. Hence, it is difficult to predict whether firms in a concentrated industry or sub-industry will have more (or less) probability to observe as FAs.

It can be seen from the Appendix-1 of Chapter-3 that the Indian NEMI constitutes 24 product groups which differ amongst each other in terms of the level of top four-firm sellers concentration ratios. A firm in Indian NEMI may predominantly operate in one or in a few of these product groups. Some of these product groups may have more presence of FAs while other may have less. To examine the relationship between market concentration and probability of the firms to appear as FAs, we have devised a firm-specific index of market concentration (IMC), which is a weighted average of the four-firm sellers' concentration ratios of each of the product groups in which a sample firm predominantly operates. The method of construction of IMC is explained in the section 2.4 and the associated Appendix-2

Sub-Industry Level Influences

To minimize the industry-level influences on the probability of a firm to appear as FA, we have selected a single industry, the Indian NEMI. Yet, this industry covers several sub-industries, which may differ among each other in terms of product profile, demand conditions, and the barriers to entry stemming from the technological sophistication, choice of techniques of production, level of product differentiations, minimum efficient scale of production and initial capital required for setting up plant, gestation period, etc. The sub-industries may also differ in terms of productivity, profitability and growth prospects, etc.

MNEs are better placed due to their asset advantages (than DFs) to overcome *barriers to entry* in a host country industry. It is also observed that the MNEs are more attracted towards industries with four characteristics, notably, high levels of R&D relative to sales; large share of professional and technical workers in their work forces; products that are new and /or technically complex; products with high levels of differentiations created through advertising, marketing and other means (Markusen 1995, UNCTAD-WIR 2005). Hence, a firm has probability to appear as FAs, it belong to a sub-industry of Indian NEMI with higher barriers to entry and with above characteristics. To capture sub-industry specific characteristics, we construct 7 sub-industry specific dummy variables (SID1,…,SID7) corresponding to the 7 sub-industries (SI1,…,SI7). The sub-industry SI0 acts as the reference industry.

The methods of construction and measurement of the variables are explained in the Appendix-1.

4. Data and Sample

We obtained basic data on a number of financial and non-financial parameters for each year of the study for designing various indicators to capture conducts and performance of a firm for carrying out the empirical exercise. The major portion of this data and information was sourced from the PROWESS database - an electronic database on information about the financial statements and various other aspects of Indian firms designed by the Centre for Monitoring the Indian Economy (CMIE). Data sourced from the PROWESS was supplemented and sometimes cross checked by obtaining relevant information from additional sources and publications, namely *Bombay Stock Exchange Directory, Annual Reports* of some companies, *Capital Line Ole* (another electronic database) or even by personally contacting the company's representatives in the case of some doubt on data. We also acquired data from

CMIE's *Industry Market Size and Share* chiefly for constructing a variable on the index of market concentration. We also used some price deflators for which data was collected from various publications of the Government of India (GoI). For each year of analysis, we compiled relevant product/industry-wise data on *Wholesale Price Index* (base year 1993-94) from the WPI series published by the Office of Economic Advisor (OEA), GoI. Similarly, we accessed year-wise data on the *All India Consumer Price Index Numbers (General) for Industrial Worker* (base year 1982) from the Labour Bureau, GoI. With the help of compiled data, we designed appropriate firm-level and sub-industry level indicators.

We extracted a list of all firms belonging to the Indian NEMI available in PROWESS database. We included all those firms in the sample for which data on each of the relevant variables were available for at least 2 years of the 7 financial years of the study. Further, we deleted sick companies, i.e., the companies with negative networth in a financial year, mainly with a view to remove outlier effect from the analysis. These exclusions left us with a usable sample of unbalanced panel of 177 firms with 936 observations. The size of overall sample (as well as the size of each sub-sample of DFs and FAs) varies from year to year during the period 2000/01 to 2006/07 of the study.

As a result, we have an unbalanced panel of firms with total number of observations over 2000/01 to 2006/07 aggregating to 936 including 261 for sub-sample of FAs and 675 for sub-sample of DFs. Table-5.1 presents the year-wise distribution of number of all sample firms, DFs and FAs over the 7 years' period of analysis. Table reveals that the number of all firms observed in each year is lower than 177, ranging from 124 to 144 in the various years of the study. Table also shows that the share of FAs in total number of firms has been between the lowest of 26.2 per cent in 2001/02 to 31.2 percent in 2006/07.

Despite sample size being smaller than that of the PROWESS database, share of sample firms in respect of some aspects of corporate financial indicators (say sales turnover or net worth) of the Indian NEMI during the period of the study ranges from 66 per cent to 90 per cent depending on the individual aspects of financial indicators. In particular, sample firms in aggregate over 2000/01 to 2006/07 covered 68 per cent of sales turnover, 90 per cent of gross profit, 85 per cent of net worth, 74 per cent of gross fixed assets, 69 per cent of total assets, 66 per cent of foreign exchange earnings

and 74 per cent of foreign exchange outgo of all the firms belonging to the NEMI as classified in the PROWESS database (Table-2). Considering the fact that PROWESS covers almost entire corporate sector, our sample with such shares on the individual aspects of financial indicators can be considered as the good representative of the corporate sector of Indian NEMI.

Table-3 presents the frequency distribution of number of FAs based on three criteria. Table suggests: a) whether we define a FA based on at least 10 per cent or 26 per cent foreign promoter's equity holding in a company, the number of FAs remain more or less same in each year of the study; b) when we define a FA based on at least 51 per cent equity holding by a foreign promoter, number of FAs in each year of study sharply get reduced in comparison to FA defined by following other criteria.

Although the Indian NEMI is divided into two major segments of general purpose and special purpose machinery at three digit level, each segment can be sub-divided into various sub-industries following the higher digit classification. We categorise Indian NEMI into 8 groups of sub-industries, accordingly Table-4 presents the distribution of the sample firms across these sub-industries. The table shows that *other industrial machinery* (SI7) shares the maximum number in sample of total firms in every year of the study during 2000/01 to 2006/07. In contrast, agriculture machinery constitutes the smallest group in terms of number of firms in every year of the study. In terms of share in the number of firms in each sub-industry, FAs as a group has the highest presence in the prime movers and least presence in *agriculture machinery and implements*.

As discussed in the last section, the sub-industries of Indian NEMI may differ in terms of concentration level the dominant firms. Table-5.5 presents the structure of Indian NEMI over the period of the study in terms of 4-firm concentration ratios applicable to each of the 8 sub-industries of Indian NEMI. These ratios were calculated with help of data obtained from a CMIE's annual publication on Industry Market Size and Share. The table reveals that *pumps, compressors and valves* are least concentrated while *agricultural machinery and implements* is the most concentrated sub-industry. Between the years 2000/01 to 2006/07, the concentration ratios of *prime movers* (diesel engines, turbines, heat exchangers, etc.); *pumps, compressors and valves*; *bearings*; *earthmoving, mining and construction machineries*; and *machine tools* have gone up. On the contrary, the concentration

ratio in the case of *agricultural machinery* (tractors and agricultural implements) and each category of *industrial machineries* has declined.

Besides concentration levels, sub-industry groups of the Indian NEMI may also be different from each other in terms various firm characteristics. Table-6 shows that mean values of various financial parameters, such as GPM, CAPI, XI, MI, RDI, MTI and LEV diverge across sub-industry groups.

As the Indian NEMI is divided into two major segments, general purpose and special purpose machinery, we also try to analyse the relative characteristics of one segment against the other with the help of the data at hand. The segment wise and year-wise net sales during 2000/01 to 2006/07 presented in Table-7 suggest that the share of special purpose machinery in net sales of Indian NEMI has been around 40 per cent. However, this share has been declining over the period of study. To know the differences in the characteristics of special purpose and general purpose machinery segments of Indian NEMI, we individually compare the mean values of a number of variables by way of Welch's t-test, which is detailed in the section 5.1. Table-8 summarizing the results on segment wise distribution of sample size, mean value, standard deviation and t-statistics for differences in mean values, shows that there are significant differences in the mean values of GPM, SZ, XI, CAPI, AMI, MTI and IMC between special-purpose machinery and general-purpose machinery segments of Indian NEMI. On an average firms in special purpose machinery are more profitable, capital intensive, spend more on advertising and marketing for differentiating products. Besides, special purpose machinery segment is also more concentrated compared to the general purpose machinery. However, firms in special purpose machinery segment on an average is smaller in size, less export intensive, pay less as a ratio of net sales on import of disembodied technology as against the firms in general purpose machinery.

Table-9 summarises the descriptive statistics of individual variables used in the study. The descriptive statistics include mean, standard deviations (overall, between and within), minimum and maximum values of each variable. The table reveals that the FCD as well as all the sub-industry specific dummy variables have no within group variation in their respective data. To know the severity of multicolinearity problem associated with the sample, we obtained the matrix of correlation coefficient between a pair of regressors which are presented in Table-10.

We also compute two additional indicators of multicolinearity, variance inflation factor (VIF) and its inverse called tolerance (TOL); the values of each one are given in Table-11. As a rule of thumb if the pair-wise or zero-order correlation coefficient between two regressors is high, say, in excess of 0.80, multicolinearity is considered as a serious problem (Gujarati 2004, p. 359). Again, as a rule of thumb, if the VIF of a variable exceeds 10 that variable is deemed highly collinear (Gujarati 2004, p. 362). In view of these rules of thumb, tables do not reveal any serious multicolinearity problem.

5. Statistical and Econometric Methods

There exists variety of methods that can be used for examining the issues set out in the objectives of the study. The most rudimentary method involves the univariate group mean comparison technique. However, the univariate method compares one characteristic at a time while ignoring a large number of other discriminant factors. Therefore, it would be appropriate to extend/enrich and compare the findings of univariate analysis with the results obtained from multiple variable techniques. The multiple variable techniques have advantage over univariate analysis for the former can consider an entire profile of characteristics common to relevant firms. To classify or make predictions in situations having dichotomous categorical dependent variable, empirical researchers have mainly employed and estimated three types of models, namely, linear discriminant analysis (LDA), logit and probit regression models. The empirical method for univariate analysis is explained in sub-section 5.1 and empirical models associated with the LDA, probit and logit models are presented and explained in sub-section 5.2.

5.1 Univariate Method of Analysis

The first step of this technique involves classification of an observation into one of the several *a priori* groupings based on certain criteria (e.g. the two groups of FAs or DFs in our study are based on the criterion of at least 26 per cent equity holding in a company by the foreign promoters).[x] In the second step, the value of mean and standard deviation of a variable representing particular characteristic of a firm is calculated for the each group. Finally, a suitable statistical technique is used for testing the significant difference in mean value of a particular variable between the two groups. The univariate means comparison method may provide important clues

about differences in conducts and performance of FAs and DFs, but the findings of such analysis cannot be considered conclusive.

To compare each aspects of conduct and performance of two groups of firms in a univariate framework, we conduct Welch's t-test using two-samples having possibly unequal variances. To conduct this test we first of all need to calculate mean and standard deviation of individual variables for each sub-sample of FAs and DFs. Thereafter, we are to obtain t-statistics with the help of STATA software that utilises the following formula:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{s} \quad \text{where } s = \sqrt{\frac{s_1}{n_1} + \frac{s_2}{n_2}}$$

Where $\overline{X_1}$ and $\overline{X_2}$ are the sample means of the FAs and DFs respectively; s_1^2 and s_2^2 are the sample variances of the FAs and DFs; n_1 and n_2 are number of observations in each group. The degrees of freedom (ν) associated with variance estimates are approximated using the Welch-Satterthwaite equation. Once t and ν are computed, these statistics are used with t-distribution to test the null hypotheses (H_o) for each variable that the difference in mean between the groups of FAs and DFs is zero (using a two-tailed test) against the alternative hypothesis (H_a) that the groups have different means. In other words:

H_0: mean (FA) – mean (DF) = diff = 0 against H_a: diff ! = 0

We preferred to use two-tail test because of the possibility that mean of a variable for FAs may be less or more than that of DFs. The tests yields p-value that may (or may not) provide evidence sufficient to reject null hypothesis.

5.2 <u>The Empirical Models of Multivariate Analysis</u>

The linear discriminant function used for the discriminant analysis and the empirical equations corresponding to the theoretical models of LDA, logit and probit, as detailed in the Appendix-2, are presented below:

Linear Discriminant Function

$$Z = b_0 + b_1 GPM_{it} + b_2 TE_{it} + b_3 RDI_{it} + b_4 MTI_{it} + b_5 AMI_{it} + b_6 CAPI_{it} + b_7 SZ_{it} + b_8 AGE_{it} + b_9 LEV_{it} + b_{10} XI_{it} + b_{11} MI_{it} + b_{12} IMC_{it} + b_{13} SID1_{it} +,\ldots,b_{19} SID7_{it} \quad (1)$$

Logit regression

$$Pr = E(FCD_{it}=1|\, X) = 1/[1 + \exp^{-Z}] \quad (2)$$

where, $Z = b_0 + b_1 GPM_{it} + b_2\ TE_{it} + b_3\ RDI_{it} + b_4\ MTI_{it} + b_5\ AMI_{it} + b_6\ CAPI_{it} + b_7\ SZ_{it} + b_8\ AGE_{it} + b_9\ LEV_{it} + b_{10}\ XI_{it} + b_{11}\ IMI_{it} + b_{12}\ MC_{it} + b_{13}\ SID1_{it} +,...,+ b_{19}\ SID7 + v_{it}$ or

$$L = \ln [Pr / (1- Pr)] = b_0 + b_1 GPM_{it} + b_2\ TE_{it} + b_3\ RDI_{it} + b_4\ MTI_{it} + b_5\ AMI_{it} + b_6\ CAPI_{it} + b_7\ SZ_{it} + b_8\ AGE_{it} + b_9\ LEV_{it} + b_{10}\ XI_{it} + b_{11}\ MI_{it} + b_{12}\ IMC_{it} + b_{13}\ SID1_{it} +,...,+ b_{19}\ SID7 + v_{it} \quad (3)$$

Probit regression

$$Pr = E\ (FCD_{it} =1|\ X) = 1- f\ [- (b_0 + b_1 GPM_{it} + b_2\ TE_{it} + b_3\ RDI_{it} + b_4\ MTI_{it} + b_5\ AMI_{it} + b_6\ CAPI_{it} + b_7\ SZ_{it} + b_8\ AGE_{it} + b_9\ LEV_{it} + b_{10}\ XI_{it} + b_{11}\ MI_{it} + b_{12}\ IMC_{it} + b_{13}\ SID1_{it} +,...,+ b_{19}\ SID7 + v_{it})] \quad (4)$$

The LDA is a statistical technique that is mainly used to classify an observation into one of the two *a priori* groups dependent on the observation's individual characteristics. Alternatively, LDA identifies the discriminating characteristics of two groups (say FAs and DFs) of firms based on certain criteria. The equation (1) is estimated for LDA. Equation 2 (or 3) and 4 represent logit and probit models respectively in which $Pr = E\ (FCD_{it} =1|\ X)$ denotes conditional expectation of FCD_{it} given X (a vector of explanatory variables) or conditional probability that a firm will appear as FA given X. The logit model is expressed in two forms, notably by non-linear equation (2) and linear equation (3). In equation 3, the odd ratio Pr/(1-Pr) shows the ratio of the probability that a firm will appear as FA to the probability that a firm will not appear as FA.

The probabilistic models (notable the logit model) are considered as the better substitutes of discriminant analysis. Yet, the estimation results of the probabilistic models are interpreted in a slightly different manner than that of LDA. The probabilistic models, both logit as well as probit regression models, relate a qualitative dependent (usually dichotomous) variable to a set of continuous and/or categorical independent variables. Probit model uses a normal cumulative distribution function (CDF), whereas the logit model employs logistic CDF, to model such relationships between a dichotomous dependent variable and the independent variables (see Appendix-2). In case of this study, both the models estimate the probability of observing a firm in the group of FAs (or DFs). Thus the positive sign of the estimated coefficient of an independent variable in these models will denote that the variable increases the probability of the firm to appear as FA.

Each one of the three models is estimated with the help of unbalanced sample of pooled data on individual variables used in the model. Use of pooled data set of cross-section firms over a period of time provides us with a larger number of data points. Therefore, it increases the degrees of freedom and reduces the co-linearity among explanatory variables and, hence, improves the efficiency of econometric estimates. The panel data models, besides the improving efficiency of econometric estimates, enable us to disentangle the unobserved heterogeneity (or individual effect) from the data, which remain constant over time. Estimation of panel data models requires that there should be within group variation in the dependent variable for adequate number of groups. Despite the superiority of panel data models we are restricted to use only the pooled data model, as our data on FCD does not have any within group variation (see Table-9). The absence of within group variation in FCD also prevented us from using year-specific dummy variables.

6. Results

6.1 Univariate Analysis

Table-12 summarizes the results on mean, standard deviation and tests of equality of group means of FAs and DFs with respect to 11 firm specific variables representing various firm-level characteristics including conducts and performances. T-statistics in respect of each variable is obtained by applying the formula explained in section 4.1. Thereafter, we test the null hypothesis that the difference in mean value of each variable between the two group of FAs and DFs would be zero. The null hypothesis is rejected in the case of 9 variables. The results indicate that FAs, as compared to DFs, on an average achieve greater technical efficiency (TE), gross profit margin (GPM) and export intensity. As compared to DFs, FAs spend higher portion of their revenue on research and development as well as on import of intermediate goods and disembodied technology. As the R&D activity and use of imported technology require higher level of skill, we may assume that skill intensity of FAs are greater than that of DFs. These results probably suggest that FAs do have firm-specific ownership advantage over DFs in terms of technology. In relation to DFs, FAs on an average spend less portion of their revenue on advertising and marketing. In other words, DFs spend more towards creation of product differentiation advantage. In comparison to DFs, FAs are also bigger in terms of their size of their operation. Results on relative AGE and CAPI indicate that FAs and DFs

do not significantly differ in terms of years of operations and choice of technique. As compared to DFs, FAs are also found less financially leveraged, implying that the latter finance their operations more from owned fund than from the borrowed.

As the univariate analysis places emphasis on each individual characteristic independently from the others, it is imperative to build upon the findings of univariate analysis and combine several characteristics in a meaningful predictive model. The next two sub-sections of this chapter undertake this task with the help of LDA and by estimating probabilistic models.

6.2 Linear Discriminant Analysis

Having developed various alternative multivariate models of relative characteristics of FCs and DFs, we first examine the results obtained from LDA. LDA was performed by using SPSS – the popular software for statistical and econometric analysis. Table-13 reports the results related to the suitability of the LDA in three panels, A, B and C. Panel A shows that the eigenvalue and canonical correlation statistics are 0.411 and 0.533 respectively, suggesting that the LDA model is satisfactory at discriminating between the characteristics of FAs and DFs. The Wilks' lambda statistics of 0.71 shows that only 29 per cent variance in discriminant scores is explained by the differential characteristics of FAs and DFs. The Wilks' lambda, however, is found significant. This indicates that we can reject the null hypothesis that the FAs and DFs have the same mean discriminant function scores and thereby conclude that the overall model is discriminating.

Panel B assesses the contribution of each variable to the discriminant function. The results on within group correlations between discriminant variables and standardised canonical discriminant functions indicate that variables SID2, SID4, SID7, SID6, CAPI and AGE make the lowest contributions to discriminant function. We will see later that these variables are also found statistically insignificant in explaining the dependent variable FCD in the probabilistic models. Thus, the selecting a variable on the basis of its level of correlations with the discriminant function may be considered as a good criterion for its inclusion in LDA.

Panel C presents the results on the test of equality of group covariance matrices assuming multivariate normality. Box's M test used for this purpose shows that the null hypothesis of equality in the group covariance matrices can be strongly rejected. This may be due either to a failure of multivariate normality or because the

group covariance matrices are not equal. In either case, the LDA approach, together with linear classification rule is inappropriate for estimating the model. In the case of large sample size, however, even small differences in covariance matrices may be found significant by Box's M when in fact no substantial problem of violation of assumptions exists. Therefore, the researchers also look at the log of determinants of group covariance matrices. If the group log determinants are similar, a significant Box's M for a large sample is usually ignored. Since this study uses the large sample, we also analyse the values of log determinants, which turn out to be dissimilar between FAs and DFs. Thus, we cannot ignore the significance of Box's M and therefore consider the use of LDA less appropriate in the context of our study.

Nevertheless, we present and examine the results of LDA pertaining to the discriminating characteristics of FAs and DFs. In particular, we examine the results of LDA following the Mahalanobis Distance (or D) square procedure. Mahalanobis distance is the distance between a case and centroid for each group of the dependent variable (FAs and DFs) in attribute space (defined by the independent variable). A case will have one Mahalanobis distance for each group and it will be classified as belonging to the group for which its Mahalanobis distance is smallest. Thus, the smaller the Mahalanobis distance, the closure the case is to the group centroid and more likely it is to be classed as belonging to that group. Since Mahalanobis distance is measured in terms of standard deviation from the centroid, a case which is more than 1.96 Mahalanobis distance units from the centroid has less than 0.05 chance of belonging to the group represented by the centroid.

In the stepwise procedure followed by SPSS, the variable that maximises the Mahalanobis distance between the two closest groups is entered at each step. Table-5.15 presents the results obtained from the LDA following the Mahalanobis D square stepwise method. As in the case of Table-13, Panel A of Table-14 shows that model is significant but does not fulfill the criteria of equal population covariance matrices. Focusing on the results incorporated in Panel B of Table-15, we find that out of 19 variables included in the model only 9 variables- TE, SZ, XI, MI, AMI, MTI, LEV, SID1 and SID5- ultimately turn out to be significant discriminator between FAs and DFs in the stepwise procedure. Panel C reports the values of the estimated coefficients associated with each of these variables in the discriminant functions of FAs and DFs. We find that FAs as compared to DFs are more technically efficient,

more export intensive and more intensive in terms of import of intermediate goods and disembodied technology. However, FAs are less leveraged and spend less as a share their sales on advertising and marketing. FAs are also larger than DFs. It is to be noticed that LDA does not find GPM and RDI to be a significant discriminator between FAs and DFs. On the other hand, the univariate analysis has found GPM as well as RDI of FAs to be greater than GPM and RDI of DFs. However, both the univariate analysis and LDA show that the AGE and CAPI are not significant discriminators between FAs and DFs.

We will see in the next section that, despite the unsuitability of LDA for the sample used for this study, the results obtained from LDA are more or less similar to the results found from the estimation of probit and logit models discussed in the next sections.

6.3 Probit and Logit models

Before estimation of probit or logit models, we conducted several tests for detecting heteroskedasticity associated with the variables used in the models. The results of these tests presented in Table-15 show that the assumption of homoskedasticity is invalid. Thereafter, we estimate the probit and logit models represented by the above equations by maximum likelihood technique with the help of STATA software. We also obtain heteroskedasticity-corrected standard errors by following White-Huber method with the help of robust option available in the software.

Table-16 presents the results achieved by the estimations of the logit and probit models using the maximum likelihood methods. We may note at the outset that the estimated logit and probit models offer similar results. The values of pseudo R^2 show that both the logit and probit models achieve same value of 0.26, implying one cannot differentiate between these models on the basis of overall goodness of fit. The values of Wald chi^2 and corresponding p-value of zero suggests that the each (probit as well as logit) model as whole is statistically significant, as compared to model with no regressors. Thus, there is little to choose between probit and logit approaches.

The results on firm-specific variables show that the coefficients of GPM, AGE, CAPI and RDI are statistically insignificant. On the other hand, the coefficients of TE, SZ, XI, MI and MTI are positive and significant and coefficient of LEV and AMI are negative and significant in both the models. Comparing the results of

univariate analysis and LDA against the results of probabilistic models, we find that: a) GPM and RDI differ significantly between FAs and DFs in univariate analysis, while both are not found as discriminating factors between FAs and DFs in LDA. GPM and RDI also do not impact the probability of a firm to appear as FA in the presence of other variables in the both types of the probabilistic models; b) AGE and CAPI do not differ significantly between FAs and DFs in the univariate analysis, LDA and the probabilistic models; c) the signs of the statistical significant coefficients of TE, SZ, XI, MI, MTI, AMI, LEV are identical in every types of analysis; d) two sub-industry specific dummy variables, SID1 and SID5 appear as significant discriminators between FAs and DFs in LDA, but the coefficients of the same are observed statistically insignificant in both the probabilistic models.

As discussed earlier, the multivariate analyses based on probabilistic models are considered more appropriate and theoretically sound, we thus consider the results obtained from the probabilistic model to be the final. We therefore discuss these results elaborately and draw conclusions and policy implications from the same. The estimation results of probit model on the factors that influence the probability of being a firm in foreign ownership also gives marginal effects (Table-16). The marginal effects are calculated for discrete change of dummy variable from 0 to 1 at the sample means and measured in terms of absolute value of a coefficient. Among the statistically significant explanatory variables, the MTI has the greatest effects followed by AMI, MI, TE, XI, LEV and SZ in descending order.

Intensity of imported disembodied technology (MTI) with the highest positive marginal effect indicate that the likelihood of being FA is the greatest for a firm that makes higher payment (as a ratio of its sales) for import of foreign disembodied technology. These results are in line with the findings of several Indian studies cited in the section-2 [e.g. Siddharthan and Krishna 1994, Basant 1997, Kumari 2007, Ray and Rahman 2006, Ray and Venaik 2001 & 2008]. It is paradoxical that the firms with FDI, which are supposed to receive advance foreign technology from the MNE system at no or nominal cost, are spending substantially higher amount (than DFs) on arm's length purchase of foreign technology. In addition, the higher intensity of payment for import of disembodied technology by FAs, coupled with no difference in R&D intensity of FAs and DFs, imply that FAs not only rely more on foreign technological know-how but also do not make major attempts to adapt or absorb the

imported technology. As FAs normally buy technology from their own MNE system, it seems that they over pay for the same in the intra-firm transactions for appeasing their parents. However, this issue needs further investigation which is beyond the scope of this thesis.

The second most important factor explaining probability of a firm to be in foreign ownership is the advertising and marketing intensity (AMI). The significantly negative coefficients of AMI observed in the estimated probit and logit models show that the FAs spend less for creating product differentiation advantage than DFs. This result probably indicates that the already established international image of MNEs and brand equity of their products are requiring FAs in the Indian NEMI to spend less on current advertising and marketing for creating product differentiation advantages. Besides, the FAs gain from the spillovers of the worldwide advertisements of their respective MNEs but do not contribute monetarily for the same. Another reason cited by Ray and Rahman (2006), who do not find product differentiation to be a discriminator between FAs and DFs, is that the threat from the entry of large number of MNEs after liberalisation from 1991 has forced oligopolistic DFs to spend heavily on advertising and marketing for the protection of their market share.

The third factor is intensity of imported intermediate goods (MI). The combined results on higher intensities of import for intermediate good and disembodied technology can also be interpreted as evidence of MNEs' indulgence in intra-firm trade at transfer prices for boosting their global profit. Inflation of payment on royalty and technical fee by FAs has been used as good means for reducing local taxes in the host country and transferring earned profit out of the host country (Lecraw 1983, Bellak 2004a). Our finding on MI is in line with the recent findings in the Indian studies [e.g. Ray and Rahman 2006, Ray and Venaik 2001 & 2008].

Our finding on technical efficiency (TE) is consistent with the prediction of internalisation (or transaction cost) approach of FDI and findings of several empirical studies that the FAs are more productive/efficient than the DFs as cited in the Section-2 [viz. Sinha (1993), Kathuria (2001, 2002), Ray (2004), Goldar et al. (2004), Sasidharan and Ramnathan (2007) for Indian manufacturing sector]. Insignificance and significant coefficients corresponding to GPM and TE in multiple variable analyses suggest that the latter captures the essence of performance in a better way and thereby act as the discriminator between FAs and DFs. Besides, the combined

results on GPM and TE can be interpreted in the following manner. First, MNEs do not acquire firms with monopoly profits reflected as reflected by GPM but acquire technically efficient firms having potential for giving consistently average profits as applicable to the industry. Secondly, the earlier studies that have found profitability to be the important discriminant between DFs and FAs have not used any measure of productivity or efficiency as an additional variable in their multi-variate analysis.[xi] Therefore, their measures of profitability might have also captured the effect of technical efficiency. Thirdly, the motivation of MNEs to minimise their tax burden and thereby show reduced profit, than they actually earn, may be responsible for understating the profits of FAs and thereby the statistical insignificance of the coefficients of GPM in LDA and probabilistic models. This is termed by Bellak (2004) as the accounting factor. Presumably, FAs are better at minimizing their tax burden than DFs owing to the formers' affiliations to the MNE system having better expertise and opportunities in terms of multinational network. Fourth, if opportunity cost of internally generated funds (i.e. retained earnings) are lower than that of externally raised funds, the managers of FAs will accept lower profitability when they use reinvested profits (Bellak 2004).

Significant and positive coefficient of export intensity (XI) suggests that FAs are not only concentrating on the host country market, but also by using the India's locational and comparative advantages, have gained relative competitive advantage over DFs on the export front. This finding is consistent with the findings of the larger set of recent Indian studies [e.g. Siddharthan and Nollen (2004), Chhibber and Majumdar (2005) and Rasiah and Kumar (2008)]. However, our study contradicts the findings of Ray and Rahman (2006), employing LDA, in this respect.

FAs are also found less financially leveraged than DFs, indicating that the FAs use greater amount of internal funds for financing their operations. This support our hypothesis build on the arguments favouring lower financial leverages maintained by MNEs as compared to DFs and empirical evidences on the same from various studies mentioned in section-2. Thus, our study is in line with the finding of the majority of empirical studies which report FAs to be maintaining lower financial leverage than the DFs in the context of the developed countries [see e.g. Akhtar and Barry (2009) for Japan; Lee and Kwok (1988), Burgman (1996), Homaifer et al.

(1998), Chen et al. (1997), Chkir and Cosset (2001) and Doukas and Pantzalis (2003) for USA].

Size of the firm, generally reflecting the firm's ownership of financial and non-financial resources, has positive influence on the firms' probability to appear in the group of FAs (than DFs). Besides, the LDA also shows that the FAs have larger size than DFs. As discussed in section-2, the reason for this could be found in the FAs' ownership of higher amount of financial and non-financial resources to overcome sunk and transaction costs associated with doing business in a foreign location. Our finding on firm size is similar to the findings of studies for East Asian countries [Ramstetter (1999a); Takii and Ramstetter (2003)].

The coefficients of IMC turn out to be insignificant in the estimated probit as well as logit model. This indicates that the probability of a firm's appearance in the group of FAs (or DFs) is not dependent on the market concentration. Similarly, the coefficients of none of the sub-industry specific dummy variables are found statistically significant either in the estimated probit or logit model. These results hint that the FAs do not show any preference for locating in one or other sub-industries of Indian NEMI. This might have happened because the sub-industries of the Indian NEMI may not be differing sufficiently in terms of overall index of characteristics so as to warrant the special attention of MNEs.

7. Summary and Conclusions

The objective of this paper was to empirically examine the differences in the relative characteristics, conducts and performance of two ownership groups of firms, FAs and DFs, in the Indian NEMI during 2000/01 to 2006/07. For this purpose, we first applied the univariate statistical method based on Welch's t-test for comparing the mean value of a variable between two groups of firms. The findings of the univariate analysis revealed that the FAs (as compared to DFs) have significantly greater TE, GPM, SZ, RDI, XI, MI, and MTI. However, in relation to DFs, FAs as a group is found on an average less advertisement and marketing intensive (AMI) as well as less financially leveraged (LEV). T-test did not reveal significant differences between FAs and DFs in terms of the mean values of AGE and CAPI.

Since the univariate method compares one characteristic at a time, we conducted the multivariate LDA. We found that the results of LDA were similar to the univariate analysis in respect of all the firm-specific variables except in the case

of GPM and RDI, as both the variables did not discriminate between FAs and DFs in the presence of other variables. However, the LDA is based on certain restrictive assumptions (viz. normality and equal group covariance matrix in respect of the independent variables), which were found inconsistent with the sample used for this study.

We, therefore, estimated two dichotomous logit and probit models, which do not require the fulfillment of these assumptions. The estimation results of both types of the probabilistic model were identical and almost similar to that of LDA. However, the interpretations of the results obtained from the probabilistic models somewhat differ from that achieved by employing LDA. The findings of the probabilistic models indicated that the likelihood of the firms to fall in the category of FAs is higher if they have the greater technical efficiency (TE), firm size (SZ), export intensity (XI), intensity of import of intermediate goods (MI) and intensity of import of disembodied technology (MTI) but the lower advertisement and marketing intensity and financial leverage (LEV). The result on AMI probably indicates that the previously established international image of MNEs and brand equity of their product are causing FAs to spend less towards advertising and marketing for creating product differentiation advantages *vis á vis* DFs. The result on financial leverage implies that FAs adopt prudential practice of employing greater amount of internal funds (in relation to debts) for financing their operations. Results on relative AGE and CAPI indicate that FAs and DFs do not significantly differ in terms of years of operation and capital intensity of production in the Indian NEMI.

In view of the common significant findings of the multivariate analyses from the LDA and probabilistic models in respect of the several variables, we conclude that our empirical analysis supports the proposition that the FAs and DFs differ in terms of the many aspects of conducts and performance in the Indian NEMI. These findings also give some indications about the quality of FDI that has come to the Indian NEMI during the aftermath of economic reforms. First, it seems that the superior resources and capabilities of FAs confer them higher technical efficiency (but not overall performance or the monopoly power in terms of GPM) and export intensity in relation to DFs. Second, as the intensity of import of intermediate goods in FAs is significantly higher than that of DFs, the former group tends to have fewer linkages with domestic suppliers of intermediate goods including capital goods, raw

material, components and spare parts. In other words, DFs with their activities in the Indian NEMI are providing higher linkages with the indigenous suppliers. Third, the combined results on higher expenses on import of intermediate goods and import of foreign technology by FAs and no difference in gross profit margins between FAs and DFs point out that the FAs are probably engaged in the transfer of profits to the MNE system through intra-firm trade. This aspect, however, require further research which is beyond the scope of this study. Fourth, despite the higher import of intermediate goods and disembodied technologies, FAs are not spending higher amounts on R&D towards adaptation or/and absorption of the imported technology and indigenization of the imported inputs. As a result, R&D intensities of FAs and DFs are the same. Finally, FAs have no preference for locating themselves in one or the other sub-industries of the Indian NEMI, indicating that the sub-industries of NEMI do not differ significantly among one another in term of locational attractiveness in the eyes of MNEs.

Table-1: Distribution of Number of Sample Firms, 2000/01- 2006/07

Year	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	Total
All	130	141	144	132	137	127	125	936
DFs	94	104	107	97	99	88	86	675
FAs	36	37	37	35	38	39	39	261
FAs as % All	27.7	26.2	25.7	26.5	27.7	30.7	31.2	27.9

Sources: Compiled and calculated from the data primarily drawn from PROWESS database and complemented with data from Capital Line Ole and other sources

Table-2: Comparing Sample and PROWESS Database, 2000/01 to 2006/07

(Rs. crore)

Year	2000-01			2001-02			2002-03			2003-04		
Indicator	PROW	Sample	@	PROW	Sample	@	PROW	Sample	@	PROW	Sample	@
Sales	27771	20752	75%	28712	22184	77%	29571	23263	79%	34216	23244	68%
PBDITA	1618	3366	208%	2527	2868	113%	2609	3148	121%	3146	3397	108%
Net worth	10681	10264	96%	10664	11211	105%	11566	12050	104%	13786	12852	93%
Gross fixed assets	15446	10970	71%	15724	11888	76%	16311	12451	76%	16482	12848	78%
Total assets	34686	24506	71%	36556	26131	71%	37936	29149	77%	40680	29618	73%
Forex Earnings	2052	1509	74%	2950	1781	60%	2718	2663	98%	3563	2260	63%
Forex Expenses	3517	2980	85%	3551	3239	91%	3888	3272	84%	4625	3441	74%
No. of Firms	242	130	54%	237	141	59%	235	144	61%	238	132	55%
Year	2004-05			2005-06			2006-07			Total		
Indicator	PROW	Sample	@	PROW	Sample	@	PROW	Sample	@	PROW	Sample	@
Sales	43860	27512	63%	56380	34329	61%	70480	45592	65%	290990	196876	68%
PBDITA	5424	4209	78%	8874	5967	67%	11331	9108	80%	35529	32062	90%
Net worth	16993	13701	81%	22652	16368	72%	29204	21385	73%	115546	97833	85%
Gross fixed assets	17339	12740	73%	18794	14040	75%	20822	15035	72%	120918	89971	74%
Total assets	48508	31898	66%	59837	39065	65%	74412	48170	65%	332615	228537	69%
Forex Earnings	4585	2972	65%	5311	3806	72%	8256	4542	55%	29435	19533	66%
Forex Expenses	7188	4203	58%	9334	6133	66%	10892	8610	79%	42995	31879	74%
No. of Firms	232	137	59%	224	127	57%	198	125	63%	1606	936	74%

@ refers to the percentage of aggregate data of sample firms on an aspect of financial indicator to the aggregate data of firms included in the PROWESS database on the same aspect of financial indicator.

Source: Complied and calculated from PROWESS database

Table-3: Frequency Distribution of Number of FAs, 2000/01 to 2006/07

Year	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	Total
FAs based on 10% Criteria	37	38	38	37	39	40	39	268
FAs based on 26% Criteria	36	37	37	35	38	39	39	261
FAs based on 51% Criteria	21	22	22	22	22	23	23	155

Sources: Compiled and calculated from the data primarily drawn from PROWESS database and complemented with data from Capital Line Ole and other sources.

Table-4: Distribution of Number of Firms across Sub-industries, 2000/01-2006/07

Code	Year	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07
SI0	Prime movers (diesel engines, turbines, heat exchangers, etc.)	10 (5)	10(4)	11(5)	10 (4)	10 (5)	10 (5)	9 (5)
SI1	Pumps, compressors and valves	15 (5)	18 (6)	18 (5)	19 (5)	23 (6)	18 (7)	18 (7)
SI2	Bearings	15 (5)	16 (5)	15 (5)	12 (5)	11 (5)	10 (5)	10 (5)
SI3	Agricultural machinery (tractors and Agricultural implements)	7 (1)	8 (1)	10 (1)	10 (0)	10 (1)	8 (1)	8 (1)
SI4	Earthmoving, mining and construction machinery, cranes	18 (4)	18 (3)	18 (3)	14 (4)	15 (4)	16 (4)	16 (4)
SI5	Machine tools	25 (6)	24 (6)	26 (6)	25 (6)	24 (6)	23 (6)	23 (6)
SI6	Industrial machinery for food, beverages and textiles	9 (3)	13 (4)	11(4)	11(4)	10 (3)	12 (3)	11 (3)
SI7	Other industrial machinery	31 (7)	34 (8)	35 (8)	31 (7)	34 (8)	30 (8)	30 (8)
	Indian NEMI	130 (36)	141 (37)	144 (35)	132 (38)	137 (39)	127 (39)	125 (39)

Notes: Firms were categorised primarily based on the classification pattern followed in PROWESS. Figure in a bracket is number of FAs.

Sources: Compiled and calculated from the data drawn from PROWESS database

Table-5: Sellers' Concentration Ratio (Top 4-firms) across Sub-industries, 2000/01-2006/07

Code	Year	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07
SI0	Prime movers (diesel engines, turbines, heat exchangers, etc.)	0.51	0.54	0.54	0.49	0.52	0.52	0.55
SI1	Pumps, compressors and valves	0.25	0.27	0.25	0.26	0.25	0.25	0.29
SI2	Bearings	0.28	0.29	0.26	0.26	0.26	0.26	0.30
SI3	Agricultural machinery (tractors and Agricultural implements)	0.67	0.52	0.62	0.62	0.54	0.56	0.62
SI4	Earthmoving, mining and construction machineries	0.46	0.48	0.43	0.49	0.47	0.48	0.53
SI5	Machine tools	0.35	0.35	0.37	0.34	0.34	0.33	0.39
SI6	Industrial machinery for food, beverages and textiles	0.38	0.43	0.41	0.42	0.42	0.38	0.35
SI7	Other industrial machinery	0.53	0.50	0.49	0.46	0.41	0.40	0.41

Sources: Calculated from data given in the latest 2008 and previous issues of Industry, Market Size, and Shares, CMIE

Table-6: Mean Values of Independent Variables for Each Sub-industry

Variable	SI0	SI1	SI2	SI3	SI4	SI5	SI6	SI7	Mean	Std. Dev.
TE	0.7189	0.7047	0.6921	0.6895	0.6803	0.7316	0.7226	0.7156	0.7069	0.0170
GPM	0.1756	0.1766	0.1801	0.1936	0.1555	0.2147	0.2254	0.1935	0.1894	0.0211
SZ	5.3330	3.5710	3.6940	4.4646	3.6885	2.6497	3.3181	2.9283	3.7059	0.7994
AGE	3.0640	3.1216	3.3443	3.3333	3.3424	3.2348	3.2549	3.0410	3.2170	0.1176
XI	0.0713	0.1933	0.1192	0.0679	0.0575	0.1597	0.1299	0.1265	0.1157	0.0446
MI	0.1634	0.0753	0.0710	0.0292	0.0887	0.1269	0.1409	0.0640	0.0949	0.0420
CAPI	4.2375	2.9924	5.6649	3.4025	3.6483	4.9317	5.9627	5.7221	4.5703	1.0845
AMI	0.0249	0.0242	0.0261	0.0346	0.0292	0.0394	0.0327	0.0311	0.0303	0.0049
MTI	0.0028	0.0026	0.0058	0.0003	0.0024	0.0019	0.0038	0.0040	0.0030	0.0015
RDI	0.0062	0.0035	0.0019	0.0086	0.0032	0.0035	0.0023	0.0029	0.0040	0.0021
LEV	0.2301	0.3294	0.3934	0.3487	0.3731	0.3568	0.2894	0.3147	0.3295	0.0485
IMC	0.5264	0.2609	0.2744	0.5937	0.4761	0.3520	0.3996	0.4574	0.4176	0.1104

Source: Compiled and calculated from the data drawn from PROWESS database

Table-7: Net Sales between Two Segments of NEMI, 2000/01 to 2006/07

(Rs. Crore)

Year	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07
General Purpose Machinery	11991	12075	13269	13582	16795	20636	28632
Special Purpose Machinery	8761	10109	9994	9662	10717	13692	16960
Indian NEMI	20752	22184	23263	23244	27512	34329	45592
Share of Special Purpose Machinery in Indian NEMI (%)	42.2	45.6	43.0	41.6	39.0	39.9	37.2

Sources: Compiled and calculated from the data drawn from PROWESS database.

Table-8: Summary Statistics of Variables for Two Segments of NEMI

	General Purpose Machinery			Special Purpose Machinery			Test of Equality of Group Means	
Variable	**Obs.**	**Mean**	**Std. Dev.**	**Obs.**	**Mean**	**Std. Dev.**	**Welch's degrees of freedom**	**t-statistics**
TE	278	0.7047	0.0680	658	0.7117	0.0867	657.89	1.32
GPM	278	0.1793	0.0846	658	0.1951	0.1285	771.33	2.23**
SZ	278	4.0592	1.7119	658	3.1610	1.5099	467.71	-7.59*
AGE	278	3.1961	0.7707	658	3.1936	0.7124	486.41	-0.045
XI	278	0.1403	0.1801	658	0.1181	0.1705	496.63	-1.75***
MI	278	0.0993	0.1041	658	0.0904	0.1020	511.90	-1.20
CAPI	278	4.1860	2.8334	658	4.9478	5.7007	911.11	2.72*
AMI	278	0.0251	0.0254	658	0.0334	0.0358	722.06	3.98*
MTI	278	0.0037	0.0074	658	0.0028	0.0074	522.37	-1.64***
RDI	278	0.0034	0.0056	658	0.0036	0.0061	567.11	0.428
LEV	278	0.3270	0.2636	658	0.3366	0.2480	493.78	0.520
IMC	278	0.3273	0.1518	658	0.4362	0.1517	520.86	10.03*

Note: * , **, *** respectively denote significance level at 1%, 5% and 10%

Sources: Compiled and calculated from the data drawn from PROWESS database

Table-9: Descriptive Statistics of Variables for full Sample, 2000/01-2006/07

Variable		Mean	Std. Dev.	Min	Max	Observations
FCD	overall	0.2788	0.4487	0.0000	1.0000	N = 936
	between		0.4301	0.0000	1.0000	n = 177
	within		0.0000	0.2788	0.2788	T-bar = 5.28814
TE	overall	0.7096	0.0816	0.5377	0.9934	N = 936
	between		0.0838	0.5447	0.9932	n = 177
	within		0.0028	0.7025	0.7156	T-bar = 5.28814
GPM	overall	0.1904	0.1173	-0.4871	0.7081	N = 936
	between		0.0979	-0.1754	0.4736	n = 177
	within		0.0683	-0.2759	0.6389	T-bar = 5.28814
SZ	overall	3.4278	1.6245	-0.1372	8.8828	N = 936
	between		1.5575	0.2772	8.5254	n = 177
	within		0.2773	2.1015	4.9944	T-bar = 5.28814
AGE	overall	3.1944	0.7298	0.0000	4.6250	N = 936
	between		0.7373	0.8959	4.6000	n = 177
	within		0.1266	2.0978	3.8896	T-bar = 5.28814
CAPI	overall	4.7216	5.0334	0.2844	50.0000	N = 936
	between		5.0590	0.3259	39.5469	n = 177
	within		1.2665	-4.5606	15.1747	T-bar = 5.28814
AMI	overall	0.0309	0.0333	0.0000	0.2506	N = 936
	between		0.0314	0.0000	0.2197	n = 177
	within		0.0127	-0.0548	0.1597	T-bar = 5.28814
MTI	overall	0.0031	0.0074	0.0000	0.0743	N = 936
	between		0.0060	0.0000	0.0372	n = 177
	within		0.0040	-0.0215	0.0547	T-bar = 5.28814
RDI	overall	0.0035	0.0060	0.0000	0.0398	N = 936
	between		0.0053	0.0000	0.0284	n = 177
	within		0.0027	-0.0093	0.0260	T-bar = 5.28814
LEV	overall	0.3338	0.2526	0.0000	0.9863	N = 936
	between		0.2432	0.0000	0.9577	n = 177
	within		0.1070	-0.1947	0.7288	T-bar = 5.28814
XI	overall	0.1247	0.1736	0.0000	0.9922	N = 936
	between		0.1523	0.0000	0.7551	n = 177
	within		0.0886	-0.3857	0.6732	T-bar = 5.28814
MI	overall	0.0930	0.1027	0.0000	0.5823	N = 936
	between		0.0918	0.0000	0.4633	n = 177
	within		0.0455	-0.1904	0.4421	T-bar = 5.28814
IMC	overall	0.4038	0.1596	0.1256	0.8955	N = 936
	between		0.1523	0.1580	0.7762	n = 177
	within		0.0568	-0.0171	0.6845	T-bar = 5.28814
SID1	overall	0.1378	0.3449	0.0000	1.0000	N = 936
	between		0.3550	0.0000	1.0000	n = 177
	within		0.0000	0.1378	0.1378	T-bar = 5.28814
SID2	overall	0.0951	0.2935	0.0000	1.0000	N = 936
	between		0.2955	0.0000	1.0000	n = 177
	within		0.0000	0.0951	0.0951	T-bar = 5.28814
SID3	overall	0.0652	0.2470	0.0000	1.0000	N = 936
	between		0.2521	0.0000	1.0000	n = 177
	within		0.0000	0.0652	0.0652	T-bar = 5.28814
SID4	overall	0.1229	0.3285	0.0000	1.0000	N = 936
	between		0.3243	0.0000	1.0000	n = 177
	within		0.0000	0.1229	0.1229	T-bar = 5.28814
SID5	overall	0.1816	0.3857	0.0000	1.0000	N = 936
	between		0.3812	0.0000	1.0000	n = 177
	within		0.0000	0.1816	0.1816	T-bar = 5.28814
SID6	overall	0.0823	0.2749	0.0000	1.0000	N = 936
	between		0.2955	0.0000	1.0000	n = 177
	within		0.0000	0.0823	0.0823	T-bar = 5.28814
SID7	overall	0.2404	0.4275	0.0000	1.0000	N = 936
	between		0.4231	0.0000	1.0000	n = 177
	within		0.0000	0.2404	0.2404	T-bar = 5.28814

Table-10: Correlation Coefficients

	TE	GPM	SZ	AGE	CAPI	AMI	MTI	RDI	LEV	XI	MI	IMC	SID1	SID2
TE	1.00													
GPM	-0.44	1.00												
SZ	-0.14	0.04	1.00											
AGE	0.08	-0.10	-0.26	1.00										
CAPI	-0.03	-0.21	0.22	0.08	1.00									
AMI	-0.15	-0.12	0.00	0.06	0.02	1.00								
MTI	0.00	-0.10	-0.05	0.04	0.08	0.14	1.00							
RDI	-0.09	-0.07	-0.29	-0.05	0.09	0.09	0.03	1.00						
LEV	0.14	0.10	0.08	0.03	0.03	-0.08	-0.01	0.03	1.00					
XI	0.04	-0.03	-0.05	0.07	0.03	0.00	-0.02	0.05	0.11	1.00				
MI	-0.08	-0.05	-0.25	0.12	-0.20	-0.09	-0.17	-0.04	0.03	0.01	1.00			
IMC	0.09	-0.10	-0.02	0.16	-0.03	-0.03	-0.02	-0.01	0.05	0.07	0.07	1.00		
SID1	0.00	-0.08	0.19	-0.01	0.06	-0.02	-0.04	0.00	-0.03	-0.11	0.14	0.40	1.00	
SID2	0.04	-0.08	0.11	-0.06	-0.07	-0.05	-0.14	0.06	-0.08	-0.05	0.19	0.36	0.68	1.00
SID3	0.06	-0.06	0.10	-0.09	0.00	-0.07	0.00	-0.15	-0.04	-0.02	0.21	-0.09	0.47	0.45
SID4	0.03	-0.03	0.17	-0.11	0.03	-0.07	-0.05	0.02	-0.07	0.00	0.12	0.10	0.64	0.61
SID5	-0.06	-0.07	0.38	-0.12	0.04	-0.10	-0.03	-0.06	-0.06	-0.12	0.04	0.26	0.73	0.67
SID6	0.00	-0.08	0.23	-0.10	-0.01	-0.06	-0.07	0.03	-0.01	-0.06	0.06	0.20	0.63	0.60
SID7	-0.05	-0.04	0.29	-0.07	-0.03	-0.06	-0.11	-0.03	-0.02	-0.08	0.20	0.14	0.72	0.68
Const	-0.77	0.31	-0.08	-0.39	-0.09	0.08	0.00	0.11	-0.27	-0.11	-0.04	-0.44	-0.38	-0.35

Table-11: Indicators of Multicolinearity

Variable	Variance Inflation Factor (VIF)[a]	Tolerance (TOL)[b]
SID7	4.02	0.25
SID5	3.86	0.26
SID1	3.31	0.30
SID2	2.71	0.37
SID4	2.59	0.39
SID6	2.24	0.45
SID3	1.98	0.51
SZ	1.81	0.55
IMC	1.66	0.60
TE	1.63	0.61
GPM	1.60	0.63
MI	1.40	0.71
RDI	1.34	0.75
CAPI	1.29	0.78
AGE	1.21	0.83
LEV	1.15	0.87
AMI	1.15	0.87
MTI	1.11	0.90
XI	1.09	0.92
Mean	1.96	0.61

a. VIF shows the speed with which variances and covariances increase and can be defined as VIF = $1/(1-r^2_{23})$, where r^2_{23} is the coefficient of correlation between X_2 and X_3. It is called variance inflating factor because it shows how the variance of an estimator is inflated by the presence of multicolinearity. If there is no colinearity between X_2 and X_3 VIF will be 1. When r^2_{23} approaches 1, VIF approaches infinite. (Gujarati 2004, Chapter 10).

b. TOL is the inverse of VIF.

Table-12: Comparing Characteristics of FAs and DFs-Univariate Method (Tests of Equality of Group Means)

Variable	Domestic Firms			Foreign Controlled Firms			Tests of Equality of Group Means	
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Welch's d. o. f.	T-stat
TE	675	0.6976	0.0777	261	0.7405	0.0835	445.23	7.176*
GPM	675	0.1800	0.1187	261	0.2175	0.1094	511.39	4.600*
SZ	675	3.1821	1.6779	261	4.0633	1.2766	619.45	8.630*
AGE	675	3.1911	0.7251	261	3.2028	0.7431	463.90	0.218
CAPI	675	4.7699	5.5087	261	4.5967	3.5243	713.20	-0.569
AMI	675	0.0331	0.0347	261	0.0254	0.0287	568.06	-3.455*
MTI	675	0.0016	0.0052	261	0.0070	0.0104	312.36	8.070*
RDI	675	0.0032	0.0058	261	0.0043	0.0065	427.06	2.376**
LEV	675	0.3655	0.2498	261	0.2516	0.2415	489.15	-6.409*
XI	675	0.1131	0.1744	261	0.1548	0.1683	489.91	3.369*
MI	675	0.0705	0.0873	261	0.1513	0.1159	380.61	10.197*

Note: * and ** denote significance levels at 1% and 5% respectively

Table-13: Results of LDA

Panel A: Canonical Distance Function

Eigenvalue[a]	Canonical Correlation[b]	Wilks' Lambda[c]	χ^2 (19)	Prob > χ^2
0.411	0.533	0.709	318.173	0.000

Panel B: Pooled Within-Groups Correlations between Discriminant Variables and Standardised Canonical Discriminant Functions

(Variables ordered by the absolute size of correlation within function)

Variable	Correlation	Variable	Correlation	Variable	Correlation
MI	0.588	**SID3**	-0.167	**SID4**	-0.069
MTI	0.540	**AMI**	-0.162	**SID7**	-0.041
SZ	0.391	**IMC**	-0.139	**SID6**	0.034
TE	0.378	**SID1**	0.130	**CAPI**	-0.024
LEV	-0.322	**RDI**	0.128	**AGE**	0.011
GPM	0.277	**SID5**	-0.120	-	-
XI	0.169	**SID2**	0.078	-	-

Panel C: Test of Equality of Group Covariance Matrices Using Box's M

FCD	Rank[d]	Log determinant[d]
0	19	-67.985
1	19	-71.062
Pooled within-groups	19	-67.244
Test Results (tests null hypothesis of equal covariance matrices)		
Box's M	Approximate F (190, 813887.4)	Prob > F
1491.554	7.632	0.00

Notes:

a. Eigenvalue = between group sum of squares/within group sum of squares

b. Canonical correlation = (between group sum of squares/total sum of squares)$^{1/2}$. In the two group case, the canonical correlation is the correlation coefficient between the discriminant score and the group variable.

c. Wilks' lambda = within group sum of squares/total sum of squares. Wilks' lambda captures the proportion of the total variance in the discriminant scores not explained by the differences between the groups.

d. The ranks and natural logarithms of determinants are those of group covariance matrices.

Table-14: Results of LDA based on Stepwise Procedure

Panel A: Canonical Distance Function

Eigenvalue	Canonical Correlation	Wilks' Lambda	χ^2 (19)	Prob > χ^2
0.394	0.532	0.717	308.666	0.000

Panel B: Test of Equality of Group Covariance Matrices Using Box's M

FCD	Rank	Log determinant
0	9	-37.027
1	9	-36.572
Pooled within-groups	9	-36.395
Test Results (tests null hypothesis of equal covariance matrices)		
Box's M	Approximate F (45, 864988.6)	Prob > F
471.810	10.344	0.00

Panel C: Mahalanobis D Squired Stepwise LDA

	Variable Entered	Mahalanobis D Squired Statistics between FAs and DFs	Exact F			
			Statistic	df1	df2	Sig.
1	MI	0.706	132.867	1	934.000	7.767E-29
2	MTI	1.241	116.635	2	933.000	6.136E-46
3	LEV	1.428	89.427	3	932.000	7.333E-51
4	SZ	1.567	73.485	4	931.000	3.809E-54
5	TE	1.659	62.193	5	930.000	5.348E-56
6	AMI	1.804	56.279	6	929.000	2.230E-59
7	SID1	1.873	50.037	7	928.000	1.660E-60
8	XI	1.919	44.812	8	927.000	5.698E-61
9	SID5	1.954	40.524	9	926.000	3.846E-61

Notes: a) At each step, the variable that maximizes the Mahalanobis distance between the two closest groups is entered; b) Maximum number of steps is 38; c) Minimum partial F to enter is 3.84; d) Maximum partial F to remove is 2.71; e) F level, tolerance, or VIN is insufficient for further computation.

Panel-D: Discriminant Functions of FAs and DFs

Category	TE	SZ	XI	MI	AMI	MTI	LEV	SID1	SID5	Constant
DFs	127.526	1.013	5.997	-10.357	-42.088	32.387	15.655	0.691	-1.107	-48.517
FAs	133.223	1.196	7.418	-2.438	-53.502	135.385	14.509	1.267	-1.643	-55.05

Table-15: Various Tests for Heteroskedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of FCD
chi2(1) = 56.99
Prob > chi2 = 0.0000

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity in independent variables
Ho: Constant variance
Variables: TE GPM SZ AGE CAPI AMI MTI RDI LEV XI MI IMC SID1 SID2 SID3 SID4 SID5 SID6 SID7
chi2(19) = 131.61
Prob > chi2 = 0.0000

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance

Variable	Chi^2	df	Unadjusted p-value
TE	9.11	1	0.00
GPM	0	1	0.97
SZ	17.29	1	0.00
AGE	4.06	1	0.04
CAPI	0.02	1	0.90
AMI	12.54	1	0.00
MTI	10.16	1	0.00
RDI	0.44	1	0.51
LEV	0.67	1	0.41
XI	9.53	1	0.00
MI	28.02	1	0.00
IMC	19.15	1	0.00
SID1	3.12	1	0.08
SID2	0.83	1	0.36
SID3	1.75	1	0.19
SID4	0.97	1	0.33
SID5	11.72	1	0.00
SID6	9.73	1	0.00
SID7	0.24	1	0.63
Simultaneous	131.61	19	0.00

White's test for Ho: homoskedasticity
against Ha: unrestricted heteroskedasticity
chi2(181) = 587.30
Prob > chi2 = 0.0000

Cameron & Trivedi's decomposition of Information Matrix-test

Source	chi2	df	p-value
Heteroskedasticity	587.30	181	0
Skewness	334.09	19	0
Kurtosis	0.09	1	0.76
Total	921.49	201	0

Table-16: Logit and Probit Models: Estimation Results

	Logit Model			Probit Model-1			Probit Model-2		
Explanatory Variable	**Coef.**	**Het. corr. Std. Err.**	**z-stat**	**Coef.**	**Het. corr. Std. Err.**	**z-stat**	**dF/dx**	**Het. corr. Std. Err.**	**z-stat**
TE	6.185	1.324	4.67*	3.728	0.761	4.90*	1.120	0.228	4.90*
GPM	-0.251	1.042	-0.24	-0.205	0.579	-0.35	-0.062	0.174	-0.35
SZ	0.194	0.076	2.55*	0.122	0.042	2.90*	0.037	0.013	2.90*
AGE	-0.004	0.004	-0.99	-0.003	0.002	-1.35	-0.001	0.001	-1.35
CAPI	-0.030	0.019	-1.64	-0.016	0.011	-1.51	-0.005	0.003	-1.51
AMI	-10.645	2.811	-3.79*	-6.383	1.586	-4.02*	-1.918	0.481	-4.02*
MTI	81.725	16.623	4.92*	44.564	9.347	4.77*	13.394	2.871	4.77*
RDI	-11.963	13.775	-0.87	-7.511	8.229	-0.91	-2.257	2.476	-0.91
LEV	-1.321	0.450	-2.93*	-0.669	0.240	-2.79*	-0.201	0.071	-2.79*
XI	1.140	0.555	2.05**	0.757	0.301	2.51*	0.228	0.091	2.51*
MI	6.525	1.055	6.19*	3.675	0.594	6.19*	1.104	0.181	6.19*
IMC	-0.727	0.875	-0.83	-0.518	0.436	-1.19	-0.156	0.132	-1.19
SID1	0.295	0.560	0.53	0.103	0.279	0.37	0.032	0.088	0.37
SID2	0.286	0.570	0.50	0.127	0.287	0.44	0.040	0.093	0.44
SID3	-0.551	0.648	-0.85	-0.299	0.316	-0.95	-0.081	0.075	-0.95
SID4	0.042	0.468	0.09	-0.062	0.246	-0.25	-0.018	0.071	-0.25
SID5	-0.656	0.522	-1.26	-0.438	0.264	-1.66	-0.117	0.063	-1.66
SID6	-0.181	0.555	-0.33	-0.060	0.287	-0.21	-0.018	0.083	-0.21
SID7	-0.001	0.494	0.00	-0.034	0.247	-0.14	-0.010	0.073	-0.14
Const.	-5.811	1.146	-5.07*	-3.423	0.636	-5.38			
Number of observations			936	Number of observations					936
Wald Chi^2 (19)			193.88	LR Chi^2 (19)					228.39
Prob > chi^2			0.00	Prob > chi^2					0.00
Pseudo R^2			0.26	Pseudo R^2					0.26
Log likelihood			-407.56	Log likelihood					-408.63

Note: *, ** denote level of significance at 1 per cent and 5 per cent per cent respectively.

: dF/dX is for discreet change of dummy variable from 0 to 1

Appendix-1
Construction and Measurement of Variables

In order to empirically test various hypotheses on comparative conducts and performance we employ two sets of variables. The first set of variables represents various indicators of firm-specific characteristics including: a foreign control dummy variable (FCD) representing foreign (or domestic) ownership of a firm; financial leverage (LEV) characterizing capital structure of a firm; firm's size (SZ) represented by natural logarithm of net sales to capture scale advantage, risk bearing capacity, etc.; firm's age (AGE) measured by natural logarithm of age of a firm to capture learning by doing, experience and vintage of plant; export intensity (XI) for the capacity to earn foreign exchange, openness to international market and international competitive advantage; import intensity of intermediate goods (MI) capturing absence of backward integration with the domestic economy and level of foreign contact; capital intensity (CAPI) for capturing choice of technique of production; research and development intensity (RDI) representing in-house capability for adaptation and absorption of technology as well as product differentiation advantage and quality assurance; import intensity of disembodied technology (MTI) for capturing technological capability and transfer pricing; advertising and marketing intensity (AMI) for creating product differentiation advantage; gross profit margin (GPM) for profitability through market power and technical efficiency (TE) for measuring efficiency in utilisation of inputs.

The second group of variables is used to capture the influence of market concentration and sub-industry level characteristics of the Indian NEMI on a firm's probability to appear as the FAs (or DFs). In accordance with the discussions in sections 2.2, we first construct an index of market concentration (IMC) which is measured as the weighted average of four-firm seller concentration ratio related to one or several of the eight sub-industries in which a firm operates. The sub-industry specific characteristics of Indian NEMI is captured by 7 dummy variables, (SID1, …,SID7), corresponding to 7 sub-industries (SI1,…,SI7). The sub-industry SI0 is used as the reference sub-industry. The methods of construction and the measurement of each of the above mentioned variables are detailed below.

FAs, DFs and FCD: We adopted an appropriate and objective criterion for segregating sample firms into two ownership groups, FAs and DFs. This criterion was mainly based on certain provisions of the Indian Company Act 1957, which states that an investor can block special resolution in a company by holding a minimum of 26 per cent of equity in the paid-up share capital of a public limited company. Following this criterion, we defined a sample company as FA if a foreign promoter holds at least 26 per cent share in the paid-up capital of the company. Accordingly, DF is referred as a company having less than 26 per cent equity by a foreign promoter. A further checking on the FAs revealed that each one of them had affiliation with a reputed MNE. FCD assumes value 1 for a FA and 0 for a DF.

Capital Structure (LEV): In the empirical research, two ratios are normally utilised to measure leverage: (i) long-term debt to total debt plus market value of equity and (ii) long-term debt to long-term debt plus market value of equity. In this study, we specifically measure the leverage of a firm by the ratio between the medium and long-term debts and net worth. The medium and long term debts of a company include the debt of over one year maturity. Net worth is the summation of equity capital and

reserves and surplus. In the reserve and surplus, we do not include revaluation reserves. We represent this ratio by LEV, higher LEV of a firm (relative to other firms) means that it is financing greater proportion of its assets by debt than by owned fund (i.e. net worth).

Firm Size (SZ): Sales turnover is a most commonly used measure of firm size in empirical studies on manufacturing sector. We approximate sales turnover by net sales (NS), which equals gross sales minus indirect taxes. NS does not include other income from non-recurring transactions, income of extra-ordinary nature and prior period income. We follow this concept but measure firm size (SZ) by natural logarithmic value of net sales of a firm in a year. This measure of firm size has advantage over measuring size by absolute value of net sales as the former reduces degree of variability in size across firms, and thereby avoids the problem of heteroskedasticity in the estimation of the regression equations.

Age of a Firm (AGE): Age of a firm is measured by the number of years of operation of a firm which is the difference between the year of presence in the sample and the firm's year of incorporation to. As every year of operation may not add significantly to the experience or oldness, we use natural logarithm of age (AGE) to represent the age of a firm.

Capital intensity (CAPI): Capital intensity (CAPI) is measured by the ratio of the cost of plant and machinery to wage bill of a firm in a year.

Product Differentiation (AMI): We measure product differentiation advantage of a firm by its advertising and marketing intensity (AMI), which the ratio of sum of a firm's expenditure on advertising and marketing to net sales in financial year. The advertising expenses include expenses on launching, promotion and publicity of goods, etc. and marketing expenses comprises commission paid to selling agents, discounts, rebates, etc.

Export Intensity (XI): It is a ratio of export to net sales of a firm in a FY in which export is measured by the firm's earnings from the f.o.b. value of exports of goods and services.

Intensity of Imported Intermediate Goods (MI): MI is a ratio between c.i.f values of imported inputs to net sales of a firm in a FY. The imported inputs include raw material, stores, spare parts, capital goods, etc. We use combined value of imported inputs as some firms do not report reliable data on import of capital goods and raw materials separately and also both the components of imports provide benefits of foreign networks for exports.

Intensity of Imported Disembodied Technology (MTI): Indian firms import disembodied technology from a foreign technological collaborator against the payment of royalty and technical fee and /or lump-sum payments for obtaining technical know-how, use of patents, engineering services, drawings and designs, brand names, trademarks and the like, etc. The royalty is normally paid on the recurring basis as a certain percentage of domestic sales and/or of exports while technical fee may be paid on lump-sum basis as one-time payments. The sum of royalty (net of tax) and lump sum payments may approximate that part of technological capability of a firm, which is acquired by the import of disembodied technology. We measure intensity of imported disembodied technology of a firm by the ratio of sum of royalty and lump sum payment to net sales.

Technical Efficiency (TE): TE in this study is derived by estimating a stochastic frontier production function (see **Annexure** for detail). Thus, TE of a given firm (in a given year) is defined as the ratio of its mean output (conditional on its level of factor inputs and firm effects) to the corresponding mean output if the firm utilizes its levels of inputs most efficiently (Battese and Coelli1992). TE, by design, has values between zero and one. If a firm's TE measure is 0.70 then this implies that the firm realizes 70 percent of the production possible for a fully efficient firm operating under the same conditions.

Profitability (GPM): We capture profitability by a measure of gross profit margin (GPM) that is a ratio of gross profit-to-net sales. The numerator gross profit is defined as profit before depreciation, interest, lease rental and direct taxes.

Financial Capacity (FINC): FINC is measured by a ratio of networth to total assets of a firm.

Index of Market Concentration (IMC): In order to construct IMC, we first categorise the Indian NEMI into 8 sub-industries (SI1,….,SI8) with the help of facilities provided in PROWESS. A minimum 51 per cent of gross sales made up from a sub-industry in a particular financial year is used as the norm for this reclassification. IMC is calculated as the sales weighted average of an index of a four-firm seller concentration ratio (SCR4) of each of the sub-industries of Indian NEMI in which a firm operates. The SCR4 is defined as the share of sales of four largest firms taken together in gross sales of a sub-industry of NEMI. Since a sample firm may operate in one or multiple sub-industries belonging to NEMI, we calculate a weighted average of SCR4 to obtain firm-specific IMC. The weight is calculated as ratio of a firm's sales revenue generated from an individual sub-industry to gross sales of the firm in a year. The procedure of calculating IMC can be more clearly illustrated by the following example. If a firm's gross sales of Rs.15 crore generated from sale of Rs.10 crore worth of bearings (SCR4 = 0.90) and Rs. 5 crore worth of pumps (SCR4 = 0.30), IMC applicable to the firm would be 0.70 (10/15*0.90 + 5/15*0.30).

Foreign Presence: To measure foreign presence in a sub-industry of Indian NEMI, we employ three variables competition effect (CEF), demonstration and imitation effect (DEF) and information effect (IEF). We measure CEF by the weighted average of FAs' share in gross sales of each of the sub-industries of Indian NEMI in which the firm operates. The procedure of obtaining the measure of CEF can be illustrated by following example. Suppose a firm operates in two sub-industries, namely, bearing and pumps and its gross sales of Rs.15 crore constitutes Rs.10 crore worth of bearings (FS = 0.30) and Rs. 5 crore worth of pumps (FS = 0.15). Hence, the CEF applicable to the firm would be 0.25 = {10/(15*0.30)} + {5/(15*0.15)}. We approximate DEF by the FAs' share of R&D in total R&D expenditure of a sub-industry scaled by share of FAs in R&D expenditure of all firms in the sample. IEF is measured by the FAs' share of exports in the total export of a sub-industry scaled by share of FAs in exports of all the firms in the sample.

Sub-industry Specific Dummy Variables: We categorise our sample firms into its 8 major sub-industries of the Indian NEMI, namely, SI0, SI1,…,SI7. Thereafter, we construct 7 dummy variables, SID1,…,SID7, corresponding to 7 sub-industries SI1, …,SI7. The observations on a dummy variable (say SID1) assumes the value 1 if a sample firm belongs to the corresponding sub-industry (say SI1), otherwise 0. The sub-industry SI0 is treated as the reference sub-industry, therefore, we do not use dummy variable for this sub-industry so as to avoid dummy variable trap.

Year-specific Dummy Variables: To account for developments over the period of study, we employ six year-specific additive dummy variables, YD02, YD03, YD04, YD05, YD06 and YD07 corresponding to the years 2001/02, 2002/03, 2003/04, 2004/05, 2005/06, 2006/07. The dummy variable YD02 takes value 1 for the year 2001/02 and 0 for other five years; YD03 assumes value 1 for the year 2002/03 and 0 for other five years; YD04 takes value 1 for the year 2003/04 and 0 for other five years; YD05 takes value 1 for the year 2004/05 and 0 for the other five years; YD06 takes value 1 for the year 2005/06 and 0 for other five years; YD07 takes value 1 for the year 2006/07 and 0 for other five years. We do not use any dummy variable for the reference year 2000/01 to avoid dummy variable trap.

Annexure

Stochastic Frontier Production Model

We estimate SFPF model by adopting Battese and Coelli's (1992) specification involving the use of unbalanced panel data. General formulation of this model is expressed by the following equations:

$$Y_{jt} = f(X_{jt}; \beta) \exp(V_{jt} - U_{jt}) \quad (1)$$

or

$$Y_{jt} = \beta X_{jt} + V_{jt} - U_{jt} \quad (2)$$

$$U_{jt} = [\exp\{-\eta(t-T)\}] U_j, \; t \in g(j); \; j = 1, 2, \ldots\ldots, N; \quad (3)$$

where Y_{jt} is the natural logarithm of production of the j^{th} firm in the t^{th} year; $\mathbf{X_{jt}}$ is the vector of logarithm of quantities of each input of production of the j^{th} firm in the t^{th} year of observation; β is a vector of unknown parameters; random error V_{jt}'s are assumed to be independently and identically distributed (iid) as $N(0, \sigma_v^2)$ reflecting two-side "statistical noise" component that accounts for the effect of all random factors such as the measurement error, luck, machine performance, etc.; V_{jt} are also assumed to be independent of U_{jt} and the input vector X_{jt}; U_j's are non-negative random components assumed to be iid as non-negative truncations of the $N(\mu,\sigma_u^2)$ distribution; U_j's are assumed to capture technical inefficiency in production, since the non-negative assumption of U ensures that the firm's actual production point lies beneath the stochastic frontier and the gap between the point frontier and actual point thus measures technical inefficiency; Eta (η) is an unknown scalar parameter to be estimated, reflecting the time trend of the efficiency of individual firms; $g(j)$ represents the set of T_i time periods among the T periods involved for which observations for the i^{th} firm are obtained. Given the assumptions on the statistical distribution of U_{jt} and V_{jt}, we first obtain maximum likelihood (ML) estimates of the SFPF represented by equation (2).

Thereafter, we obtain the technical efficiency of firm j at the time period t (i.e. TE_{jt}) as the minimum-mean-squared-error predictor of the technical efficiency of the i^{th} firm at the t^{th} time period with help of help of equation (4):

$$E[\exp(-U_{jt})| E_j] = \frac{1 - f[\eta_{jt}\sigma_j^* - (\mu_j^*/\sigma_j^*)]}{1 - f(-\mu_j^*/\sigma_j^*)\}} \exp\left[-\eta_{jt}\mu_j^* + (1/2)\eta_{jt}^2\sigma_j^{*2}\right] \quad (4)$$

where E_j represents the ($T_j \times 1$) vector of η_{jt}'s associated with the time period observed for the j^{th} firm, where $E_{jt} \equiv V_{jt} - U_{jt}$;

$$\mu^* = [\mu \sigma_v - \eta_j' E_j \sigma^2] / [\sigma_v^2 + \eta_j' \eta_j \sigma^2] \quad (5)$$

$$\sigma^{*2} = [\sigma_v^2 \sigma^2] / [\sigma_v^2 + \eta_j' \eta_j \sigma^2] \quad (6)$$

The function f (.) denotes the probability distribution function (pdf) for the standard normal variable. In the case Cobb-Douglas SFPF, E_{jt} is a linear function of the vector, β. The operational predictor for equation 4 is obtained by substituting the relevant parameters by their maximum-likelihood estimates.

Our empirical model consists of a single equation production function with natural logarithm of output as the dependent variable, and material input, labour input, capital input as three independent variables. The Cobb-Douglas form of production function is chosen, because of its well-known advantages and simplicity. In principal, confining the analysis to this one functional form can be somewhat restrictive. However, a few studies [e.g. Kopp and Smith (1980) and Krishna and Sahota (1991)] suggest that the functional specifications have small impact on measured efficiency. In a relatively recent study, Driffield and Kambhampati (2003) do not find significant differences in the estimation results obtained either from trans-log or Cobb-Douglas specification. The log linear form of Cobb-Douglas production function to be estimated in accordance with the estimation methods described above is expressed as follows:

$$\ln Y_{jit} = b_0 + b_1 \ln M_{jit} + b_2 \ln L_{jit} + b_3 \ln K_{jit} + V_{jit} - U_{jit} \quad (6)$$

where Y, M, L, K represent output, material input, labour input and capital input respectively. The subscript j (j = 1,…,177) refers to the j^{th} sample firm; i (i = 1, …,936) denotes i^{th} observation and t (t = 1,…,7) represent year of operation. The ln symbolises natural logarithm. V_{jt} and U_{jt} are the random variables whose distributional properties are described in the previous section. We use Coelli's (1996) "FRONTIER 4.1" software for estimating above equation by MLE method and thereafter obtaining the parameters of the model and predictors for the year-specific and firm-specific TE. In this framework, TE of a given firm (in a given year) is defined as the ratio of its mean output (conditional on its level of factor inputs and firm effects) to the corresponding mean output if the firm utilizes its levels of inputs most efficiently (Battese and Coelli1992).

We use a set of unbalanced panel data on a sample of 177 firms belonging to Indian NEMI. We consider the data for 7 years during the period 2000/01 to 2006/07. A total of 936 observations are used as 303 observations are missing from the panel. The data on nominal value of each of the variables employed to represent output and inputs of a firm is collected from the Prowess database for each year of the study. These data include: a) value of production (VoP) that is rupee value of net sales plus net increase or decrease in stock of finished goods, b) aggregate annual expenses incurred by a firm on the purchase of raw materials, components, stores, spare parts, etc. It also includes expenses incidental to the purchase of materials, c) wage bill i.e. a firm's annual staff expenses on payment of wages and salaries, bonus, contribution to and provision for provident, pension, gratuity funds, etc. and d) the original cost of plant and machinery as at the end of a financial year.

Since we use many years of data on a firm, we need to compute real values of the same by deflating the value of each input and VoP by the appropriate annual price indices. Hence, we obtained relevant product-wise data on Wholesale Price Index (WPI) for each year of the study from the WPI series published by Office of Economic Advisor (OEA), Government of India. To deflate data on wage bill, we collected data All India Consumer Price Index Numbers (General) for Industrial Worker (CPI) from Labour Bureau, Government of India. In the following paragraphs, we discuss the method of constructing each variable employed for estimation of stochastic frontier production function. In addition, we also explain the justification for and limitation of data utilized for measuring output and input variables.

Output (Y): WPI deflated VoP represents the output (Y) of a firm in our study. To deflate VoP, we have used year-wise data on WPI for a firm's major product group. In this regard, the major product group of each company was matched with the WPI classification, and the matching price series was chosen for the deflation. If the appropriate deflator was not available, the deflator corresponding to the nearest product group is utilized for the purpose. For a few diversified companies operating in various segments of NEMI, we have used WPI of NEMI as the deflator.

The value of production, instead of value added, is employed to measure the output because: (i) the use of the former facilitates the inclusion of material input as another important input of production, that can also be used efficiently (or

inefficiently) along with the labour and capital, (ii) the use of value added as a measure of output can yield misleading results if there is imperfect competition or increasing returns to scale (Basu and Fernald 1995). Moreover, the option to employ value added or value of production depends upon whether there are substantial gains in the management and procurement of raw material to firms, and thereby it is essentially an empirical question (Patibandala 1998 and Driffield and Kambhampati 2003). Many Indian studies in recent years have estimated production function with material input as an important independent variable (see e.g. Driffield and Kambhampati 2003 and Banga 2004).

Material Inputs (M): Materials inputs (M) constitute one of the important constituents of production in the business. To remove the effect of year-to-year change in prices, M in this study is deflated by WPI corresponding to the main product group to which M belonged. For this purpose, M of each company was divided into various categories and matched with the WPI classification, and the best available price series was chosen for deflation.

Labour Input (L): Labour input is measured by "*man hours*", "*workers*", "*number of employees*". Indian firms rarely report this information in their annual reports, since the Indian Company Law does not make it mandatory. To overcome this problem, some studies on Indian manufacturing sector [e.g. Goldar et al. 2004 and Kathuria (2000, 2002)] calculate the average wage rates for different industries for different digits of classifications from *Annual Survey of Industries*, and divide the wage bill of a firm by the average wage rate of the corresponding industry to obtain the number of workers employed in the firm. This method of estimating the number of employees in a firm has the following shortcomings. First, it assumes identical wage rate for all the employees in an industry. In reality, however, wage rates may vary across firms in an industry on account of differences in capital intensity, size, skill compositions, geographical locations of firms and types of ownership (for example foreign and domestic) (Bellak 2004a). In case, FAs pay higher wages compared to the DFs in the Indian NEMI, this method may overestimate the number of employees in the MNE. Secondly, it is normal practice among Indian firms, particularly in the recent years, to outsource a number of manual works to labour contractors. The payments made to labour contractors are included in the wage bill of the firm but the workers employed through the contractors are not included in the payroll of the firm.

In view of the above shortcomings, we employ total wage bill, which also reflects the skill composition of employees at firm level (Bhavani and Tendulkar 2001), as a proxy measure for the labour input in our study. Some scholars in India have preferred to use wage bill as the measure for labour input in their respective studies (see for example Siddharthan and Lal 2004, Ray 2006). As we use panel data, we deflate WS by the CPI, so as to mitigate the effect of inflation on the wage bill of a firm.

Capital Input (K): Ideally, capital input (K) should be measured by the current replacement cost of the fixed assets of a firm. Nevertheless, the absence of relevant information/data has compelled the researchers to follow alternative methods for measuring capital input in their empirical studies. One such widely used method captures K by the gross (or net) fixed assets of a firm either in nominal term as given in the annual report of a firm or more satisfactorily in real term, which is calculated as gross (or net) fixed assets deflated by an appropriate price index. We also follow the similar method. To capture K, however, we utilise data only on the original cost of plant and machinery (or gross fixed stock of capital), rather than the gross fixed assets that includes the original cost of land and building as well. We exclude land and building from the gross fixed assets as many companies use rented premises and the value of land can be significantly under (or over) estimated in the Indian conditions. We do not use data on net fixed cost of plant and machinery because many Indian companies manipulate data on depreciation and machineries are used even beyond their life span.

The above method has a drawback for it does not take into account the fact that the fixed assets of a firm involve assets of different vintages bought at different points of time and thereby proves inconsistent with the ideal current replacement cost 'measure'. To eliminate the vintage effect, some scholars (e.g. Goldar et al. 2004 and Kathuria 2000, 2001) have used *perpetual inventory* method, which requires detailed information on the age structure of capital assets, a long time series of data on gross fixed capital stock, the benchmark capital value, etc. In the absence of such data, the researchers make number of assumptions, which are sometimes unrealistic. Hence, we do not use perpetual inventory method, despite the limitation of the method selected for this study.

Results of maximum likelihood estimates of parameters of SFPF are given in Table-1. The results show that the coefficients of each of the three inputs explaining production behaviour of sample firms are statistically significant. In our model, ML estimates of coefficients also signify elasticity of output with respect to material, labour and capital input. The comparison of these elasticity show that elasticity of output with respect to material input (0.71) is the highest and substantial, followed by elasticity of output with respect to labour (0.14) and capital input (0.10) respectively. Although the value of the coefficient associated with material input is substantial, it is much less than the unity. Notably, when we use two input production function, ignoring raw material, we implicitly assume that the coefficient associated with material input is close to unity. Further, return to scale, measured as a sum total of these elasticities (0.95), is quite close to unity, indicating that the production technology is characterised by constant returns to scale.

The software also gave the firm specific and year-specific TE_{jt} from which we calculated the mean value of TE_{jt} over the data period of a firm. The analysis of this data shows the most technically efficient firm with mean TE of 99.3 per cent belongs to the group of FAs whereas the least technically efficient firm with mean TE of 55.5 per cent belongs to the group of DFs; b) the five most technically efficient firms in the sample includes two FAs, each one with mean TE of 99.3 per cent and 97.0 per cent, and three DFs, each one with mean TE of 96.3 per cent, 96.1 per cent and 95.9 per cent; c) the five least efficient firms, with mean percentage TE of 57.9, 57.9, 55.8, 55.1 and 54.5, belong to the group of DFs.

Table-1: Maximum Likelihood Estimates of Parameters of SFPF

Variable/Parameters	Coefficient	t-ratio
Ln M	0.7059	85.68*
Ln W	0.1399	8.13*
Ln C	0.1004	6.83*
Constant	1.2017	29.17*
Sigma-squared (σ_s^2) $\equiv \sigma_v^2 + \sigma^2$	0.0315	5.62*
Gama (γ) = σ^2 / σ_s^2	0.7765	32.13*
Mu (μ)	0.3127	9.44*
Eta (η)	0.0064	0.8357
Log likelihood function		705.57
LR test of the one-sided error		462.36
Number of iterations		10
Number of cross-section		177
Number of Years		7
Number of Observations		936
Number of Observations not in the panel		303

Note: * shows that the coefficient is significant at one per cent level.

Table-2: Summary Statistics of Variables used in the Estimation of SFPF

Variable	Variation	Mean	Std. Dev.	Min	Max	Observations
lnY	Overall	3.43	1.62	-0.14	8.91	N = 936
	Between		1.55	0.30	8.54	No. of Firms = 177
	Within		0.28	2.09	5.03	T-bar = 5.29
ln M	Overall	2.97	1.68	-0.76	8.40	N = 936
	Between		1.60	-0.36	8.05	No. of Firms = 177
	Within		0.30	1.62	4.67	T-bar = 5.29
Ln L	Overall	0.10	1.66	-4.31	6.17	N = 936
	Between		1.61	-4.07	5.81	No. of Firms = 177
	Within		0.20	-1.34	1.57	T-bar = 5.29
Ln K	Overall	2.55	1.68	-1.52	7.49	N = 936
	Between		1.64	-1.50	7.41	No. of Firms = 177
	Within		0.23	0.49	4.28	T-bar = 5.29
TE	Overall	0.7096	0.0816	0.5377	0.9934	N = 936
	Between		0.0838	0.5447	0.9932	No. of Firms = 177
	Within		0.0028	0.7025	0.7156	T-bar = 5.29

Notes

[i] The study measures innovatory activities by R&D intensity, import of foreign disembodied technology, and product differentiations through advertising; captures inter-firm forward linkages by distribution outlays as a ratio of net sales turnover, export intensity; approximates backward horizontal linkages by purchase of finished goods as a percentage of sales and import of finished goods as percentages of net sales; measures backward vertical linkages by value added as a percentage of net sales and import of raw materials expenditure as a percentage of net sales.

[ii] As per the accounting practice, the interest on debt is deducted before arriving at net profit while dividend is deducted after net profit. Since the corporate tax is deducted before arriving at net profit, financing through equity is more costly than debt financing.

[iii] The prime movers, boilers, turbines, combustion engines and steam generating plants; agricultural machinery; industrial machineries and machine tools have been the part of high priority sector.

[iv] The main driving force behind this dispersion has been a set of push and pulls factors. Push factors involve increased competitive pressure, rising costs of R&D in developed countries, scarcity of skilled manpower, increasing complexity of R&D activity (UNCTAD 2005). On the pull side, availability of skilled manpower at lower cost in economies in transition and select developing countries, the ongoing globalisation of manufacturing processes, possibility of splitting of R&D functions into self contained divisible activities enabled by advances in communications and information technologies, emerging opportunities for collaborations with R&D laboratories in developing countries, availability of highly skilled manpower at lower cost in some developing countries, strengthening of intellectual property rights regime in fast growing economies and proactive policies in some developing countries (including India) towards encouragement of FDI with higher degree of equity participation and technology transfer (UNCTAD 2005, p29).

[v] Finding in this indeed shows that FAs are more technically efficient than DFs.

[vi] Refer to Appendix-1 of Chapter-7 for details about the studies conducted during the pre-reform period.

[vii] Expenses on generation and development of FSA and auxiliary services like training, controlling, etc are counted as expenses of the headquarter but the FAs derives the benefits of the same without incurring any cost or by incurring minimal cost. DFs, although they may operate affiliates, have to bear the full cost of such assets or services.

[viii] Hallward-Driemeier et al (2002) used questionnaire survey covering 2700 manufacturing firms from the five East Asian countries Indonesia, Korea, Malaysia, the Philippines and Thailand. Their regression analysis revealed that, even after controlling for sector, size and export orientation, FAs have higher productivity than DFs in all countries except Korea.

[ix] Mobility barriers are defined as entry barriers, which not only impede fresh entry to the industry but also restrict inter strategic group mobility of the existing firms. Thus, firms in a particular strategic group may not only enjoy protection from new entrants to the industry but also from existing firms belonging to other strategic groups in the same industry (Kumar 1990).

[x] The groups could be more than two also in a discriminant analysis.

[xi] See for example Kumar (1991).

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