# RIS DISCUSSION PAPERS

**Export Competitiveness in knowledge-based Industries: A Firm-Level Analysis of Indian Manufacturing**

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RIS-DP # 43/2003

**Research and Information System for the Non-Aligned and Other Developing Countries**

# Export Competitiveness in the Knowledge-Based Industries: A Firm-Level Analysis of Indian Manufacturing

**A study prepared as a part of the project sponsored by the DSIR, Ministry of S&T under TATT Scheme**

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Revised Version: July 2003

*Abstract: The present study makes an attempt to identify factors that play important role in the export competitiveness of Indian manufacturing firms with particular emphasis on knowledge-based industries. The study finds that younger firms drive export competitiveness in the high technology and low technology sub-samples of Indian manufacturing whereas in the medium technology older firms are more competitive. Firm size is observed to have a non-linear impact on export performance largely represented by an inverted U-shape curve. It is also found that the firm's own innovative activities are by far the most important technological factor contributing to the enhanced competitiveness whereas the import of foreign technology through technology contracts found to have detrimental effects on the export competitiveness in high technology and medium-high technology segments of Indian manufacturing. Access to foreign raw materials and inputs is also observed to be a critical factor for export success of Indian firms across technology segments. Another important variable that can be used to increase export competitiveness in high technology and low technology industries is encouraging Indian firms to establish subsidiaries abroad. Foreign affiliates in Indian manufacturing are found to achieve higher export success than domestic firms. The outward-looking policy initiated since 1991 had definitely improved the export competitiveness of Indian manufacturing including technology-intensive segments.*

*Key words: Export intensity; FDI; Economic Reforms*
*JEL Classification: F1; F21*

# Export Competitiveness in the Knowledge-Based Industries: A Firm-Level Analysis of Indian Manufacturing

## 1. Introduction

In the globalizing world economy a heavy emphasis is placed on the export success of a nation for it's long-term economic performance. Export success is likely to lead to productivity growth (e.g. De Melo and Robinson 1992; Tybout 1992; Edwards 1997) by reducing technical inefficiency and enabling greater exploitation of economies of scale by augmenting the size of the market. It may also results in higher innovative activity, as exporting firms are not only more conscious of technological development abroad in the form of new technologies, new products, new organizational skills etc. but also are prompted to innovate continuously in order to stay in the business (Braga and Willmore 1991; Kumar and Saqib 1996; Kumar and Agarwal, 2000). Further, exporting puts firms and economies on potentially dynamic learning path when global buyers assist exporting firms to reach international quality and delivery standards through transferring technical and managerial expertise (Fransman 1985). Export expansion can even help attract higher quantity and quality of FDI into the economy (UNCTAD, 2002) and thus can generate additional growth impetus. These contributions of exports success tend to be particularly rewarding as the technology profile of economy's export upgrades in favour of more knowledge-intensive products[1].

The knowledge-intensive products are not only high value adding in nature but also contain demanding technological efforts on the parts of producers and generate knowledge-spillovers for the rest of the economy. They tend to have income elasticity of greater than unity and are faster growing segments in international market. The main competitive advantages in these product lie in advanced and fast changing technologies with high R&D investments, high skills and complex learning process. The low-technology products, by contrast, tend to be low value-adding, have slower growing market, offer limited learning potential, smaller scope for technological upgradation, and less intra-industry and inter-industry spillovers. The competitive advantage in these products is generally driven by low wage costs and it is highly prone to price competition (see e.g. Guerrieri and Milana 1995; NSF 1995; Lall 1999, 2000; UNCTAD, 2002). Therefore, export success in knowledge-based industries have higher growth potential than only relying on low technology industries.

In that context, it is a matter of concern that the Indian manufactured exports continues to be dominated by low technology manufactures like processed food, textiles, toys, leathers, simple metal products, etc. India has little presence in the world markets for high technology goods except for generic pharmaceuticals, IT software, and some low-end electronics goods[2]. The manufacturing exports from India continue to be significantly driven by the traditional comparative advantage arising out of conventional resource endowments, principally cheap labour, low skill, and natural resources like raw materials, and less by new comparative advantage driven by skills, technological capabilities, quality, flexibility, design and reliability.

[1] Subrata and Price (1997) found that non-traditional manufactured exports (i.e. machinery and transport equipments and other miscellaneous: S. I. T. C sections 7, 8 & 9) Granger-cause output growth (i.e. non-export Real GDP growth) whilst traditional manufactures (i.e. leather, rubber, wood, paper, textiles and metal: rest of S. I. T. C section 6) have no significant impact on output growth.

[2] One recent estimate indicates that with nearly 89 % of the total manufactured exports, the resource-based manufacturers and low technology products dominate the India's export structure in 1998. The share of high and medium technology products are respectively 4.1 % and 10.1 %. See Lall 2000, Table-4.1 p. 38-39.

Given the growing competition in standardized and matured industries, this structure of India's exports does not allow rapid expansion. Therefore, there is an urgent need for India to upgrade the technology profile of her export structure. However, such a movement is not easy as export structures are path dependent (Lall 2000) and are shaped by a variety of factors encompassing from firm-specific factors to the macro-economic policy factors and differ substantially across industries. A better understanding of these factors is clearly called for formulating appropriate policies to effect the transformation into knowledge-intensive export structure.

This paper seeks to identify factors that are important for export success of Indian manufacturing enterprises, particularly in the global high technology industries. In the study, *export competitiveness is measured in terms of degree of export-orientation.* The structure of the paper is as follows. Section 2 discusses analytical framework and hypotheses on several possible determinants of the export performance of Indian enterprises. The empirical analysis and findings are summarized in Section 3. Section 4 provides concludes with a few policy remarks.

## 2 Determinants of Export Behaviour: The Analytical Framework and Hypotheses

The export behaviour of a firm generally involves two important decisions: whether to export or not and if the decision is to export, then how much to export. Hence depending upon these decisions there are two groups of firms in a particular industry: one group which participates in exporting and another which does not. In this context, the export competitiveness variable, export intensity, takes on the value zero for the latter group of firms and takes on the actual export level as a share of sales for the former group of firms. In such a case where the value of dependent variable is not observed for a large proportion of cases, the most appropriate choice is to employ a Tobit model. The Tobit model characterizing export behaviour of Indian manufacturing firms is specified as:

$$\begin{aligned} EXPOINT_{it} &= X_{it}\beta + u_{it} \qquad if\ X_{it}\beta + u_{it} > 0 \\ &= 0 \qquad\qquad\qquad if\ X_{it}\beta + u_{it} = 0 \end{aligned} \tag{1.1}$$

Where $X_{it}$ is a vector of $k$ ($k$=1…$k$) factors that explain the export intensity ($EXPOINT_{it}$) of $i$th firm in $t$th period. • is the vector of Tobit coefficients and $u_{it}$ is a normally distributed error term.

As the Tobit analysis explains two types of decisions viz. whether to export and if so how much, Tobit coefficients combine two types of effects respectively. McDonald and Moffitt's (1980, p.318) decomposition enables one to disaggregate the Tobit coefficients into these two types of effects:

$$\frac{\partial E(EXPOINT)}{\partial X_k} = F(z)\left(\frac{\partial E(EXPOINT^*)}{\partial X_k}\right) + E(EXPOINT^*)\left(\frac{\partial F(z)}{\partial X_k}\right) \tag{1.2}$$

Where F(z) is the cumulative normal distribution function for the proportion of cases above the limit. E(*EXPOINT*) is the expected value of export intensity for all cases (firms exporting and not exporting). E($EXPOINT^*$) is the expected value of export intensity for cases above the limit (firms with exporting). $\partial E(EXPOINT^*)/\partial X_k$ is the change in the expected value

of export intensity of exporting firms. $\partial F(z)/\partial X_k$ is the change in the cumulative probability of exporting for non-exporting firms associated with an independent variable.

Thus, equation (1.2) states that the total change in export intensity consists of two effects: (1) the change in export intensity of exporting firms, weighted by the probability of exporting; and (2) the change in the probability of exporting, weighted by the expected value of export intensity of exporting firms.

Furthermore, for exporting firms $\partial E(EXPOINT^*)/\partial X_k$ and for non-exporting firms, $\partial F(z)/\partial X_k$ are given by:

$$\frac{\partial E(EXPOINT^*)}{\partial X_k} = \beta_k * \left[1-(z*\frac{f(z)}{F(z)}-\frac{f(z)^2}{F(z)^2}\right]$$

$$\frac{\partial F(z)}{\partial X_k} = \beta_k * \left[\frac{f(z)}{\sigma}\right] \qquad (1.3)$$

Where f(z) is the unit normal density, $\sigma$ is the standard deviation of the error term that tobit programs ordinarily report and $\beta_k$ is the ordinary tobit coefficient associated with $X_k$.

In (1.3) the bracketed term in $\partial E(EXPOINT^*)/\partial X_k$ gives the fraction of the total effect of k*th* independent variable that is on account of the effect of being above the limit. The fraction of total effect associated with the effect of export probability of firms without exporting can be obtained by subtracting 1 from the bracketed term. It is important to note the fraction of any independent variable's effects on cases above the limit always remains the same since F(z), f(z) and z remain the same for a particular tobit estimation. This procedure will be followed to estimate these two effects for deriving more information than what ordinary Tobit coefficient generally provide.

We may now proceed to identify possible determinants of export decision to be included in $X_k$. Following the earlier theoretical and empirical literature on the determinants of export activity at firm-level, the study posits that export activity of Indian manufacturing firms may depend upon three set of factors- firm-specific factors, sector-specific characteristics and policy inducements. The set of firm-specific determinants includes variables like firm age, size, enterprise-level technological efforts, product differentiation activities, raw material import intensity, productivity, profit margins, outward investments and foreign affiliation. The set of policy factors include two set of factors- (1) those directly affecting firms export behaviour by giving fiscal benefits where exporting companies can claim duty-drawbacks or cash compensatory support or benefit under the international price re-imbursement scheme; (2) those indirectly affecting firms export behaviour by changing business environment in which firms are operating like policies relating to FDI, imports, and other regulatory system.

**2.1 Firm-specific determinants**

*2.1.1 Firm Size and Export Behaviour*

Literature on export behaviour has since long analyzed the relationship between firm size and exporting (for a survey see Bonaccorsi, 1992; Calof, 1994). In this literature very often the working hypothesis is a positive relationship between firm size and export behaviour. The firm size is argued to be a proxy for resource base, risk perception and economies of scale is thought to determine the export attitude and performance in a developmental and sequential manner. The smaller firms are characterized by resource constraints, they may be more risk-averse and scale-inefficient. The larger firms on the contrary reflect success in achieving scale economies, higher

profitability, have preferential access to credit and hence more ability to withstand uncertainty associated with global markets. However, the existing literature has mixed findings on the relationship between firm size and export behavior. Some studies find a positive relationship between firm size and export intensity whereas others report an insignificant relationship, while some studies reporting a non-linear relationship. Roberts and Tybout (1997) estimated a dynamic probit model with plant random effects, found that firm size, apart from the firm's prior exporting experience, its age and its affiliation to multi-plant firms favorably affect the export entry decision by Colombian firms[3]. Using a Tobit framework Kumar and Siddharthan (1994) observed that the relationship between firm size and export intensity is predominantly an inverted U-shape for Indian manufacturing comprising of 13 broad industries based on a panel data of 640 firms for the period 1987-88 to 1989-90. Another recent study based on a sample of 3,659 Italian manufacturing firms over 1989-1991 finds the estimated relationship between firm size (measured by one year lagged total sales) and export intensity to be of an inverted U-shape within the group of small firms, not significant for medium sized firms and negative, but U-shaped for large firms (Sterlacchini, 2001). In view of the possible non-linearity in the relationship between firm size (SIZE) and export performance the present study has employed SIZE and $SIZE^2$ as determinants of export behaviour.

*2.1.2 Enterprise-Level Technological Efforts and Export Behaviour*

Technology is postulated to explain inter-firm variation in export behavior as it can significantly determine both price and non-price segment of international competitiveness. Technological change can cause both higher productivity of firms and better quality of the product. In the recent literature, technology has been postulated as endogenous to the system and cannot be assumed to be a set of blueprints freely available to the firm. Since technology embodies specific, local, often tacit, and only partly appropriable knowledge, firms must make efforts to develop their innovative capabilities. In a broader sense technical capability of a firm includes its ability to operate, to absorb, and to create technological knowledge encompassing entrepreneurial, managerial and technical components. However, developing countries' firms have little technological capability in the sense of technology creation and are heavily dependant on the imports of technology from abroad. Their R&D activity is generally meant for local adaptation of those technologies or minor improvements thereof. Following the literature three measures of technological efforts has been considered. First, the firm's own technological efforts to adapt or innovate, measured as the in-house R&D expenditure as a percentage of sales (*RDINT*). Second, technological payments as a percentage of sales have been used as a proxy for the firm's propensity to import disembodied technology from abroad (*DISTECH*). Third, the import of capital goods incorporating latest knowledge and innovations by the firm as a share of total sales has also been used (*EMTECH*). The empirical findings on R&D and export performance are predominantly indicative of a positive relationship. Wakeline (1998) has estimated a Tobit as well as a truncated regression model to investigate the role of innovation in determining export behaviour of a sample of 320 UK firms over the 5 years from 1988-1992. She found that the firm's probability to export positively depend upon the number of firm innovations and the level of innovation in the sector, while firm innovating dummy decreases it. The production of innovations at the sector level was observed to depress firm's intensity to exporting. Braunerhjelm (1996) through OLS framework on a sample of 250 Swedish manufacturing firms obtained that the stock of intangibles (derived from firm's investment in

[3] Bernard and Jensen (1999) in the case of the US manufacturing firms and Bernard and Wagner (2001) in the case of German manufacturing corroborate the favourable effect of firm size measured in terms of employment to have a positive effect on the probability of exports.

R&D, marketing, software and education) per employee and current R&D expenditure per employee have significant positive impact on firm's export intensity. Among developing country studies, Kumar and Siddharthan (1994) found that R&D intensity positively affects export intensity only in 4 industries that belong to low or medium technology industries out of a total 13 Indian manufacturing industries. From this the authors infer that the own innovative activity of a firm in developing countries like India may not be adequate to provide competitive edge in high technology industries.

*2.1.3 MNE Affiliation and Export Behaviour*

Affiliation with foreign MNEs may matter a great deal in accessing and succeeding in the global market. Before a firm can decide to enter into exporting it has to collect and analyze information on various aspects of foreign market such as consumer preferences, regulations, distribution channels and other market characteristics. For a purely domestic firm this collection of information on new markets involve considerable financial and other costs as compared to firms with foreign ownership. Foreign firms usually have a bundle of both proprietary and non-proprietary assets, which provides them with competitive advantage over local firms in production, distribution and marketing (Caves, 1971; Hymer, 1976; Dunning, 1979) and also considerably decreases the sunk entry costs to exporting (Sjöholm, 1999). The set of proprietary assets include technology, brand names, skills, organizational expertise, marketing and distribution networking and the set of non-proprietary assets comprise of finance, capital goods and intermediate inputs. With these sets of assets foreign firms' probability to enter into export market and to perform better is supposed to be higher than those for local rivals. Further in exports markets for knowledge-based products which are characterized by significant technological and marketing entry barriers the export-enhancing role of foreign firms may be critical due to scarcity of the requisite technology and knowledge in developing countries. However, the possibility that foreign firms can play an important role in export performance of foreign firms does not rule out the opposite scenario. In fact whether foreign subsidiaries in developing countries like India will participate in export activity or not depends very much on the overall corporate strategy of the MNE. To achieve global profit maximization and to ensuring that exports from one affiliates do not steal market of another subsidiary, parent tends to exercise control over subsidiary's involvement in export markets. The higher the marketing and technological barriers to entry, the more may be the parental control on affiliates by a larger degree of equity control or by controlling the export distribution processes (Torre 1971; Singh 2001). Previous studies on the role of foreign firms in promoting export from India however did not find any statistically significant difference in the export behaviour of firms on account of ownership (Kumar, 1990; Kumar and Siddharthan, 1994). Both these studies relate to the pre-reform period and hence it was suggested that with a large protected market, firms in Indian economy irrespective of its ownership are inclined to domestic market rather than costly and risky exporting activity. In a recent study on Indian manufacturing, Aggarwal (2001) found a weak support that foreign firms have performed better than local firms in the post reform period 1996-2000. However the result is not robust across various technology groupings and the foreign ownership dummy turns out to be significant at ten-percent level only in the case of medium-high-technology industries. The other measures of MNE affiliation, namely, foreign equity share was observed to have insignificant impact in most of the cases. Sjöholm (1999) in a study on Indonesian manufacturing reported a positive and statistically significant coefficient of foreign ownership in the Tobit estimation for all establishments as well as majority of industry estimations. Athukorala et al (1995) have distinguished foreign firms operating in developing countries into two distinct categories: Third World multinational enterprises (TWMNEs) and

developed country MNEs (DCMNEs). The estimated results on the export decision of firms in Sri Lankan manufacturing indicate that there is no significant difference between domestic firms and DCMNEs but the affiliates of TWMNEs perform significantly better. However, none of the explanatory variables including MNEs affiliation dummy turns out to be significant in the export level equation. In the present study we have included a dummy variable (*FODUM*) to represent foreign affiliates in Indian manufacturing and expect a positive coefficient for the same.

*2.1.4 Outward Foreign Direct Investment and Export Behaviour*

The relationship between outward investment and home country export has been intensively examined in the literature (Lipsey and Weiss 1981, 1984; Lipsey, Ramstetter and Blomstrom 2000; Svensson, 1996; Pfaffermayr 1996; Egger 2001). These studies, mainly based on developed economies, predominantly suggest a significantly positive relationship between the two. Lipsey and Weiss (1981, 1984) in a study of US exports to a cross-section of 44 foreign destinations, found US manufacturing affiliates abroad promoting US exports but negatively influencing exports by foreign countries. This finding of complementary relationship between overseas production and home country exports was quite consistent over 14 manufacturing industries being studied. Complementary between outward FDI and exports also have been reported for Australian manufacturing by Pfaffermayr (1996), for Sweden by (Swendenborg, 1973, 1979, 1982), for Japan by Lipsey et al (2000) and Head and Reis (1999). A few studies have reported a substituting relationship between outward foreign direct investment and home country exports. Svensson (1996) and Braunerhjelm (1996) for Swedish firms found that foreign production has consistently negative impact on firm's export. Egger (2001) in a dynamic panel data estimation of bilateral intra-EU exports and outward FDI relationship does not find any statistically significant impact of the cross-effects between exports and stock of outward FDI. Blonigen (1999) found that Japanese automobile production in the United States has a statistically significant positive relationship on imported Japanese automobile parts whereas Japanese automobile parts production in the United States has a strong substitution relationship with U.S. imports of Japanese automobile parts.

The overwhelming evidence reviewed above clearly indicates to a positive relationship between outward investment and home country exports at least in the case of developed countries. There is hardly any econometric study on the relationship between home exports and outward investment in the case of developing countries. This is because outward investment is a relatively new activity for developing country enterprises. The present study attempts to bridge this gap by providing evidence from a developing country like India.

Whether the outward investment made by a firm substitute or complement its exports largely depends upon the motivations behind that investment. Kumar (1995) based on motivations classified FDI originating from developing countries into four types namely market seeking, trade supporting, efficiency seeking and strategic asset seeking FDIs. In the initial round of evolution during 1970s the FDI flows from developing countries were primarily destined to developing countries and generally belonged to the market seeking and efficiency seeking type. Such FDIs have originated in order to overcome protection in the targeted markets and/or exploiting their competitive advantage in small scale, labour-intensive production technique in combination with various locational advantages like availability of cheaper raw materials, cheap labour costs offered by host developing countries (Lecraw, 1977, 1992; Lall, 1986). Since 1980s the quantum of outward FDI from developing country has significantly increased and their motivations also have changed. They are now increasingly located in developed countries and increasingly becoming trade supporting and strategic assets seeking type (Kumar, 1995). LDCs investment in developed countries are motivated by different set of motivations as compared to

other developing countries (Brouthers et. al, 1996). Generally LDCs firms may not be having much emphasized traditional firm specific ownership advantages like technological, marketing and brand superiority to compete in a developed country market. Therefore, their motivation is more likely to be getting access to technology, brand names, and market (i.e. strategic type) or trade supporting in that to create marketing network and to provide aftersales services. With an increasingly liberalizing global trade regime concurrent with the fact that competitiveness is driven more by technology and quality, the motivation for outward investment is increasingly to set up trade supporting affiliates in the overseas markets. Therefore it can be argued that the outward investment by firms in a developing country like India may be more of trade supporting type and hence can be expected to encourage export of the parent.

As far as probability of exporting is concerned it can be argued that the enterprises that have not invested abroad are likely to have lower probability of exporting as compared to those undertaking investment abroad. The latter set of firms through their affiliates can have easy access to information regarding taste and preference of foreign consumers, legal provisions governing foreign markets and can further ensure more flexibility, punctual delivery and faster response in dealing with global buyers. Another critical component of export success, namely provision of product specific services like instruction, installation, repairs, providing spares can also be ensured through subsidiaries. Obviously firms that are exporting but do not have any foreign presence can be predicted to exhibit lower propensity to exports than firms that are exporting as well have foreign presence. In the study we have used the age of multinationality i.e. number of years the firm is in foreign operation as a proxy for outward direct investment from India (*INDMNE*). This measured has been preferred over the stock data as the latter not only suffers from the problem of historical prices but also have less intra-firm variance over time. We expect that the firm's export performance is positively related to its status as well as operation intensity of outward investment as reflected by the employed variable.

### 2.1.5 *Other Determinants: Age, Product Differentiation, Raw Material Imports, Productivity, and Profitability*

*Age*

The age of the firm is an important determinant of its export behavior. Age can be a surrogate for the accumulated past experiences and skills on production, organization and marketing. Firms who have been in the market for a very long time are likely to develop significant firm-specific advantages relative to start-ups and hence are expected to have relatively higher export possibility and performance. Therefore, a positive relationship between age (*AGE*) and export performance has been postulated.

*Product Differentiation*

The product differentiation strategy of a firm could be predicted to have an effect on its export behaviour. This fact may be especially true in the case of export markets for knowledge-based industries that are characterized by significant marketing entry barriers. A firm that can offer its product with a wide ranging marketing characteristics, innovative designs and with globally recognized brand name is more likely to exploit exports markets than a firm without such marketing skills and knowledge. However, manufacturing firms in developing countries like India usually lag behind in these respect compared to their developed country counterpart (Torre, 1971). Nevertheless, firms those are incurring large advertising and other sales promotion costs to differentiate their products from others (i.e. building brand images) and to achieve

innovative design capability are theoretically better placed to have higher export possibility and export performance. In the study we have used firms expenses incurred on advertising and sales promotion, marketing and distribution of products as a percentage share total sales (*PRODIFFINT*) to capture the product differentiation strategy and it is expected to positively determine the possibility and extent of export activity.

*Raw Material Imports*

Sourcing of raw materials abroad by the firm can have positive impact on its export behavior. There are two obvious channels in this case. Firstly, to the extent imported raw materials are qualitatively better or are more competitive in terms of costs than local alternative this will enhance the productivity of the importing firm. Secondly, the foreign suppliers may pass on important information regarding foreign markets even including technical information and thus can serve as a channel of market access. Hence, firms sourcing of raw materials abroad as measured by expenses on raw material imports as a percentage of sales (*IMRINT*) can be expected to positively affect firms export activity.

*Productivity*

More productive firms are expected to do better in international market than less efficient firms. Productive firms relatively use resources efficiently and hence in turn are low cost producers, which provides them comparative advantage in exporting. Productivity of a firm has been defined as the value-added per unit of wage cost. We are convinced that this measure of productivity is no substitute for total factor productivity but given the fact that our data set provides gross fixed asset of firms at historical prices and without any information about the depreciation rate, it leaves us with no other option in this case. Using labor productivity as a measure of productivity has obvious advantage that it not only captures the inter-firm skill differential but also differences in capital-intensity. A firm can have higher productivity because it is using higher skilled labour or higher capital intensity or both. Whatever may be the cause of the productivity (*PRODVITY*) of the firm it is expected to affect its export competitiveness favorably.

*Profitability*

Profitability can also be an important determinant of export behaviour at the firm level. It can serve as an indicator of managerial skills and also capture the tax concessions granted by the government for export activity as only the profitable firms are able to benefit from them. Moreover profitable firms are better placed as compared to unprofitable firms in terms of resources to withstand the risks attach with export activities. Hence a positive relationship between profitability (*PROFITMARGIN*) and export behaviour has been postulated.

**2.2 Sector-specific characteristics**

The export behaviour of firms can be expected to vary over industries. Perhaps the most obvious industry specific effects may arise because of comparative advantages and implied industry specific specialization of the country. The learning to exporting effects from exporters to non-exporters also varies across industries. The potential to exporting is larger in those industries where there is a large share of exporters because it is now less costly for non-exporters to enter into foreign markets because of information diffusion regarding demand condition abroad, distribution system or legal and institutional set up of foreign markets (Bleaney and Wakelin, 1999). Inter-industry export differential may also emanate from the fact that firms differ in their created intangible assets, competitive rivalry and resultant market performances

over industries. Another reason could be the fact that government regulation and policy regimes differ over industries. Therefore, it is important to control for industry specific effects in the investigation of firm level export determinants. The present study has included a set of industry dummies ($\Sigma_j SECDUM_j$) in the estimation to capture industry specific effects.

**2.3 Policy-specific factors**

There has been a radical shift in the policy regime governing trade, industry and technology with the initiation of economic reforms in India in 1991. The basic objective of trade policy reforms was to increase global competitiveness of the Indian economy to lay the foundations for sustained economic growth. With the objective of accelerating and achieving a higher export growth path, various direct and indirect measures of trade promotion like tax benefits, simplifying export credit scheme and green cards for exporters, establishing Special Economic Zones (SEZs), more flexible Duty Exemption Scheme to take care of import needs of the exporters, Golden status certificate for export and treading houses, allowing higher FDI participation through automatic route, incentives for R&D and creation of a Technology Upgradation Fund Scheme, etc., have been implemented. It also saw phasing-out of many qualitative and quantitative restrictions (i.e. delicensing, lower tariffs and reclassification of tariff categories) over imports because imports of capital goods, raw materials and components were thought to determine the global competitiveness of Indian enterprises. FDI was encouraged because it can brings in intangible assets like technology, organizational skills, marketing strategy, and market access, which can improve India's export performance in the world market as it did in the outward oriented economies of the East Asia like Singapore, Malaysia and Hong Kong. Therefore policy factors can be grouped into two groups- direct export promotion incentives and policies affecting exports through indirectly. We have used following two proxies to capture the effects of these two sets of policy measures:

*2.3.1 Direct export promotion incentives*

The fiscal benefits that a firm is obtaining on account of several export promoting scheme like duty-drawbacks, Cash Compensatory Support (CCS) and International Price Reimbursement Scheme (IPRS) etc., has been used as the proxy for government policies directly affecting export activity. Under the scheme of duty-drawbacks Indian exporters are compensated for the customs and excise duties on inputs used in the manufacture of exported products. The scheme of IPRS was introduced in 1981 to offset the gap between international and domestic prices on components used in export manufactures. The CCS scheme was introduced in the early sixties in which government used to give cash support to the exporters based on total exports as a partial refund for various indirect taxes levied. To encourage exports from India several other export promotion scheme also were resorted like replenishment import licence, tax exemption of export income, subsidised export credit, export credit insurance etc. However, many of these incentive schemes are been rationalized or withdrawn in the process of economic reforms but still one would expect that fiscal benefits as a percentage share of sales (*FISCALINT*) derived from government export promotion measures have a favorable impact the export behaviour of Indian enterprises.

*2.3.2 Liberalization*

The impact of other measures that came into place with economic reforms and can indirectly affect export activities has been represented by a dummy variable (*LIBDUM*) taking value zero for pre-reform period (1989-90 to 1992-93) and unity for reform-period (1993-94 to 2000-01). A foreign trade regime that promote and support outward orientation can be expected

to create a conducive business atmosphere in which both firm's probability to export and to perform better increases considerably. Lowering of the level of protection force domestic firms to increase their productivity to stay in the business by both utilizing resources efficiently and constantly upgrading and improving their technological capability. Firms can easily import required intermediate inputs and capital goods for their production and this can in turn provide them required efficiency to enter into export market. Also many of the legal and administrative hurdles that were present during import-substituting period and were responsible for creating distortion in resource allocation are no more there or even if these exist their restrictive role is moderate. Therefore, a positive coefficient for *LIBDUM* in export behaviour has been postulated.

After identifying various possible factors which may determine export competitiveness of Indian manufacturing firms, the final estimable form of the model can be obtained by incorporating theses factors explicitly into the model (1.1):

$$
\begin{aligned}
EXPOINT_{it} = {} & \beta_0 + \beta_1 AGE_{it} + \beta_2 SIZE_{it} + \beta_3 SIZE_{it}^{\,2} + \beta_4 RDINT_{it} + \beta_5 DISTECH_{it} \\
& + \beta_6 EMTECH_{it} + \beta_7 IMRINT_{it} + \beta_8 PRODIFFINT_{it} + \beta_9 PRODVITY_{it} \\
& + \beta_{10} FISCALINT_{it} + \beta_{11} PROFITMARG IN_{it} + \beta_{12} INDMNE_{it} + \beta_{13} FODUM \\
& + \beta_{14} LIBDUM + \sum_j \beta_j SECDUM + u_{it} \qquad \text{if } X_{it}\beta + u_{it} > 0 \\
= {} & 0 \qquad \text{if } X_{it}\beta + u_{it} \leq 0 \qquad (1.4)
\end{aligned}
$$

# 3. Empirical Analysis

## 3.1 The Data Set

The model (1.4) has been estimated by the pooled Tobit regression for a sample of 4,263 Indian manufacturing firms with 32,217 observations over the period 1989-90 to 2000-01. There are 18,576 observations associated with exporting firms and about 13,641 observations belong to non-exporters. As the primary focus of the study is on knowledge-based industries, these firms are grouped into four technological sub-samples following the OECD revised technological classifications as provided in OECD Science, Technology and Industry Scoreboard, 2001: (1) high technology, (2) medium-high technology, (3) medium-low technology and (4) low technology industries. Details about this classification and measurements of variables have been provided in the Appendix. The database used in the study is an exclusive *RIS-DSIR* database that has been created in RIS from different sources as a part of the present study. The RIS-DSIR database has been created in two phases. In the first phase, data on Indian firms undertaking outward foreign direct investment has been obtained mainly from the published source of India Investment Centre (IIC) supplemented by the unpublished data from the Ministry of Commerce and Ministry of Finance, Government of India. The constructed dataset contains information on name and address of both the Indian and Foreign Collaborator, activity of collaboration, the amount and share of Indian equity capital, year of approval of projects and the status of the projects i.e. whether it is in operation or under implementation or cancelled. Finally, the collected firm-level data on Indian investment abroad has been merged with the firm-level financial data obtained from the Prowess Data Base (2002) of the Centre for Monitoring Indian Economy (CMIE).

## 3.2 Estimation Procedure

The Tobit models will be estimated with maximum likelihood robust standard errors obtained from STATA. These standard errors are Huber-White estimates of standard errors and are robust to the problem of non-normality and heteroscedasticity in the residual variance. Two types of marginal effects in the framework of McDonald-Moffitt decomposition has also been

provided to further understand the probability and intensity effects of each independent variable. Further, to determine the relative importance of independent variables in explaining the export behaviour of Indian firms, fully standardized coefficients have been presented. In view of the panel structure of the dataset, it would have been useful to estimate a fixed effects Tobit model taking account of firm-specific heterogeneity. However, theoretical developments on conditional fixed-effects Tobit model are still in infancy and there does not exist a sufficient statistic allowing the fixed effects to be conditioned out of the likelihood and hence we are unable to provide results from fixed effects. Results from unconditional fixed-effects can be obtained by including firm-specific dummies in the Tobit estimation but results obtained will be biased and inferences drawn on those results will be misleading. Random-effects Tobit model has not been preferred as the test of *quadchk* in STATA indicate that estimating a random-effects Tobit model by quadrature approximation is not stable and hence is not appropriate for our model[4].

We have also checked our dataset for severity of multicolliearity that can contribute to inflating standard errors for the estimates. Two statistics have been computed for detecting multicollinearity namely, variance inflating factor (VIF) and condition index (CI) which are presented in the appendix. It can be seen all VIFs are below 4 and are nowhere near to the rule of thumb of 10 exceeding which indicates existence of strong collinearity. The same conclusion that a moderate level of multicollinearoty characterizes our dataset can be reached by employing the thumb rule in the case of CI[5].

### 3.3 Estimates for the Overall Manufacturing and Broad Technology Classes

Tables 1-3 summarize the estimation results for the overall manufacturing and sub-samples based on technology-intensity. It can seen that the estimated models for total sample as well as technology sub-samples are highly significant as indicated by very high value of Wald Chi-square statistic. This suggests that the various determinants of export behaviour taken together contribute significantly to the explanation of export competitiveness of Indian enterprises. To get a rough idea about the power of explanation of the fitted model we have provided adjusted R-square obtained from OLS estimation. Had these model been estimated by the standard OLS estimation then the explanatory power of the model would have been about 31 percent in the case of total sample and ranges within 61-11 percent in the case of technology sub-samples estimation. Given the fact OLS estimate are biased as it ignore the censuring nature of dependent variable and also ignore the panel-specific heterogeneity the explanatory power of the fitted models is quite reasonable. The performance of individual variables in the export performance of Indian enterprises is discussed below.

[4] To estimate random-effects tobit models STATA uses Gauss-Hermite quadrature to approximate the high-dimension integrals that are part of the likelihood for these models. Even though quadrature is one of the most accepted approaches to estimating these models there are case where it can be poor like in case of large panel size, high within panel-correlation or variable that are constant or near constant within panel. Quadchk is the quadrature check for determining whether the quadrature is stable for a particular model or not. See Vince Wiggins (March 2001) in STATA FAQ statistics 'Obtaining different results when executing xttobit on the same data in different sessions'.

[5] A condition index greater than 30 indicate strong collinearity. See Peter Kennedy (1992) A Guide to Econometrics, MIT Press, Cambridge.

**Table-1 Pooled Tobit Estimation of Export Intensity (%) for Overall Manufacturing**

| *Dependent variable: Export intensity (%)* | | | | |
|---|---|---|---|---|
| *Independent Variables* | *Coefficients (Robust Z-value)* | *McDonald-Moffitt Decomposition* *Marginal effects at means* | | *Fully standardized coefficients* |
| | | $\partial E(EXPOINT^{*})/\partial X_k$ | $\partial F(z)/\partial x_k$ | |
| | (Column-A) | (Column-B) | (Column-C) | (Column-D) |
| AGE | -0.02793870*** (3.34) | -.0099648 | -.0003689 | -0.0172 |
| SIZE | 0.00290833*** (5.39) | .0010373 | .0000384 | 0.0377 |
| $SIZE^2$ | -2.28e-07*** (4.36) | -8.12e-08 | -3.01e-09 | -0.0304 |
| RDINT | 0.11394092** (2.35) | .0406388 | .0015046 | 0.0189 |
| DISTECH | -0.00518708*** (2.96) | -.0018501 | -.0000685 | -0.0311 |
| EMTECH | 0.00447642*** (31.90) | .0015966 | .0000591 | 0.3734 |
| IMRINT | 1.08004599 (1.57) | .3852154 | .0142623 | 0.0325 |
| PRODIFFINT | 0.00207624 (0.99) | .0007405 | .0000274 | 0.0124 |
| PRODVITY | 0.00198846*** (5.55) | .0007092 | .0000263 | 0.0955 |
| FISCALINT | 0.98532974*** (11.14) | .3514332 | .0130115 | 0.1056 |
| PROFITMARGIN | 0.00758273*** (4.95) | .0027045 | .0001001 | 2.1001 |
| INDMNE | 1.27247244*** (19.22) | .4538472 | .0168034 | 0.0859 |
| FODUM | 6.71116967*** (10.94) | 2.53821 | .0882929 | 0.0491 |
| LIBDUM | 5.86857686*** (14.21) | 2.024556 | .0771188 | 0.0715 |
| D_Textile & leather | 17.10340151*** (20.88) | 6.809152 | .2206513 | 0.1986 |
| D_Wood & paper | -13.73384638*** (13.00) | -4.330483 | -.1748735 | -0.0809 |
| D_Rubber & plastic | 0.40612646 (0.46) | .1453451 | .0053638 | 0.0033 |
| D_Other non-metallic mineral products | 58.17711510*** (19.07) | 35.30328 | .4885128 | 0.1551 |
| D_Cement & glass | -5.08061392*** (5.36) | -1.731242 | -.0666592 | -0.0318 |
| D_Metal | -1.56855911* (1.91) | -.5528539 | -.0206942 | -0.0152 |
| D_Chemicals | -2.37100216*** (2.72) | -.8301169 | -.0312567 | -0.0218 |
| D_Electrical machinery | -1.28202417 (1.43) | -.4521167 | -.0169153 | -0.0088 |
| D_Non-electrical machinery | 4.73089242*** (5.94) | 1.758642 | .0623954 | 0.0343 |

| | | | | |
|---|---|---|---|---|
| D_Transport equip. | 2.99177020*** (3.64) | 1.095808 | .0395067 | 0.0204 |
| D_Pharmaceuticals | 8.82963219*** (9.39) | 3.40387 | .1156963 | 0.0633 |
| D_Electronics | 4.64279574*** (4.48) | 1.727119 | .061233 | 0.0293 |
| Constant | -10.30351373*** (12.90) | -3.674909 | -.1360607 | |
| | | | | |
| Sigma | 30.19626 | | | |
| Log likelihood | -98569.68 | | | |
| Wald chi2(26) | 29716.67 | | | |
| Prob > chi2 | 0.0000 | | | |
| Observations | 32217 | | | |
| Obs with exporting | 18576 | | | |
| Obs. With non-exporting | 13641 | | | |
| Adj R-squared | 0.3147 | | | |

Note: Absolute value of robust Z-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%; Marginal effects for dummy variable is for discrete change from 0 to 1; Adj R-squared is from OLS estimation of the model; Food,bev.& tobacco products has been treated as the base category in the estimation.

**Table-2 Pooled tobit estimation of export Intensity (%) over high technology and medium-high technology sub-samples**

| *Dependent variable: Export intensity (%)* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Independent Variables* | *High Technology* | | | | *Medium-high Technology* | | | |
| | *Coefficients (Robust Z-value)* | *McDonald-Moffitt Decomposition* | | *Fully standardized coefficients* | *Coefficients (Robust Z-value)* | *McDonald-Moffitt Decomposition* | | *Fully standardized coefficients* |
| | | *Marginal effects at means* | | | | *Marginal effects at means* | | |
| | | $\partial E(EXPOINT^{*})/\partial X_k$ | $\partial F(z)/\partial x_i$ | | | $\partial E(EXPOINT^{*})/\partial X_k$ | $\partial F(z)/\partial x_i$ | |
| AGE | -0.08357746*** (3.84) | -.0335013 | -.0012397 | -0.0501 | 0.02555591** (2.16) | .0095366 | .0004986 | 0.0193 |
| SIZE | 0.01407524*** (3.81) | .0056419 | .0002088 | 0.1122 | 0.00075018 (1.20) | .0002799 | .0000146 | 0.0144 |
| $SIZE^2$ | -7.80e-06*** (3.83) | -3.12e-06 | -1.16e-07 | -0.1083 | -2.21e-07*** (2.73) | -8.24e-08 | -4.31e-09 | -0.0262 |
| RDINT | 0.61514298*** (4.29) | .2465748 | .0091242 | 0.0802 | 0.10658923*** (3.35) | .0397757 | .0020796 | 0.0276 |
| DISTECH | -0.20443354*** (2.68) | -.0819469 | -.0030324 | -0.4599 | -0.58514778*** (3.02) | -.2183583 | -.0114167 | -0.1102 |
| EMTECH | 0.00762872 (0.63) | .003058 | .0001132 | 0.0222 | 0.00439587*** (111.05) | .0016404 | .0000858 | 0.5037 |
| IMRINT | 8.55457435** (2.21) | 3.429028 | .1268877 | 0.3488 | 14.76195934*** (3.98) | 5.508688 | .2880181 | 0.1708 |
| PRODIFFINT | -0.00669942 (0.16) | -.0026854 | -.0000994 | -0.0053 | 0.03280484** (2.31) | .0122417 | .00064 | 0.0612 |
| PRODVITY | 0.00081098 (1.42) | .0003251 | .000012 | 0.0543 | 0.00430047*** (4.32) | .0016048 | .0000839 | 0.1197 |
| FISCALINT | 2.85446039*** (10.86) | 1.144186 | .0423394 | 0.2199 | -0.19242736*** (4.56) | -.0718077 | -.0037544 | -0.0437 |
| PROFITMARGIN | 0.00639041 (1.30) | .0025616 | .0000948 | 0.2691 | 0.00622301** (2.12) | .0023222 | .0001214 | 0.1927 |
| INDMNE | 1.67730245*** (7.18) | .6723322 | .024879 | 0.1229 | 0.73946518*** (9.76) | .2759446 | .0144276 | 0.0718 |
| FODUM | 6.97005534*** (4.23) | 2.974194 | .1007744 | 0.0747 | 3.88432407*** (5.90) | 1.515037 | .0752243 | 0.0507 |
| LIBDUM | 3.50474396*** (3.37) | 1.371451 | .0522558 | 0.0493 | 2.37430819*** (4.87) | .8700445 | .0463399 | 0.0415 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| D_Electrical machinery | | | | | -1.70953959** (2.48) | -.6285504 | -.0333714 | -0.0282 |
| D_Non-electrical machinery | | | | | 3.16556098*** (5.15) | 1.212148 | .0615284 | 0.0543 |
| D_Transport equip. | | | | | 1.33351930** (2.09) | .5035727 | .0259855 | 0.0218 |
| D_Pharmaceuticals | 4.00390156*** (3.67) | 1.595648 | .0594311 | 0.0712 | | | | |
| D_Electronics | | | | | | | | |
| Constant | -4.69697965*** (3.52) | -1.882744 | -.069669 | | -5.21067981*** (6.46) | -1.944458 | -.1016647 | |
| | | | | | | | | |
| Sigma | 26.53365 | | | | 20.4271 | | | |
| Log likelihood | -11863.023 | | | | -27512.329 | | | |
| Wald chi2 | 437.61 | | | | 41189.11 | | | |
| Prob > chi2 | 0.0000 | | | | 0.0000 | | | |
| Observations | 3491 | | | | 9041 | | | |
| Obs with exporting | 2354 | | | | 5687 | | | |
| Obs. With non-exporting | 1137 | | | | 3354 | | | |
| Adj R-squared | 0.1090 | | | | 0.4315 | | | |

Note: Absolute value of robust Z-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%; Marginal effects for dummy variable is for discrete change from 0 to 1; Adj R-squared is from OLS estimation of the model; electronics and chemicals have been treated as the base category for high technology and medium technology sub-sample respectively.

**Table-3 Pooled tobit estimation of export Intensity (%) over medium-low technology and low technology sub-samples**

| *Dependent variable: Export intensity (%)* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Independent Variables* | *Medium-low Technology* | | | | *Low Technology* | | | |
| | *Coefficients (Robust Z-value)* | *McDonald-Moffitt Decomposition* | | *Fully standardized coefficients* | *Coefficients (Robust Z-value)* | *McDonald-Moffitt Decomposition* | | *Fully standardized coefficients* |
| | | *Marginal effects at means* | | | | *Marginal effects at means* | | |
| | | $\partial E(EXPOINT^*)/\partial X_k$ | $\partial F(z)/\partial x_i$ | | | $\partial E(EXPOINT^*)/\partial X_k$ | $\partial F(z)/\partial x_i$ | |
| AGE | 0.08019553*** (4.40) | .0277473 | .0012278 | 0.0417 | -0.09803892*** (6.14) | -.0321941 | -.001004 | -0.0593 |
| SIZE | 0.00741742*** (8.94) | .0025664 | .0001136 | 0.1389 | 0.02040860*** (9.52) | .0066938 | .0002087 | 0.1139 |
| $SIZE^2$ | -4.76e-07*** (8.26) | -1.65e-07 | -7.29e-09 | -0.1155 | -3.03e-06*** (8.35) | -9.95e-07 | -3.10e-08 | -0.0946 |
| RDINT | 0.04056243** (2.40) | .0140344 | .000621 | 0.0101 | -0.24509042 (0.55) | -.0805136 | -.0025108 | -0.0052 |
| DISTECH | 0.11623256*** (3.05) | .0402159 | .0017796 | 1.3590 | 0.02159699 (0.47) | .0070817 | .0002208 | 0.0090 |
| EMTECH | -0.00573813* (1.79) | -.0019854 | -.0000879 | -0.7970 | 0.00372446 (1.01) | .0012214 | .0000381 | 0.0208 |
| IMRINT | 9.02392751** (2.31) | 3.122235 | .1381592 | 0.1286 | 0.76221761** (2.02) | .2499689 | .0077953 | 0.0279 |
| PRODIFFINT | 0.00273843 (0.53) | .0009474 | .0000419 | 0.0105 | -0.00232232 (0.72) | -.0007592 | -.0000237 | -0.0179 |
| PRODVITY | 0.00200014*** (2.90) | .000692 | .0000306 | 0.1270 | 0.00207291*** (4.60) | .0006805 | .0000212 | 0.0812 |
| FISCALINT | 2.31468353*** (4.82) | .8008693 | .0354385 | 0.1514 | 4.12043294*** (5.65) | 1.347082 | .0420088 | 0.2684 |
| PROFITMARGIN | 0.00558485** (2.33) | .0019323 | .0000855 | 0.1505 | 0.01757006*** (2.82) | .00576 | .0001796 | 6.6827 |
| INDMNE | 0.80791912*** (6.79) | .2795361 | .0123695 | 0.0577 | 1.45137971*** (9.35) | .4765996 | .0019389 | 0.0759 |
| FODUM | -1.02890612 (0.59) | -.3520775 | -.0157256 | -0.0056 | 11.61636774*** (6.78) | 4.154123 | .1200788 | 0.0526 |
| LIBDUM | 5.91224775*** (8.25) | 1.96756 | .0896525 | 0.0712 | 9.49469816*** (9.86) | 2.978402 | .0953795 | 0.0930 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| D_Textile & leather | | | | | 17.45168629*** (15.50) | 5.717869 | .1769616 | 0.2147 |
| D_Wood & paper | | | | | -14.78862410*** (11.71) | -4.442655 | -.1450912 | -0.1153 |
| D_Rubber & plastic | -58.44401636*** (19.93) | -16.92067 | -.6819819 | -0.7992 | | | | |
| D_Other non-metallic mineral products | | | | | | | | |
| D_Cement & glass | -63.43953305*** (21.33) | -15.08609 | -.6230376 | -0.7214 | | | | |
| D_Metal | -60.88963122*** (20.83) | -21.72559 | -.7538521 | -0.8957 | | | | |
| Constant | 46.59089821*** (15.36) | 16.12023 | .7133213 | | -18.97081801*** (15.39) | -6.222753 | -.1940569 | |
| | | | | | | | | |
| Sigma | 25.97072 | | | | 38.42972 | | | |
| Log likelihood | -22760.537 | | | | -34496.177 | | | |
| Wald chi2 | 16035.57 | | | | 1760.65 | | | |
| Prob > chi2 | 0.0000 | | | | 0.0000 | | | |
| Observations | 8138 | | | | 11547 | | | |
| Obs with exporting | 4380 | | | | 6155 | | | |
| Obs. With non-exporting | 3758 | | | | 5392 | | | |
| Adj R-squared | 0.6091 | | | | 0.1453 | | | |

Note: Absolute value of robust Z-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%; Marginal effects for dummy variable is for discrete change from 0 to 1; Adj R-squared is from OLS estimation of the model; Food,bev.& tobacco products is the base category in the case of low technology category and other non-metallic mineral products is the base category for medium technology category.

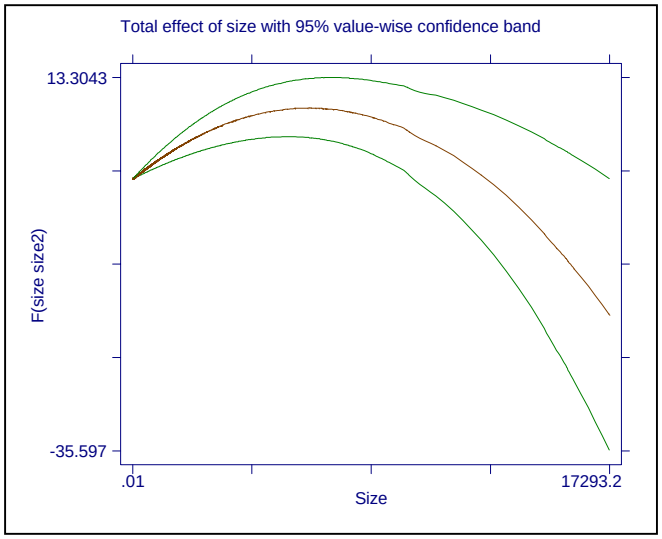
*Age:* In the total sample estimation, the age of the firm turns out with a negative sign and achieves a very high level of statistical significance. From McDonald-Moffitt decomposition of marginal effects, it can be seen that a one-year increase in the age of the firms results in an expected decrease of about 0.099 percent in the export intensity of firms that are engaged in export activity, ceteris paribus. For export probability we found that each additional year increase in age, on an average, leads to 0.0037 percent lower probability of exporting for firms that are not involves in export activity. Therefore, this result is opposite to the postulated positive relationship. This role of firm's age in affecting exports behaviour need to be understood in the developmental milieu of the economy. Indian firms have operated in an inward looking business environment for nearly more than three and half decades since Independence. These firms have accumulated experience dealing with a highly protected domestic market and became used to buyers not so demanding in terms of quality, packaging or after sales services. With such experiences accumulated by the firms in the inward looking period, it is of little help in a competitive world market. Therefore, given the large size of domestic market the older firms with their established firm specific advantages including local distribution networks seemed continued to rely on domestic market as the preferred route for their growth. The technology sub-sample estimations reveal that the role of firm age differs significantly across technological classification. Interestingly it was observed to have a negative impact on the export behaviour in high and low technology segment of Indian manufacturing whereas it positively affects export performance in medium technology segment. This suggests that age of the firm does not put Indian firms in medium technology industries at a disadvantage. It means that in these industries, accumulated learning of firms is of value. This behavioural differences that older firms in high and low technology industries are shying away from the exports markets whereas their counterparts in medium technology industries are actively participating in exporting are needs to be further investigated before we definitely say anything on the behaviour. It is also important to note that about 36 percent of the total effect of age is associated with decreasing export intensity and the rest about 64 percent is attributing in decreasing the export probability of firms not engaged in export activity (Table-4). In the case of technology sub-samples the fraction of total effect of age on export intensity ranges within 33 to 40. This suggests that the effects of an independent variable in affecting export behavior of Indian manufacturing enterprises is dis-proprtationately larger towards affecting export probability than towards export intensity.

**Table-4 The Decomposition of Total Effect of An Independent Variable (In percentage)**

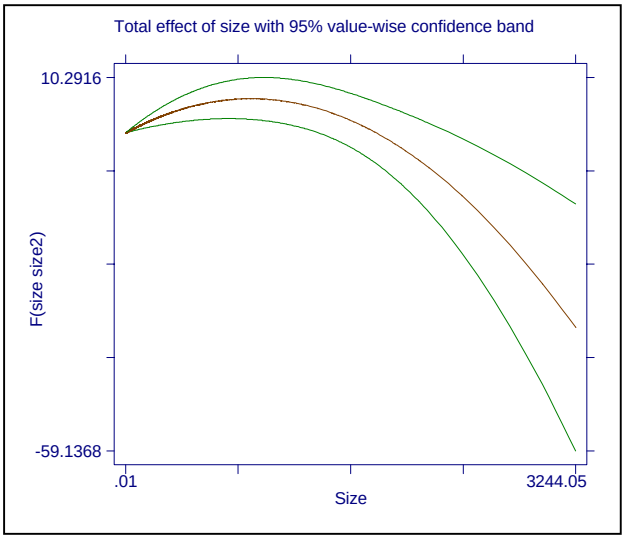
| Industry category | Total Effect | Effect on export intensity | Effect on export probability |
|---|---|---|---|
| All Industries | 100 | 36 | 64 |
| High technology | 100 | 40 | 60 |
| Medium-high technology | 100 | 37 | 63 |
| Medium-low technology | 100 | 35 | 65 |
| Low technology | 100 | 33 | 67 |

*Firm Size*: For total Indian manufacturing the relationship between firm size and export behaviour is observed to be non-linear. Both the firm size and its quadratic term come out with significantly positive and negative impact respectively. Other things being equal, increases in firm size increases export intensity as well as export probability but after a threshold, size has a negative impact. The estimated total effect of size on export behaviour has been shown in Figure-1 and is an inverted U-shape curve. For total sample, the curve representing the total

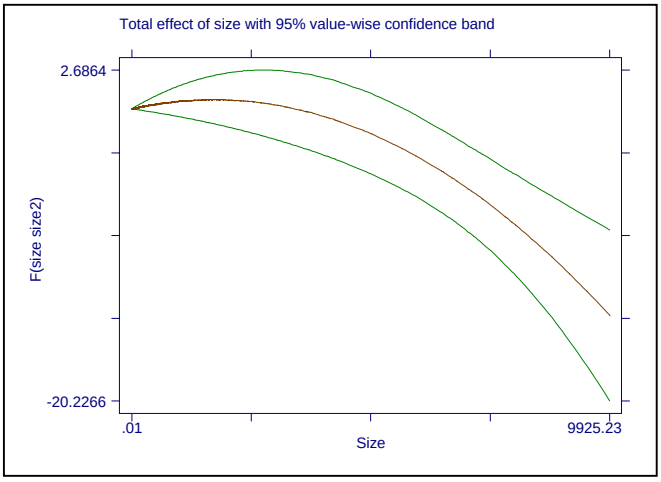
**Figure:1 The total effects of firm size on export behaviour**



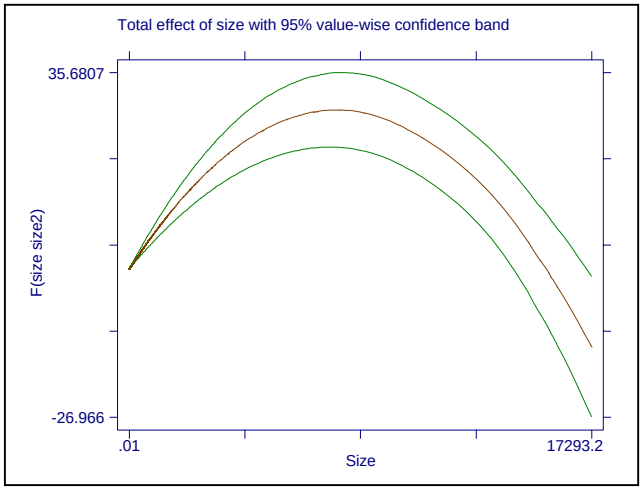

(A) All Industries



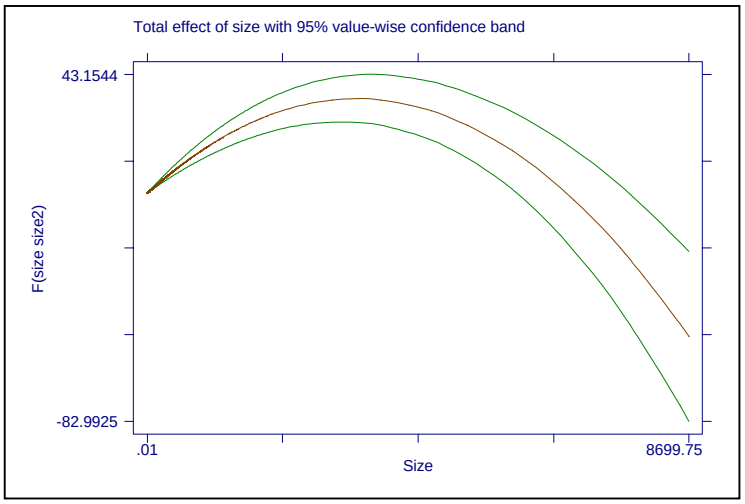

(B) High technology




(C) Medium-high technology




(D) Medium-low technology




(E) Low technology

effect of firm size achieves its maximum at about Rs. 6389 crores of firm size (Table-5). The same non-linear relationship between firm size-export behaviour has been observed in the case of technology sub-sample estimations except medium-high technology industries. In the case of medium-high technology industries firm size is positive but fails to achieve statistical significance whereas its squared term is negative and significant. The estimated threshold effects of high, medium-low and low technology sub-samples are found to be Rs. 903 crore, Rs. 7787 crore and Rs. 3363 crore respectively.

**Table-5 An analysis of non-liner effects of firm size on export behaviour**

| *Industry* | *Range of size* | *Size+Size2 has maximum in the turning point* |
|---|---|---|
| All industries | [.01, 17293.221] | 6388.446 |
| High Technology | [.01, 3244.05] | 903.2089 |
| Medium-high technology | [.01, 9925.2305] | 1698.267 |
| Medium-low technology | [.01, 17293.221] | 7787.268 |
| Low Technology | [.01, 8699.75] | 3363.173 |

*Technological efforts*: For total manufacturing all the three measures of technological efforts namely R&D intensity, disembodied technology import intensity and embodied technology import intensity are found to be important determinants of firm-level export behaviour. The R&D intensity has a positive and statistically highly significant effect. For total manufacturing, keeping all else constant, a one percent increase in R&D intensity, on an average, produces about 4.1 percent increase in export intensity of exporting firms and about 0.015 percent increase in the probability of non-exporting firms to engage in export activity. In the case of technology sub-samples, the variable consistently has a positive and significant impact except for low technology industries. Thus, the results support our prediction that firm's own innovative effort is an important contributing factor towards competitive edge in the global market. The more the technology intensive is the manufacturing segment the more critical is the role of innovation.

In a developing country like India firms greatly rely on foreign knowledge for their technological inputs as their indigenous technological capabilities are limited due to financial and scientific resource constraints. How has foreign disembodied knowledge (*DISTECH*) helped in improving the export competitiveness of Indian firms? For the total Indian manufacturing *DISTECH* has come up with a strongly negative impact on the export behaviour of Indian firms. In particular, a one percent increase in the technology payments intensity (*DISTECH*), on an average, brings about 0.019 percent reduction in the export intensity of exporting firms and about 0.00069 percent reduction in the export probability of non-exporting firms, keeping other variables constant. The same negative and significant effect is observed in the case of high and medium-high technology segment of the total manufacturing. However, it has a positive sign in the case of medium-low and low technology segment and is statistically significant in the case of former sub-sample. Literature on the technology transfer to developing countries suggests that foreign technology comes with several other costs besides the financial cost of importing it. One important restriction that frequently accompanies the technology contracts is export prohibition clauses, limiting the manufactured product produced using the imported technology to the technology receiving country (Hood and Young 1979;UNCTC 1984; Kumar, 1985). As the technology is increasingly becoming the driving force of international competitiveness, this restriction appears to be used more frequent with technology contracts going into knowledge-intensive manufacturing of developing country like India. Therefore firms resorting to the disembodied import of technology from abroad to build their technological capability in high and medium-high technology industries are forced by the conditionalities attached with technology contracts to concentrate on the domestic markets[6]. Another reason could be the fact that developing country firms being technology followers in the knowledge-intensive industries are not able to achieve effective technology transfer due to large technology-gap vis-à-vis their developed country counterparts. The import of disembodied technology surely helps in enhancing the technological capability of enterprises in a developing country but not in increasing their global competitiveness as the owner of imported technology are the global competitors. For international competitiveness, they should be able to modify, and improve upon the imported technology and designs to develop their own firm specific advantages and services.

Regarding the impact of imported capital goods (*EMTECH*) as a channel of technology acquisitions on the export behaviour of enterprises, the empirical results for total manufacturing indicate that it had definitely improved the ability of Indian firms to export more out of their total sales as well as the probability of non-exporters to participate in the export activity. Recent growth models in the tradition of endogenous growth model rightly emphasized that the imports of intermediate inputs and capital goods are an important determinant of the link between trade and economic growth (Grossman and Helpman, 1991; Rivera-Batiz and Romer, 1991). However the results from technology sub-samples suggest that the export-enhancing role of capital goods imports is limited to medium-high technology industries only. For medium-low technology industries it has a negative sign, however, weakly significant and is not statistically different from zero in the case of high and low technology sub-samples.

[6] The R.B.I. conducted surveys of foreign collaboration in Indian industry have repeatedly found high incidence of export restrictive clauses associated with foreign technical collaboration. The latest survey for the1986-94 period finds as many as 40 percent of technology agreements contain export restrictions. Nearly 62 percent of restrictive clauses take the form of direct prohibition of export by the technology receiving Indian firms to all the countries or specified countries and another 27 percent require that Indian party must obtain permission for exports from the technology supplier firm. (See Kumar, 2001)

*Raw material imports*: Many of the knowledge-based industries in developing countries for their development depend crucially on the imports of raw materials and intermediate goods because of underdeveloped local sources or owing to quality differentials. Does this variable influence the export behaviour of Indian enterprises? Results from the total manufacturing sector as well as technology sub-samples indicate that the firm's imports of raw materials had a stimulating influence on their export performance. In the case of total sample it has got a positive sign and is significant only at a12 percent level. In the case of all the technology sub-sample estimations it is found to have positive sign and achieve a modest level of significance. The implication is clear in this case. The imported raw materials tend to improve firm's global competitiveness. It seems that Indian enterprises are able to productively use imported raw materials to improve their global business performance.

*Product Differentiation*: The link between product differentiation and export performance has been postulated to be positive. The strategy of product differentiation is crucial in creating and enlarging demands for the product by convincing the potential buyers that the product in question is unique and qualitatively better as compared to what rivals are offering. However results indicate that the impact of advertising on export performance is statistically not different from zero for the total manufacturing. Among technology-sub samples only in the case of medium-technology segment its impact is observed to be different from zero and is positive. It appears that the product differentiation advantages backing of Indian firms for export participation is very low in large segment of Indian manufacturing and in many industries it does not matter in their export strategy. In part it may be due to the fact that Indian enterprises often act as sub-contractors and vendors of OEM producers in the developed countries selling products under their brand names.

*Productivity*: The impact of labour productivity on export performance strongly comes out in the empirical exercise. The results evidence that the productivity significantly improves both the probability and export intensity of firms in the Indian manufacturing. Results from technology sub-samples suggest that the firms belonging to medium-high, medium-low and low technology industries significantly benefits from efficiency of their resource use for their global competitiveness. In the case of high technology it has a positive sign but does not reach the level of statistical significance. This result makes sense because in high technology industries export competitiveness may be critically dependant upon technological creativity and innovativeness because of monopolistic competition rather than on labour productivity. But in the case of other technology sub-samples efficiency of resource use is a major factor explaining export success.

*Government export promotion measures*: The fiscal benefits given by government to a firm to induce it to go for exporting has a positive sign and is statistically significant at 1 percent level in the case of total manufacturing. The sub-sample estimations indicate that this export-enhancing role of government incentives is positive and significant for high technology, medium-low technology and low technology segment whereas its impact is significantly negative in the case of medium-high technology industries. Again further research is needed to answer the question of why fiscal benefits offered by government for export promotion have failed to be effective in the case of medium-high technology segment. Overall we can say that government incentives

have played an important role in improving export competitiveness in majority of Indian industries.

*Profitability*: The profitability variable, *PROFITMARGIN*, is significant with a positive sign in the case of total sample estimation as well as medium-high technology, medium-low technology and low technology sub-sample category. In the case of high technology industries it turn up with a positive sign but could not attain normal significance level. Therefore it appears that profitability plays an important role in the export performance of Indian enterprises especially in medium and low technology industries. In high technology industries its impact on export behavior is not statistically different from zero.

*Outward foreign direct investment:* The estimations find that *INDMNE* measuring the number of years that the firm is in foreign operations to have a positive and significant impact on the probability as well as intensity to exporting of Indian manufacturing firms irrespective of technology classification. The impact is significant and robust across technology classification and total manufacturing sector. Therefore, it is apparent that the outward investment is an important factor in strengthening the global competitiveness of Indian firms in the knowledge-intensive as well as low and medium technology segments of industry.

*Ownership*: The role of multinational enterprise (MNE) affiliates in the expansion of manufactured exports from India has been observed to be positive. Foreign firms in the total manufacturing sector had exhibited better export performance than their local counterparts. Their export catalyst role is robust cutting across technology category. They have performed better than domestic enterprises in high technology, medium high technology and low technology industries. Only in the case of medium-low technology the foreign ownership dummy was found to have a negative coefficient that is statistically not different from zero. This finding supports the expectation that foreign firms given their intangible assets such as new technology, skill, internationally recognized brand names and well established global marketing network can play a crucial role in strengthening export competitiveness of developing countries, especially in the knowledge-based industries than in the low technology industries.

*Liberalization*: The estimations suggests that following the liberalization of foreign trade regime, Indian enterprises have shown significant improvement in their export performance as well as higher likelihood to participate in exporting. This finding is robust across technology sub-samples as well. In particular, the full sample estimation indicates that the export intensity of exporting firms in the reform-period (1993-94 to 2000-01) is, on an average, 20 percent higher than the pre-reform period (1989-90 to 1992-93), holding other variables constant. The effects of economic liberalization on the probability of non-exporting firms to participate in exporting is also found to be quite substantial, the export probability is expected to be higher by 7.7 percent in the reform-period. Therefore, the change in policy regime in 1991 towards an outward-looking appears to have promoted Indian firms to expand their operations in global markets. The liberalization of the economy may have worked in various ways in boosting export competitiveness of Indian enterprises. Increasing competitive pressures, free access to imported inputs and setting up of Special Economic Zones (SEZs) may have helped in boosting export performance.

*Relative contribution of independent variables towards export behaviour*

It will be very useful from the policy perspective to know which of the determinants is most important in explaining the export behavior of Indian manufacturing firms. The vector of un-standardized tobit coefficient as discussed in the foregoing offers little insights as these coefficients depend on the units of measurement. We need to make these coefficients scale free before we can say anything about the relative significance of different factors influencing exporting in Indian manufacturing. The most common method used for this purpose is the method of standardization[7]. The results obtained from this method has been furnished under the column heading 'standardized coefficients' in Tables- 1, 2 and 3 and have been summarized in Table-6.

It can be seen from Table-6 that there exist wide variation in the results across total sample and sub-samples estimations. Still a few inferences can be deduces from it. For overall manufacturing the profitability of an enterprise is the most dominant explanatory factor for venturing into exporting. Its rank varies from third to fourth over the sub-sample estimation based on technology-intensity. It suggests that being a relatively uncertain activity, only highly profitable firms are able to move into it. Further, the tax incentives available for exporting are also available to profitable firms alone. The imports of capital goods by the firm turns out to be the second most contributing factor in the export performance for total sample while it tops the ranking list in the case of medium-high technology sub sample and remain second in the case of medium-low technology industries. The government fiscal incentives stood as the third most important factor promoting enterprise level exporting for the overall manufacturing level. Except for medium-high technology sub-sample the ranking of the variable either remain same or had one-place variation. Therefore it can be suggested that government policies in the form of export promotion measures and fiscal incentives matter a lot for promoting enterprises into exporting in a developing country like India. Although labour productivity is the fourth dominant explanatory for exporting in the case of total manufacturing its ranking varies widely over the sub sample estimations. The variable distinguishing outward investing Indian firms comes out to be the fifth most contributing factor for export activity followed by foreign investment dummy in the fifth place. It is important to note that the contribution of outward investments towards India's exporting has been consistently much higher in ranking than inward investments. Therefore developing and promoting outward investment activity of Indian enterprises could be effective means of strengthening their export competitiveness. The findings also suggest relatively higher importance of technology variables for the relatively higher technology industries than the low technology ones.

[7] To obtain these coefficients one need to compute the standardized variables and then re-estimate the tobit model. Alternatively the standardized coefficient $\beta_{1s}$ for a particular variable $X_i$ can be obtained as $\beta_{1s} = \beta_{1u} * (\sigma_i / \sigma_y)$ where $\beta_{1u}$ is the un-standardized coefficient associated with $X_i$ , $\sigma_i$ and $\sigma_y$ is the standard deviation of $X_i$ and Y (the dependent variable respectively.

**Table-6 Ranking of Independent variables based on fully standardized coefficients**

| Independent variables | All industries | High technology | Medium-high | Medium-low | Low technology |
|---|---|---|---|---|---|
| AGE | 13*** | 11*** | 13** | 11*** | 8*** |
| SIZE | 8*** | 6*** | 14 | 5*** | 3*** |
| SIZE2 | 11*** | 7*** | 12*** | 8*** | 4*** |
| RDINT | 12** | 8*** | 11*** | 13** | 14 |
| DISTECH | 10*** | 1*** | 5*** | 1*** | 13 |
| EMTECH | 2*** | 13 | 1*** | 2* | 11 |
| IMRINT | 9 | 2** | 3*** | 6** | 10** |
| PRODIFFINT | 14 | 14 | 7** | 12 | 12 |
| PRODVITY | 4*** | 10 | 4*** | 7*** | 6*** |
| FISCALINT | 3*** | 4*** | 9*** | 3*** | 2*** |
| PROFITMARGIN | 1*** | 3 | 2** | 4** | 1*** |
| INDMNE | 5*** | 5*** | 6*** | 10*** | 7*** |
| FODUM | 7*** | 9*** | 8*** | 14 | 9*** |
| LIBDUM | 6*** | 12*** | 10*** | 9*** | 5*** |

Note: * significant at 10%; ** significant at 5%; *** significant at 1%

### 3.4 Industry wise estimations

The significant coefficient associated with several industry-specific dummies in the overall and technology-intensive sub-samples estimations clearly indicate that the export behavior of firms varies greatly over industries. The assumption behind such aggregative analysis is that the shift in regression function on account of differential intercepts is enough to account for industry-specific heterogeneity. However, such heterogeneity may also result from differential slope coefficients in the export regression. The estimation of industry-specific regression is thus useful in this case. In what follows results obtained from industry-wise estimations has been provided in Table-C.2 in the appendix and summarized in Table-7. Following are the broad patterns that emerge from this exercise:

***Table-7 Summary results from industry-wise analysis***

| *Independent Variables* | ***Sign of Statistically Significant Coefficients*** | | | |
|---|---|---|---|---|
| | *High and Medium-high Technology* | | *Medium-Low and Low Technology* | |
| | *(+ ve)* | *(- ve)* | *(+ ve)* | *(- ve)* |
| AGE | Non-electrical machinery | | Metal Products<br>Cement & glass | Non-metallic minerals<br>Textile & leather<br>Food, bev. & tobacco |
| SIZE | Pharmaceuticals<br>Electrical machinery<br>Chemicals | | Metal Products<br>Cement & glass<br>Non-metallic minerals<br>Rubber & plastic<br>Wood & paper<br>Textile & leather<br>Food, bev. & tobacco | |
| $SIZE^2$ | | Electronics<br>Pharmaceuticals<br>Non-electrical machinery<br>Electrical machinery<br>Chemicals | | Metal Products<br>Cement & glass<br>Non-metallic minerals<br>Rubber & plastic<br>Wood & paper<br>Textile & leather<br>Food, bev. & tobacco |

| | | | | |
|---|---|---|---|---|
| RDINT | Electronics<br>Pharmaceuticals<br>Transport equipment | | Cement & glass<br>Rubber & plastic | Non-metallic minerals |
| DISTECH | | Pharmaceuticals<br>Non-electrical machinery<br>Chemicals | Metal Products<br>Cement & glass<br>Wood & paper | Rubber & plastic |
| EMTECH | Pharmaceuticals<br>Transport equipment | Electrical machinery | | Metal Products<br>Cement & glass<br>Wood & paper |
| IMRINT | Pharmaceuticals<br>Electronics<br>Chemicals<br>Electrical machinery<br>Non-electrical machinery<br>Transport equipment | | Metal Products<br>Cement & glass<br>Rubber & plastic<br>Textile & leather | |
| PRODIFFINT | Pharmaceuticals<br>Electrical machinery<br>Non-electrical machinery | | Non-metallic minerals<br>Textile & leather | |
| PRODVITY | Chemicals<br>Transport equipment | Electrical machinery | Cement & glass<br>Food, bev. & tobacco | |
| FISCALINT | Pharmaceuticals<br>Electronics<br>Electrical machinery<br>Non-electrical machinery<br>Transport equipment | Chemicals | Metal Products<br>Cement & glass<br>Rubber & plastic<br>Wood & paper<br>Textile & leather | |
| PROFITMARGIN | Electrical machinery<br>Non-electrical machinery | | Metal Products<br>Cement & glass<br>Non-metallic minerals<br>Rubber & plastic<br>Wood & paper<br>Textile & leather<br>Food, bev. & tobacco | |
| INDMNE | Pharmaceuticals<br>Electronics<br>Chemicals<br>Electrical machinery<br>Non-electrical machinery<br>Transport equipment | | Metal Products<br>Non-metallic minerals<br>Rubber & plastic<br>Wood & paper<br>Textile & leather<br>Food, bev. & tobacco | |
| FODUM | Electronics<br>Chemicals<br>Non-electrical machinery | Pharmaceuticals | Cement & glass<br>Rubber & plastic<br>Wood & paper<br>Food, bev. & tobacco | Non-metallic minerals |
| LIBDUM | Pharmaceuticals<br>Chemicals<br>Non-electrical machinery<br>Transport equipment | | Metal Products<br>Cement & glass<br>Wood & paper<br>Textile & leather | |

Source: Based on Table- C.2. provided in appendix.

(1) For majority of industries the impact of age on export behavior of firms is statistically not different from zero and even for those with significant impact is not necessarily favorable. In the case of technology-intensive sub-samples (i.e. high and medium-high technology) the variable age could come significant in only one industry namely in non-electrical machinery with positive sign. It has a significant coefficient for five industries in low technology-intensive sub-samples (i.e. low and medium-low technology) out of which for three industries viz. non-metallic mineral products, textile & leather, and food & tobacco it has a negative sign.

(2) The significant role of firm size in promoting exports from India has been further evidenced by the results obtained from individual industries. Out of total 13 industries included in the study, as many as 10 industries have a significantly positive coefficient of size. Therefore, it can be inferred that firm size endows several benefits to a firm to break into export market and perform well in exporting. These benefits may be in the form of scale economies, access to

market information, preferential access to credit, etc. However, the benefit of large size for exporting is effective only up to a critical level. This fact is conveyed by the significantly negative sign of the squared term of firm size for majority of individual industries. Therefore, the variable firm size affects export behavior of Indian manufacturing firms in a non-linear fashion largely represented by an inverted U-shaped curve.

(3) The broad patterns obtained from industry-level estimation on the role of R&D activity seems to lend support to the earlier observation made from overall and sub-sample estimations that indigenous technological efforts of firm is very critical for export success. In knowledge-based industries like electronics, pharmaceuticals, and transport equipment the variable *RDINT* turns to be significantly positive. Even for low technology-intensive industries like cement & glass and rubber & plastic the R&D activity of firms is found to be an important determinant of their export performance.

(4) The industry level findings suggest that the effect of imported technology on export behavior of Indian enterprises varies over technology groupings. They appear to have played a restrictive role in the case of high technology-intensive industries whereas a favorable role in low technology-intensive industries. All the three knowledge-intensive industries such as electronics, pharmaceuticals and transport equipment for which the variable DISTECH is observed to be significant are turns out to be negative. It has got significant coefficients for the four industries belong to low technology-intensive group, of which for three industries it has positive sign. It appears that in high technology industries, export success can not be built on the basis of imported knowledge alone.

(5) The import of capital goods has played a significant role in the export activity of enterprises belonging to six Indian industries. However, firms belonging to only two industries viz. pharmaceuticals and transport equipment have benefited positively from imported capital goods in their export activity.

(6) The industry-wise results strongly support the argument that the access to foreign raw materials contributes significantly to the export performance of Indian enterprises. There are altogether ten industries for which the variable is significant and for these industries it is consistently positive. Out of these, six industries belong to technology-intensive industries. Thus suggesting that the export-enhancing role of imported raw material is relatively more critical for knowledge-based industries than low technology-based industries. Therefore, liberalization of imports of raw materials may facilitate in exploitation of export potential. It may also enable Indian enterprises especially in knowledge intensive industries to attract sub-contracting deals from MNEs as a part of rationalization of production across countries.

(7) The variable capturing the product differentiation activities of Indian firms, PRODIFFINT, has turned out to be significant in only in the case of five industries out of which three belong to knowledge-based industries. The sign of the variable is positive for all these industries. Therefore, ability of Indian enterprises to differentiate their products with their brand building and advertising activities does help in establishing their presence abroad.

(8) The labour productivity is found to be significantly positive for two knowledge-intensive industries such as chemicals and transport equipment and another two from low-technology sub-sample namely cement & glass and food, beverages & tobacco. At least in these industries efficiency of resource use and capital intensity or modernization may be of critical importance for export competitiveness.

(9) The impact of variable, FISCALINT, measuring the government induced fiscal incentives for export promotion is found to be strongly positive for ten industries evenly distributed between knowledge-based and low technology sub-sample. This implies that government export promotion policies have been instrumental in creating new exporters and increasing export-intensity of exporting firms. The effect of fiscal incentives is favorable in the case of both knowledge-intensive as well as low technology industries. The only industry for which the variable turns out to be significantly negative is chemicals.

(10) The impact of profit margin on export behavior of Indian firms is found to be predominantly positive. The variable is positive for all the nine industries for which it is observed to be significant. Out of nine industries, two are technology intensive industries while rest are classified as low technology intensive. This suggests that profit margin is relatively more significant for exporting in low technology industries as compared to technology intensive industries.

(11) The result on the variable INDMNE confirm the earlier finding from total sample and sub-sample estimations that overseas presence through subsidiaries does increase the exports from the economy. The coefficient of the variable is found to be significant for twelve industries out of thirteen industries in the study and consistently its sign is positive for all these industries. The technology-intensive and low technology- intensive sub sample each have six industries for which the coefficient is significant.

(12) The impact of foreign ownership on the export performance is found to be positive for majority of industries. The variable, FODUM, is positive and significant for seven industries of Indian manufacturing. Three are knowledge-intensive industries such as electronics, chemicals and non-electrical machinery and other four are low technology industries such as cement & glass, rubber & plastic, wood& paper, and food& beverage. However there are two industries, pharmaceuticals and non-metallic mineral products for which the variable got a negative impact.

(13) The results on the liberalization dummy unambiguously indicate that the export behavior of Indian manufacturing firms has improved substantially during the reform phase as compared to pre-reform situation. The variable turns out to be significant for eight industries and invariably it is positive.

## 4. Conclusions and policy implications

There is an urgent need for developing countries to diversify their export structure away from traditional low technology products to high technology products. As export structure is path dependent this transition into knowledge-intensive export structure is difficult and calls for clear understanding of the factors that are crucial in affecting export competitiveness in knowledge-based industries. It is in that context, the present study analyzed the important determinants of the export competitiveness of India in knowledge-based industries.

The analysis conducted and reported in this study using a dataset assembled exclusively for the study is able to examine on the role of such factors as outward investment in export success that have become important in the reform-period.

Large size lends a definite edge to firms in overseas markets, at least up to a critical threshold level. It would follow from this that some consolidation of smaller Indian firms may be useful from the point of view of export competitiveness.

The research also brings out the critical role that the firm's own innovative activities play in building export competitiveness especially in relatively high technology and medium technology industries. It may follow from this that promotion of in-house R&D activity may yield rich dividends not only in terms of building local capabilities but also for strengthening their export competitiveness. Besides own technological effort of enterprises, imports of technology especially in embodied form also facilitate export competitiveness. Hence, a liberal policy towards imports of capital goods may be good fro export competitiveness. However, technology imports in disembodied form such as licensing may not always facilitate export orientation given the tendency of technology suppliers to impose restrictive clauses in the agreements. In the high technology industries in particular, building export competitiveness on the basis of imported technology may not be easy. Therefore, policies should encourage technology importers to complement it with further technological efforts.

The findings also suggest a role of product differentiation in the form of brand building and advertising in strengthening export competitiveness at least in certain industries. Therefore, these activities of Indian enterprises should be encouraged by encouraging the non-price rivalry among Indian enterprises.

The efficiency of resource use expectedly has a favourable effect on export competitiveness. Indian enterprises need to improve their efficiency of resource use to survive and prosper in this globalizing world economy.

Outward investment has emerged as an important determinant of export competitiveness. Overseas presence and visibility lend a critical edge to enterprises in their export effort by facilitating flows of market information and specific needs of particular markets and providing after-sales-services that are important aspects of competitiveness. Hence, a liberal approach towards outward investment may be desirable.

Indian affiliates of MNEs appear to be performing better than their local counterparts in terms of export-orientation. In light of the findings of earlier studies relating to pre-liberalization period of no significant difference in the export orientation of foreign and local enterprises, it would appear that reforms have promoted foreign MNEs to begin to explore the potential of India as an export-platform production in a modest manner. However, India has a long way to go exploit the advantages of MNEs for export-orientated manufacture. In China, for instance, MNEs account for 45 percent of all manufactured exports (compared to just 3-5 percent in India) and about 80 percent of high technology exports (UNCTAD, 2002). Further inducement to MNEs entering the country towards export-oriented manufacturing by leveraging India's advantages

such as large domestic market, abundant low cost skilled manpower, among others, would be desirable.

Relatively older firms seem to have a disadvantage in building export-competitiveness in relatively high technology industries presumably because of the need for greater flexibility, specialization, core competencies and innovativeness that are crucial for succeeding in the international markets in these industries. Hence, entry of new highly specialized firms in high technology areas may be facilitated by easy availability of venture capital and other facilities.

Fiscal incentives and tax concessions (as captured by the role of profitability) do play a role in prompting Indian enterprises to export. In a country with large and relatively sheltered domestic market, entering relatively uncertain and more competitive international markets may not be favoured by firms without any incentives. Furthermore, these incentives may also be required to compensate for relatively high cost of capital and other inputs applicable in India.

Finally, the analysis underlines a definite improvement in export-orientation of Indian enterprises after liberalization. Apparently the reforms implemented since 1991 have helped in addressing some of the anti-export biases prevailing in the pre-1991 period and helping India improve her profile in the international division of labour in manufactured exports.

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## *Appendix A: Dataset and Measurements of Variables*

The dataset used in the present study is a sub-sample of a larger dataset, **RIS-DSIR database**, constructed from different sources at the Research and Information System for the Non-aligned and Other Developing Countries, as a part of the Department of Scientific and Industrial Research (DSIR) research project 'A Strategic Approach to Strengthening the International Competitiveness in Knowledge-based Industries: Some Explorations into the Role of FDI Inflows, Outward Investments, and Enterprise Level Technological Effort in Promotion of India's Knowledge Intensive Exports'. The dataset, which covers firm-level data on various financial variables like exports, imports, sales, R&D, outward investments, etc. of more than 500 Indian manufacturing companies, has been compiled from the *PROWESS database* (2002), the Ministry of Commerce, the Ministry of Finance, and the India Investment Centre.

### *Measurements*

*A1. Dependent Variable*

$EXPOINT_{it}$: Exports of *i*th firm as a percentage of sales in the year t.

*A2. Independent Variables*

$AGE_{it}$: The age of *i*th firm in number of years.
$SIZE_{it}$: Total sales of *i*th firm in *t*th year.
$SIZE^2_{it}$: The squared term of the sales of *i*th firm in *t*th year.
$R\&D_{it}$: Total R&D expenditure as a percentage of total sales of *i*th firm in *t*th year.
$DISTECH_{it}$: Royalties, technical and other professional fees remitted abroad by *i*th firm as a percentage of sales in the year t.
$EMTECH_{it}$ : Imports of capital goods by *i*th firm as a percentage of sales in *t*th year.
$IMRINT_{it}$: Imports of raw materials by *i*th firm as a percentage of sales in the year *t*th year.
$PRODIFFINT_{it}$: Advertising and sales promotion expenses incurred by *i*th firm as a percentage of sales in *t*th year.
$PRODVITY_{it}$: is the labor productivity defined as net value-added generated per unit of wage cost (%).
$FISCALINT_{it}$: The fiscal benefits received by ith firm as a percentage of sales on account of various government schemes targeted at certain industries and/or to promote specific objectives like export promotion.
$PROFITMARGING_{it}$: Profit before tax (PBT) as a percentage of sales.
$INDMNE_{it}$: The age of multinationality of Indian firms in number of years. It is defined as the number of years of foreign operation of firms undertaking outward foreign direct investment.
*FODUM*: Dummy variable for foreign affiliates in Indian manufacturing taking value 1 for firms with 25 % or more foreign equity participation and 0 otherwise.
*LIBDUM*: Liberalization dummy taking 1 for reform period 1993-94 to 2000-01 and 0 for the pre-reform period 1989-90 to 1992-93.

***Appendix B: Technological Classification of Indian Manufacturing Industry***

| *Technology category* | *Industry* |
|---|---|
| Low technology | 1. Food, beverages & tobacco products<br>2. Textile, leather & footwear<br>3. Wood, paper & paper products |
| Medium-low technology | 4. Rubber & plastic products<br>5. Other non-metallic mineral products<br>6. Cement & glass<br>7. Basic metal & metal products |
| Medium-high technology | 8. Chemicals excluding pharmaceuticals<br>9. Electrical machinery<br>10. Non-electrical machinery<br>11. Transport equipment |
| High technology | 12. Pharmaceuticals<br>13. Electronics |

Note: The above technological classification is based on OECD (2001) 'OECD Science, Technology and Industry Scoreboard, 2001'

***Appendix C***

**Table-C.1 Collinearity Diagnostics**

| Variable | VIF | Tolerance | Condition Index | R-Squared |
|---|---|---|---|---|
| AGE | 1.09 | 0.9199 | 1.0000 | 0.0801 |
| SIZE | 3.86 | 0.2593 | 1.0044 | 0.7407 |
| SIZE | 3.51 | 0.2845 | 1.2354 | 0.7155 |
| RDINT | 1.08 | 0.9231 | 1.2538 | 0.0769 |
| DISTECH | 3.45 | 0.2899 | 1.2626 | 0.7101 |
| EMTECH | 3.37 | 0.2965 | 1.2806 | 0.7035 |
| IMRINT | 1.00 | 0.9959 | 1.3147 | 0.0041 |
| PRODIFFINT | 1.05 | 0.9480 | 1.3390 | 0.0520 |
| PRODVITY | 1.06 | 0.9428 | 1.3466 | 0.0572 |
| FISCALINT | 1.06 | 0.9462 | 1.3519 | 0.0538 |
| PROFITMARGIN | 1.00 | 0.9969 | 1.3602 | 0.0031 |
| INDMNE | 1.17 | 0.8568 | 1.3641 | 0.1432 |
| FODUM | 1.06 | 0.9467 | 1.3707 | 0.0533 |
| LIBDUM | 1.02 | 0.9818 | 1.3855 | 0.0182 |
| D_Textile & leather | 1.98 | 0.5051 | 1.4034 | 0.4949 |
| D_Wood & paper | 1.26 | 0.7935 | 1.4156 | 0.2065 |
| D_Rubber & plastic | 1.49 | 0.6698 | 1.4260 | 0.3302 |
| D_Other non-metallic mineral products | 1.06 | 0.9448 | 1.4431 | 0.0552 |
| D_Cement & glass | 1.29 | 0.7735 | 1.4790 | 0.2265 |
| D_Metal | 1.70 | 0.5899 | 1.5108 | 0.4101 |
| D_Chemicals | 1.66 | 0.6025 | 1.5639 | 0.3975 |
| D_Electrical machinery | 1.36 | 0.7377 | 1.5790 | 0.2623 |
| D_Non-electrical machinery | 1.41 | 0.7106 | 1.6328 | 0.2894 |
| D_Transport equip. | 1.36 | 0.7376 | 3.5113 | 0.2624 |
| D_Pharmaceuticals | 1.39 | 0.7183 | 3.6603 | 0.2817 |
| D_Electronics | 1.31 | 0.7621 | 3.7543 | 0.2379 |

Mean VIF= 1.62, Condition Number =3.7543

**Table-C.2 Industry-wise Pooled Tobit Estimation of Export Intensity (%) , continue**

| *Dependent variable: Export intensity (%)* | | | | | | |
|---|---|---|---|---|---|---|
| Independent Variables | *Coefficients (Z value)* | | | | | |
| | *Industry* | | | | | |
| | Food, bev. & tobacco | Textile & leather | Wood & paper | Rubber & plastic | Other non-metallic mineral products | Cement & glass |
| AGE | -0.17993817*** (6.14) | -0.05836683*** (2.93) | 0.03640224 (1.32) | -0.01629028 (0.61) | -0.76567868*** (3.34) | 0.12661855*** (4.82) |
| SIZE | 0.02468287*** (7.37) | 0.03612952*** (5.53) | 0.05001536*** (7.69) | 0.01739962*** (7.49) | 1.74276743** (2.36) | 0.01052753*** (4.11) |
| $SIZE^2$ | -0.00000334*** (7.01) | -0.00002994*** (3.92) | -0.00004174*** (6.63) | -0.00000415*** (4.77) | -0.02033357* (1.81) | -0.00000395*** (4.00) |
| RDINT | -1.43562550 (0.85) | -0.31759447 (0.40) | -0.87573807 (0.48) | 0.12042029*** (3.45) | -20.37003473** (2.46) | 1.87134986** (2.13) |
| DISTECH | 1.38342502 (1.49) | -0.18461366 (0.69) | 7.01036836*** (3.08) | -0.47309207* (1.89) | -2.31811747 (0.25) | 0.06090489*** (5.73) |
| EMTECH | -0.01350838 (1.50) | 0.00382615 (0.81) | -0.00173056* (1.95) | 0.02961555 (1.14) | 0.01588115 (0.92) | -0.02637416* (1.86) |
| IMRINT | 4.85290390 (0.73) | 16.12773431* (1.80) | 0.02360072 (0.37) | 16.05965179** (2.00) | 25.52936075 (1.05) | 32.73949755* (1.79) |
| PRODIFFINT | 0.00377806 (0.96) | 0.05352831*** (2.64) | 0.14603677 (1.60) | 0.07786266 (0.81) | 1.42186780*** (3.73) | 0.01867356 (0.86) |
| PRODVITY | 0.00453155*** (3.76) | 0.00056457 (1.10) | -0.00009601 (0.06) | 0.00016728 (0.14) | -0.00002096 (0.00) | 0.00831748*** (3.16) |
| FISCALINT | 1.47132176 (1.52) | 5.17130162*** (10.35) | 2.36112484*** (3.11) | 2.52211389*** (5.33) | -0.64808291 (0.49) | 1.71742522* (1.92) |
| PROFITMARGIN | 0.01247013** (2.52) | 0.04177185*** (2.78) | 0.00317493*** (3.23) | 0.04659798*** (3.19) | 0.08740311*** (2.82) | 0.00324487** (2.07) |
| INDMNE | 1.21976137*** (5.61) | 1.53359583*** (7.43) | 1.05117710*** (3.91) | 1.25111617*** (7.39) | 13.45956458*** (3.71) | 0.01274069 (0.11) |
| FODUM | 12.42733116*** (4.52) | -1.00453461 (0.49) | 16.15051554*** (5.56) | 5.47723066** (2.02) | -62.64780680*** (7.16) | 9.17021982*** (5.12) |
| LIBDUM | 2.97617658 (1.58) | 13.12300786*** (10.94) | 4.05726410*** (3.14) | 1.84309244 (1.52) | 5.12461341 (0.45) | 5.00008628*** (4.26) |
| Constant | -14.78355908*** (6.98) | -6.41501936*** (4.87) | -16.88519036*** (8.71) | -7.07315191*** (4.41) | 42.22925423*** (3.23) | -15.92313614*** (7.97) |
| | | | | | | |
| Sigma | 43.223 | 37.09825 | 14.61559 | 24.695 | 40.649 | 16.488 |
| Log Likelihood | -10603.159 | -21147.749 | -2286.4589 | -7299.695 | -1123.216 | -3655.545 |
| Wald Chi2 | 248.82 | 649.33 | 150.3 | 253.14 | 255.35 | 190.7 |
| Prob > chi2 | 0.0000 | 0.0000 | 0.0000 | 0.000 | 0.0000 | 0.0000 |
| Observations | 4250 | 5990 | 1307 | 2555 | 259 | 1482 |
| Obs. with exporting | 2469 | 3902 | 472 | 1427 | 211 | 777 |
| Obs. With non-exporting | 1781 | 2088 | 835 | 1128 | 48 | 705 |

Note: Absolute value of robust z-statistics in parentheses; * Significant at 10%; ** Significant at 5%; *** Significant at 1%.

**Table-C.2 Industry-wise Pooled Tobit Estimation of Export Intensity (%)**

| Dependent variable: Export intensity (%) | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Independent Variables* | *Coefficients (Z value)* | | | | | | |
| | *Industry* | | | | | | |
| | Metal products | Chemicals | Electrical machinery | Non-electrical machinery | Transport equipment | Pharmaceutical | Electronics |
| AGE | 0.16221140*** (7.12) | -0.02195197 (0.91) | -0.02543955 (1.09) | 0.08117856*** (4.25) | 0.00990945 (0.53) | -0.02647808 (1.06) | -0.06112743 (1.49) |
| SIZE | 0.00471015*** (4.47) | 0.00569935* (1.90) | 0.02090004*** (4.88) | 0.00158983 (1.13) | -0.00028446 (0.46) | 0.04440402*** (6.79) | -0.00099498 (0.32) |
| $SIZE^2$ | -0.00000030*** (4.44) | -0.00000420*** (2.91) | -0.00001297*** (4.17) | -0.00000045** (2.14) | -0.00000009 (1.31) | -0.00002577*** (4.67) | -0.00000260* (1.79) |
| RDINT | 2.75938800 (1.46) | 0.02681283 (0.74) | 0.10172669 (0.18) | -0.06067345 (0.33) | 1.13220847*** (3.07) | 0.47665243*** (2.85) | 0.60525706* (1.78) |
| DISTECH | 0.61798607*** (6.35) | -0.33605300* (1.77) | -0.39501985 (0.58) | -1.08122914*** (2.84) | -0.20474425 (1.46) | -0.77254153*** (5.46) | -0.30601085 (1.32) |
| EMTECH | -0.04984455*** (6.22) | -0.00707523 (0.60) | -0.05054300** (2.33) | 0.13560695 (1.14) | 0.00447202*** (62.97) | 0.05287051*** (5.86) | -0.01650312 (0.90) |
| IMRINT | 27.77858502*** (7.91) | 49.77054155*** (8.73) | 36.33232080*** (4.56) | 27.20262874*** (3.36) | 6.39453593** (2.47) | 67.89118339*** (7.52) | 5.82496439* (1.83) |
| PRODIFFINT | 0.00084734 (0.15) | 0.01527150 (0.91) | 0.20056186*** (3.42) | 0.40915901*** (3.46) | 0.01746777 (0.85) | 0.10283042* (1.89) | -0.04401084 (0.61) |
| PRODVITY | 0.00126702 (1.38) | 0.00468354*** (3.57) | -0.01008366*** (5.06) | 0.00150764 (0.53) | 0.01346416*** (5.27) | 0.00089579 (1.55) | 0.00172431 (0.96) |
| FISCALINT | 2.37368651*** (3.68) | -0.43236664*** (6.96) | 1.76099698*** (4.32) | 2.35598094*** (3.25) | 1.13212599*** (2.85) | 2.76744177*** (8.00) | 1.24862958** (2.08) |
| PROFITMARGIN | 0.00641951*** (2.67) | 0.00308920 (0.84) | 0.11273085*** (3.29) | 0.05396967** (2.31) | 0.00213012 (1.05) | 0.00092108 (0.94) | 0.00268104 (0.92) |
| INDMNE | 0.85936351*** (4.00) | 1.06592330*** (5.69) | 1.16917917*** (4.73) | 0.33276849*** (3.23) | 0.68537798*** (5.52) | 0.75206329*** (3.41) | 3.55968490*** (4.38) |
| FODUM | 1.26341166 (0.85) | 5.37622222*** (3.52) | 0.57861354 (0.38) | 1.69993438** (2.42) | 1.71162622 (1.35) | -2.49584080* (1.82) | 18.59635322*** (5.75) |
| LIBDUM | 8.12785799*** (7.70) | 3.86833810*** (3.65) | 1.32310553 (1.49) | 2.03019233** (2.33) | 1.91382747** (2.42) | 2.94639837*** (2.59) | 2.38230637 (1.41) |
| Constant | -18.44937203*** (14.16) | -10.48807907*** (7.98) | -4.05586728*** (2.86) | -4.12592048*** (3.19) | -3.97467663*** (3.48) | -7.99754885*** (4.52) | -3.32651269* (1.79) |
| | | | | | | | |
| Sigma | 24.359 | 25.902 | 17.5467 | 14.97057 | 14.89 | 23.817 | 26.743 |
| Log Likelihood | -10159.07 | -9688.7648 | -4932.603 | -6532.9348 | -5664.1598 | -6699.6957 | -4990.3567 |
| Wald Chi2 | 2155158.9 | 223.83 | 231.79 | 124.89 | 814419.19 | 485.88 | 99.42 |
| Prob > chi2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Observations | 3842 | 3408 | 1826 | 2028 | 1779 | 1983 | 1508 |
| Obs with exporting | 1965 | 1870 | 1041 | 1491 | 1285 | 1369 | 985 |
| Obs. With non-exporting | 1877 | 1538 | 785 | 537 | 494 | 614 | 523 |

Note: Absolute value of robust z-statistics in parentheses; * Significant at 10%; ** Significant at 5%; *** Significant at 1