Role of Technological and Knowledge Resources and Capabilities in Firms' Decision to Export (A case of inward oriented Indian industries)

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1. Introduction

Despite Indian economy following over two decades of outward oriented growth and trade policies, it has been, of late, facing the serious problem of burgeoning trade and current account deficits (RBI 2013).[2] This situation could be ameliorated if most of the firms start exporting on a continual basis among the inward oriented industries having low export intensities. Therefore, it is important to know which type of firms undertakes export activity in the inward oriented industries of India. A firm intending to export faces major hurdle in terms of its incapability to overcome *sunk cost*[3] of entry into export market. The sunk cost may include such costs as expenditure on market research, setting up of a new distribution channel, developing foreign marketing network and contacts, acquiring skills for dealing in international market, modifying the existing products as per the requirement of overseas buyers and conforming to the standards, norms and safety regulations applicable to the countries of export (Cole et al. 2010). If a firm has some advantages by which it could overcome *sunk cost* barriers, it would be able to export profitably.

There exists a large number of studies in the context of developed countries which report heterogeneity in productivity, previous experience in export, firm's size (reflecting overall resources), age (reflecting learning by doing or experience) and skill intensity to be the important factors underlying a firm's decision to export.[4] However, there is much less number of studies in the context of emerging developing economies and only a few in the case of India. Among these studies, an important one (Berman and Hericourt 2010) on a cross-section of 9 emerging and developing economies emphasizes on access to finance to be more important than productivity on the export decision of the firm and a study by Thomas and Narayanan (2012) does not find productivity to be an important

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[2] The trade deficits and current account deficits, each as a percentage of GDP, have been hovering around 10.0 and 4.5 per cent respectively during the last 3 years (Table III.3: Major Items of India's Balance of Payments**,** p. 29**,** External Sector, Monetary Policy Statements 2013-14, RBI Bulletin, August 2013).

[3] Sunk costs are fixed cost and cannot be recovered once incurred whether the firm undertakes export or not.

[4] Important surveys of this literature can be found in Wagner (2007), Greenaway and Kneller (2007) and Bernard et al. 2007).

determinant of decision to export in the Indian manufacturing sector during the period 1999-2009. At the same time, a large set of studies pertaining to the emerging Asian economies and newly industrializing countries (NICs) have reported technological and knowledge resources and foreign contacts acquired through FDI to be the important determinant of decision to export in the presence of sunk cost barriers to entry in the export market [Sjöholm and Takii (2008), Blalock and Roy (2007), Fung et al. (2008), Wignaraja (2008), Cole et al. (2010), Keshari (2012) and Thomas and Narayanan (2012)]. Two studies have also found decision to export to be either positively related to R&D intensity (Thomas and Narayanan 2012) or negatively related (Keshari 2012). Among all these studies, only Bhat and Nararyanan (2009), Thomas and Narayanan (2012) and Keshari (2012) have focused on the Indian experience. Besides, only Thomas and Narayanan (2012) focus on the entire manufacturing sector while the remaining two studies are industry-specific.

In the above background, this research paper seeks to examine the determinants of decision to export (or export propensity) in a group of inward oriented Indian industries, in which average export intensities of industries vary between from 6 to 20 per cent over the financial year (FY) 2001-2012.[5] Among the determinants of the decision to export, the paper focuses on the technological and knowledge resources and capabilities. We primarily adopt theoretical framework of resource based view (RBV)[6] including its extension into dynamic capability approach (Teece et al. 1997) for undertaking the empirical work. Besides, the paper also utilizes the highlights of literature on *sunk cost* barriers to entry into export market, predictions of the heterogeneous-firm international trade models for overcoming such barriers, theory of foreign direct investment (FDI) and conventional Hecksher Ohlin (HO) international trade theory. In recent past, a few empirical studies on the developing countries have applied RBV as influential theoretical framework for analyzing the determinants of firm-level export intensity or export levels (viz. Singh 2009 and Rodriguez 2005) and export propensity as well as export intensity (Fung et al. 2008).

Empirical part of the study is conducted in two ways. First, it seeks to identify the differing characteristics of exporters and non-exporters by comparing the mean values of various indicators of technological and other characteristic. Secondly, it estimates a panel data model, with probit specification, of the determinants of decision to export. The model includes a number of explanatory variables for capturing technological and knowledge based resources and capabilities such as research

[5] Refer to Table-6 for data.
[6] Most cited exponent of this view is Barney (1991).

and development intensity (RDI), major channels of foreign participations [foreign direct investment (FDI), import of intermediate goods (MI), intensity to import of disembodied technology (IMDT)], learning by doing over the years or experience (AGE), capital intensity (CAPI), product differentiation (PDIFF) and other variables [viz. firm's size (SZ), credit constraint (CRC)]. The model also controls for the industry and time related macroeconomic effects (e.g. business cycle).

The study uses an unbalanced panel of data on a sample of 1835 firms with 13672 observations covering a period of 12 financial years (FY) 2000/01 to 2011/12 for conducting the empirical part of the study. The sample of firms is drawn from 7 divisions of industries classified at two digit level of *National Industrial Classification: All Economic Activities-2008* (NIC). These divisions are manufacture of basic metals (NIC-24), fabricated metal products (NIC-25), computer, electronic and optical products (NIC-26), electrical equipment (NIC-27), machinery and equipment, n.e.c. (28), automobiles (motor vehicles, two and three wheelers) and auto ancillaries (NIC-29 and NIC-30). To achieve international competitiveness, a firm in these industries needs to: i) acquire product design and engineering (precision measuring, material engineering and process control) capabilities; ii) maintain high quality standards including good finish of the product; iii) incur high capital expenditure for setting up business; vi) spend on sunk and transaction cost associated with exporting and servicing overseas clients.

Findings of the study suggest that technology and knowledge based resources and capabilities acquired through FDI and imports of intermediate goods, learning by doing (or experience), capital intensity, product differentiation have positive and significant influence on the decision to export. Besides, the firms with greater resources measured by size, and capacity raise credit from banks and financial institutions are found helpful in entering the export market. The main contributions of this paper to the existing empirical literature are: first, it combines the insights of literature on sunk cost barriers to entry in export market, models of firm heterogeneity and international trade and the RBV with its extension for predicting the influence of technological and knowledge factors on Indian firms' participation into export market; secondly, it exploits the features of panel data model, controlling simultaneously for the potential presence of time and industry (sub-industry) effects and unobserved heterogeneity, on the firms' decision to export of the Indian economy during the period (FY 2001-2012).

Rest of the paper is organized as follows. Section-2 discusses the analytical framework and recent empirical literature explaining the determinants of decision to export by a firm. Section-3

explains the probit model of decision to export, the explanatory variables used in the model and forwards the hypotheses on the relationships between the decision to export and individual explanatory variables. Section-4 describes the data sources and characteristics of the sample. Section-5 discusses the statistical and econometric methods adopted for the empirical analysis and the results obtained from their applications. Section-6 presents the conclusions of the study.

2. Determinants of decision to export

The present study considers undertaking export activity by a firm to be the extension of its domestic *competitive advantage* to the international arena where it has to compete not only with its peers at home but also with the firms based in other countries. Following RBV and other relevant literature, we argue here that the firms are heterogeneous in terms of a host of technological and knowledge based *resources and capability*, most of which are responsible for heterogeneity in the productivity (or overall cost or price) as well as their various dimensions of product performance (e.g. quality, brands and product differentiations). These heterogeneities make the firms' capacity to overcome *sunk cost* barriers divergent and thereby variously influence the firms' decision to export in an industry. Thus, export ability of firm itself becomes an important form of competitive advantage.

2.1 *Theoretical framework*

RBV expounded (or articulated) by Barney (1991) defines a firm "to have a sustained competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy" (Barney 1991, p. 102). In dynamic capability approach 'the competitive advantage is seen in terms of a 'firm's ability to integrate, build and reconfigure internal and external competences, given path dependencies and firm-specific asset positions' (Teece et al. 1997, p. 516). Kogut and Zander (1993), emphasises on the technological and knowledge-based intangible assets and capabilities, which are transferable within different units of the organization, to be the important sources of competitive advantages in a firm as they posses high degree of specificity, complexity and tacit component. Porter (1985) identifies cost and product differentiation advantages as two major dimensions of a firm's international competitive advantage. Focusing on innovation and learning processes in developing countries, some scholars (viz. Lall 2000, Nelson, 2008) stress that the technological capabilities created through access to foreign technology (via FDI and arms length import of embodied and disembodied technology) and through their application, absorption and adaptation as well as production engineering capabilities developed through mastery over a range of manufacturing

process, interactions with buyers of final products and suppliers of intermediate goods all are considered important in providing firm-level international competitive advantage (notably in medium and high technology industries). Recent literature on firm-level exports identifies that: a) firms are greatly heterogeneous in terms of productivity even within an industry; b) *sunk cost* of entry in overseas market inhibits the firms from undertaking export activity. Combining these two facts in a heterogeneous-firm international trade model, some scholars have predicted that firms with productivity higher than a given threshold will only export (viz. Melitz 2003 and Helpman et al. 2004).

The RBV considers firms as the entities holding idiosyncratic *resources and capability* which are responsible for divergence in competitive advantage of firms even within an industry. These *resources* are generally divided into tangible and intangible assets. Tangible assets, inter alia, include physical assets. Intangible assets and capability may include wide range of firm-specific assets (e.g. technological, market, human and organizational-assets) and financial capacity. An extension of RBV emphasizes on a firm's dynamic capability that is the capability to successfully deal with rapidly changing environment in addition to the capability for converting existing resources into competitive advantage. The elements of dynamic capability may involve development of distinctive processes and evolution path adopted or inherited by a firm (Teece et al. 1997). These distinctive processes may include organizational and managerial process for combining, integrating and coordinating a team of relevant *resources* (static capability); learning process (dynamic capability) for performing the given task in better and quicker ways; reconfiguration and transformation of assets as per the changing technology and market demand (Teece et al. 1997). RBV considers origins of a firm's sustainable competitive advantage in its rare, valuable and imperfectly imitable, substitutable and mobile *resources* and capability (Barney 1991). Since intangible assets and capabilities imbibe these characteristics, they are taken as the main sources of heterogeneity in competitive advantage and performance among firms.

Conceptually, *intangible assets* and *capability* are different but it is difficult to delineate them operationally, especially in empirical studies. For the purpose of this research we consider following types of *resources*, and *capability* generated/acquired through these resources: fixed assets (land, building, mines, plant, machinery and equipments), financial assets (capacity to obtain credit from banks and financial institutions); technological and knowledge based resources and capability generated through in-house efforts (viz. research and development and learning by doing); market assets and related capabilities developed by its own expenditure on advertising, marketing, selling and distribution activities; access to a package of tangible and intangible assets acquired through inward FDI [e.g.

equity capital, foreign technology (tacit or explicit), modern managerial, organizational and marketing expertise, market intelligence, right to use word-wide distribution and sales channels of multinational enterprises (MNEs), foreign contacts and training, enhancement in corporate image, etc.]; access to disembodied technology and associated benefits (foreign contacts enabling exports) through foreign technical collaboration agreements; access to cost or quality enhancing intermediate goods and foreign contacts acquired through imports of goods. Based on the above mentioned resources and capability a firm may thus: i) achieve reduction in its cost of production; ii) develop new or improved product (with better operational performance, designs, features, quality and finish) suitable for export market; iii) create differentiation advantages based on strong brand equity through advertising and marketing or offering superior (presale or after sales) services, etc.

2.2 ***Empirical literature and identification of explanatory variables***

In recent years, some important studies have appeared, focusing on the experience of emerging developing economies. Majority of these studies have found productivity of a firm to be an important determinant of decision to export in the presence of sunk cost barriers to export [e.g. Sjoholm and Takii (2008) for Indonesia, Cole et al. (2010) for Thailand, Berman and Hericourt (2010) for 9 developing and emerging economies]. Aw et al. (2000) does not find more productive firm to be exporting in the case of Korean manufacturing sector. In the case of Indian manufacturing sector, Thomas and Narayanan (2012) do not find evidence of higher productive firms to be self-selecting into export for the entire period (1990-2009) of their study; but they report positive evidence for the sub-period 1999-2009. Recognizing heterogeneity in terms of access to finance, some studies have added financial constrained into the Melitz's (2003) model of determinant of decision to export. Notably, Berman and Hericourt's (2010) study for a cross-section of 9 developing counties has reported that heterogeneity in terms of access to finance is an important determinant of decision to participate in export market. Besides, the productivity is found to be the significant determinant of the export decision if the firm has sufficient excess to external finance.

RBV consider in-house research and development (R&D) as a part of innovational resources and capabilities. R&D activity may enhance the international competitiveness of firms either by reducing cost or improving product performance (e.g. quality). This may happen in three ways: i) R&D may lead to efficiency in use of inputs of production, adaptation and absorption of imported technology and thereby reduce costs of production, operation and maintenance of plant and machinery; ii) it may add additional features or improve the quality and finish of the products; iii) R&D in some cases may

also result in innovation of new products or cost reducing processes. The empirical evidence with regards to the effect of R&D on decision to export is generally positive [e.g. Bhat and Narayanan (2009) for Indian basic chemical industry and Thomas and Narayanan (2012) for the entire Indian manufacturing sector during 1990-2009]. Following the firm level technological capability approach of Lall (1992) and combining various sources of technology, Wignaraja (2008) finds that firms with higher technological capability (measured by an index of technological capability) have greater probability to export in the textile and clothing sector of China and Sri Lanka. Keshari (2012) however finds a negative relationship between R&D intensity and probability to export in the Indian machinery industry.

Since learning (by doing or experience), as a function of time, plays an important role in enhancing capability of a firm, the dynamic capability approach considers learning over the years to be an important factor in sustaining competitive advantage. As a firm needs to learn additionally about overseas market before venturing into export, learning by doing could be an important factor in taking decision to export too. The longer period of operation in an industry may result in accumulation of information, knowledge and expertise required for sustaining competitive advantage. Since learning by doing is a function of time, it is generally measured by age of a firm, and its effect on decision to export is likely to be positive. Nevertheless, this measure of learning by doing may also lead to rigidity in outlook due to path dependence nature of learning and plant vintage. Thus the firms' age may act as constraint on decision to export. The empirical studies linking decision to export with the age of a firm have reported mixed evidence. Some studies report age of the firm having no effect on decision to export [e.g. Bhat and Narayanan (2009) for Indian chemical industry, Wignaraja (2008) for Chinese and Sri Lankan clothing industry]. A few studies report that the older firms have higher probability to export [Fung et al. (2008) for Chinese manufacturing, Thomas and Narayanan (2012) for entire Indian manufacturing sector and Keshari (2012) for Indian machinery industry].

Capital intensity may measure firm-specific knowledge embodied in plant, machinery, information and communication equipments employed by a firm. Thus, the higher capital intensity may be a reflection of greater automation, use of information and communication technology and modernisation of plant and machinery all of which may result into high level of precision, performance, finish and quality of the products. Besides, higher capital intensity at firm-level may result into higher technical efficiency (Keshari 2013). Thus, we may expect a positive relationship between decision to export and CAPI. On the other hand, since India is a labour abundant economy, it has comparative

disadvantage in capital-intensive products as per the conventional Heckscher-Ohlin theory of factor proportions. Hence, the firms with higher capital intensity are unlikely to export. Most of the studies, examining the effects of the capital intensity on decision to export, report negative relationship [e.g. Fung et al. (2008) for Chinese manufacturing and Wignaraja (2008) for Chinese clothing industry; Bhat and Narayanan (2009) for Indian basic chemical industry and Keshari (2012) for Indian machinery industry]. Few studies also report positive relationship between the decision to export and capital intensity [e.g. Sjöholm and Takki (2008) for Indonesian manufacturing].

Some empirical studies on developing countries have also emphasized the importance of various channels of foreign participation in overcoming sunk cost barriers to export by improving the competitive advantage of the firm through the transfer of technology and other intangible resources (viz. market intelligence and knowledge about the taste and preferences of foreign customers, export procedures and documentation and legal framework). By providing additional long term stable equity capital, cutting-age technology and advanced management and marketing techniques, FDI, the most important channel of foreign participations may improve the international competitiveness of a firm by reducing its cost of production and marketing, improving the quality of its product, helping the firm in exporting the final products through their foreign networks and contacts. The import of foreign disembodied technology may also improve the competitiveness of a firm by reducing its cost of production and/or improving the quality of its products. Besides, the suppliers of foreign technology may also help the recipient firm in exporting the final products through their networks. On the other hand, technology suppliers may also restrict the exports from the technology recipient firm.

Import of intermediate goods, including machinery and equipments, spare parts and components and raw materials, may improve the international competitive advantage of a firm for the following reasons: a) imported intermediate goods may be cheaper compared to the similar products available in the domestic market; b) imported machinery, components and spare parts may act as an additional source of productivity enhancing and material saving modern (embodied) technology to a firm; c) the import of intermediate goods may fulfill the more exacting quality, finish and precision requirements of the final products to be exported to the international market; d) overseas suppliers may provide information about the new overseas markets/buyers and promote linkages with foreign buyers in the mutual interest; e) imports may also put pressure on a firm to export so as to meet its foreign exchange requirements without exchange risk since the export leads to foreign exchange earnings.

Among the channels of foreign participations, FDI is found important in large number of studies [viz. Sjöholm and Takii (2008) and Blalock and Roy (2007) for Indonesia, Fung et al. (2008) for China, Wignaraja (2008) for China and Shri Lanka, Cole et al. (2010) for Thailand; Keshari (2012) for Indian machinery industry during 2001-2007 and Thomas and Narayanan (2012) for the entire Indian manufacturing sector during 1990-2009]. A study by Sjöholm and Takii (2008) for Indonesian manufacturing plants has reported import of intermediate goods to be a significant factor in export decision, but with very small coefficient. Bhatt and Narayanan (2009) find import of raw material having favourable impact on export propensity while Keshari (2012) do not find import of intermediate inputs to be significant determinant of export propensity. Keshari (2012) finds import of disembodied technology to have positive impact on export propensity but the statistical significance of the relationship is weak.

RBV consider product differentiation achieved through various means to be part of market asset leading to firm-level competitive advantage. Some empirical studies do report product quality and differentiation created through advertising and marketing or by other means to be important determinant of decision to export [viz. Cole et al. (2010) for Thailand, Bhavani and Tendulakar (2001) in the case of Indian textile and apparel industry and Bhat and Narayanan (2009) in the case of Indian basic chemical industry].

In RBV tradition, size is considered as one of the important indicators of the amount of organizational resources (Barney 1991) and to the extent that excess resources are available, a firm will look for opportunities for expansion (Penrose 1959). Hirsch and Adler (1974) points out that the larger firms are better equipped to bear the costs and risks involved in exporting, therefore, they would be more inclined to export than the smaller ones. The recent studies finding favourable effect of size on *decision to export* include Fung et al. (2008) for Chinese manufacturing; Bhat and Narayanan (2009) for Indian basic chemical industry, Keshari (2012) for Indian machinery industry and Thomas and Narayanan (2012) for entire Indian manufacturing sector; Sjöholm and Takii (2008) for Indonesian manufacturing firms; Cole et al. (2010) for Thailand.

In sum, the above survey of recent empirical literature suggests that the technological and knowledge based *resources and capabilities* (viz. R&D, FDI, import of embodied and disembodied technology, product differentiation, learning by doing, capital intensity), productivity, firm size and credit constraints have important influence on the decision to export. In the present study, we do not use any measure of productivity or efficiency to explain decision to export. We rather employ variables

capturing technological and knowledge based resources and capability which are responsible for creating heterogeneity in the productivity/efficiency[7] as well as heterogeneity in some dimensions of product performance (e.g. FDI and R&D for quality). We thus propose that firms with greater/superior *resources and capabilities* shall have productivity advantages resulting in low cost of production or/and offer products with markedly higher quality and product differentiation suitable to highly demanding international customers and competitive export market. These firms shall be able to overcome sunk costs barriers successfully and thereby export.

3. Econometric model, measurement of variables and hypotheses

3.1 *Probit Model of Determinants of Decision to Export*

Based on the discussions in the last section, we develop an empirical model to examine the determinants of decision to export (XD_{it}). The model assumes that a firm *i* decides to export in each year *t* if the incremental expected profit associated with exporting is positive. To parameterize the reduced-form model that describes the firm decision, it is assumed that variation in probability (apart from unobserved components) arises from three different sources observable differences in firm characteristics (X_{it}), industry-specific characteristics (IND_{it}) and external time related economic conditions (θ_t). According, we specify the following panel data model of the determinants of decision to export with probit specification:

$$Pr = E\,(XD_{it} = 1|\ \mathbf{X}) = \beta X_{it} + IND_{it} + \theta_t + \varepsilon_{it;}\ i = 1, \ldots, n;\ t = 1, \ldots T_i\ ,$$

$Pr = E(XD_{it} = 1|\mathbf{X})$ denotes conditional expectation of XD_{it} given a vector of explanatory variables (**X**) or conditional probability that a firm will appear as exporter or take a decision to export given **X**. Thus XD is defined as a dummy variable assuming value 1 for exporting firm and 0 for non-exporting firms in a sample year. To identify an exporting firm, we use 5 alternative criteria based on export intensity (export to sales ratio) of a firm with at least 1 per cent, 2 percent, 3 per cent, 4 per cent or 5 per cent export in a sample year. If joint normality is assumed for $\varepsilon_{it} = \alpha_{i\,+}\, u_{it}$ independence of ε_{it} from **X** and that u_{it} are serially correlated, a panel probit random effect maximum likelihood estimator can be readily implemented with the help of STATA software. Definitions and measurement of variables and hypothesised relationships between decision to export and explanatory variables used in the model are summarized in Table-1.

[7]Many studies have reported technological resources to be the important determinants of firm-level efficiency in various industries of the Indian manufacturing sector [viz. Keshari (2013), Ray (2006), Goldar et al. (2004)]

Table-1

Explanatory variable	Definition and Measurement	Hypothesized relationship with XD
Credit constraints (CRC)	CRC captures incapacity to raise credit from banks and financial institutions. A manufacturing firm is considered leveraged if its total outside liability (TOL)[8] exceeds its tangible networth (TNW)[9]. Indian banks consider a manufacturing firm to be highly leveraged if the value of this ratio exceeds 3 and thereby do not easily extend credit to such borrowers. Thus CRC is captured by an additive dummy variable which takes the value 1 if the ratio of TOL to TNW in a firm in a FY is greater than or equal to 3, otherwise 0.	Negative
FDI	A dichotomous additive dummy variable which takes the value 1 for FDI firms (FFs) and 0 for domestic firms (DFs). In line with recent definition of FDI, FFs are defined as firms in each of which a foreign promoter holds at least 10 per cent of the firm's total paid up equity capital. Accordingly DFs are firms in each of which a foreign promoter hold less than 10 per cent equity. As compared to DFs, FFs have access to additional *resources and capability* (and may also enjoy higher productivity) to overcome sunk cost barriers to entry into export market.	Positive
Intensity to import disembodied technology (IMDT)	Import of disembodied technology may improve the competitiveness of a firm by reducing its cost of production and/or improving the quality of products and may offer contact and networks for exports. On the other hand, technology suppliers may also restrict the exports from the technology recipient firm. IMDT is measured by a ratio of a firm's total expenditure on payments of royalty and technical fees for the import of disembodied technology to sales.	Positive
Import intensity (MI)	Ratio of a firm's combined expenditure on import of raw material, components, spare parts and capital goods to sales. Use of imported inputs, captured by MI, is expected to improve the competitiveness of a firm by reducing its cost of production and/or improving product performance and by offering export enabling foreign contacts and networks.	Positive
R&D intensity (RDI)	Research and development activity, captured by RDI, is expected to improve competitiveness of a firm by reducing its cost of production and/or improving the quality of products. RDI is measured as ratio of R&D expenditure to sales.	Positive
Product differentiation (PDIFF)	Ratio of a firm's expenditure on advertising, marketing, selling and distribution to sales turnover	Positive
Firm's age (AGE)	AGE captures learning by doing or experience. It is measured by natural logarithm of firm's age (i.e. the difference between its year of presence in the sample and its year of incorporation). As every year of operation may not add significantly to the experience, we use natural logarithm of firm's age to reduce the variability.	Positive
Capital intensity (CAPI)	CAPI is the ratio of a firm's gross fixed assets (GFA) to sales. GFA may include land, mines, building, plant and machinery, equipment, furniture and fixtures, etc. acquired by a firm over the years. The relationship between XD and CAPI is expected to be positive following RBV but negative following HO theory of international trade.	?
Firm size (SZ)	SZ captures total amounts of resources available with a firm. It is measured as natural logarithmic value of sales turnover of a firm in a year. Logarithmic value of sales is taken to reduce degree of variability in size across firms, since every unit of addition in sales may not add significantly to the firm's resources, and for avoiding the problem of heteroskedasticity in the estimation of a regression equation.	Positive
NIC241, NIC242,	We categorize the sample firms into 12 industry groups and use 11 additive dummy	The

[8] TOL is measured as sum of current and non-current liability.
[9] TNW is measured equity capital plus reserves excluding revaluation reserves.

NIC243, NIC250, NIC260, NIC270, NIC271, NIC273, NIC281, NIC282, NIC290, NIC300	variables (with reference to NIC241, which is dropped) in the model to take care of their individual effects. A minimum 51 per cent of a firm's sales made up from an industry in a particular financial year is used as the norm for this classification. The industry-specific characteristics (e.g. degree of inward or outward orientation of the industry, concentration levels, capital intensity and technology intensity, etc.) may also have important influence on XD and need to be controlled.	relationship is not predicted.
External time related economic factors and events (θ)	External time related factors and events are captured by year-on year changes affecting export propensity. These may include business cycles, supply and demand conditions, prices, etc. affecting exportability of a firm. To control these influences on XD, we employ 11 year-specific dummy variables (FY02, ..., FY12) with reference FY2001	The relationship is not predicted

4. Data, Sample and Industry Characteristics

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

To create a sample we draw data on firms from 7 divisions of NIC, namely industries manufacturing basic metals (NIC-24), fabricated metal products (NIC-25), computer, electronic and optical products (NIC-26), electrical equipment (NIC-27), machinery and equipment, n.e.c. (28), automobiles including two, three and four wheelers and auto ancillaries and parts (NIC-29 and 30). After cleaning up the data, we included all those firms in the sample for which data on each of the relevant variables were available for at least 2 years of the 12 financial years of the study. Further, we deleted sick companies, i.e., the companies with non-positive networth in a financial year, mainly with a view to remove outlier effect from the analysis. These exclusions left us with a usable sample of unbalanced panel of 1835 firms with 13672 observations. The number of firms varies from year to year during the period 2000/01 to 2011/12 of the study.

Tables-(2,…,13) and Figures (1, …,12) summarize several characteristics of the sample and industries covered in the study. They include, *inter alia*, industry-wise and year-wise distribution of number of firms in the sample, sales turnover, share of exporters in the number of firms, shares of FDI firms, export intensity, import intensity, etc. Table-2 shows that number of firms is only 711

(minimum) in terminal year 2011/12 and 1392 (maximum) in 2008/09. Average sales turnover during the sample period varies between minimum for Rs. 9574 crore for wiring and wiring device industry and maximum for Rs. 164726 crore (Table-3). Table-4 shows that the percentage of exporters (i.e. firms with at least 1 per cent export intensity) has increasing trend over the sample period in every selected industry. Distribution of number of exporters varies widely between 43 per cent of total firms (minimum) in basic iron and steel industry to 86 per cent of total firms (maximum) in general purpose machinery (Table-4). Similarly the distribution of number of FDI firms in total number of firms varies widely between the minimum of 6 per cent in fabricated metals industry to the maximum of 77 per cent in general purpose machinery (and wiring and wiring devices) (Table-5).

Average export intensity over the sample period also varies widely from a minimum of 6 per cent for automobile industry to maximum of 20 per cent for computers, electronics and optical products (Table-6). Average import intensity over the sample period also varies widely from a minimum of 6.3 per cent for fabricated metals to 25.5 per cent for computers, electronics and optical products (Table-7). Average intensity of import of disembodied varies widely from a minimum of 0.01 per cent for basic iron and steel industry to maximum of 0.67 per cent for automobile industry (Table-8). Similarly, average R&D intensity varies widely from a minimum of 0.01 per cent for basic iron and steel industry (and fabricated metals industry) to maximum of 0.55 per cent for automobile industry (Table-9). On an average during the sample period, computers, electronics and optical products industry is found most capital intensive (73.5%) while electrical motors, turbines, electric distribution and control equipment industry is found least capital intensive (37.4%) (Table-10).

Automobile industry is found most product differentiated with 8.2 per cent of its sales revenue devoted to advertising, marketing, selling and distribution, while basic metals and iron industry is found least product differentiated with only 2.3 per cent (Table-11). As summarized in Table-12, descriptive statistics shows mean, standard deviation, minimum and maximum of each firm-specific explanatory used in the model. It also suggests within and between variations in variables. Overall analysis of sample and industry characteristics suggests the need for controlling industry-specific heterogeneity and year-wise variations. Summary of computations on variance inflation factor presented in Table-13 reveal no serious multicolinearity problem in terms of rule of thumb for the variance inflation factor (>10) for the individual regressors.

5. Empirical analysis and results

5.1 *Univariate Statistical Method and Results*

The first step of this technique involves classification of an observation into two *a priori* groups of exporting and non-exporting firms. Exporting firm is defined as a firm with at least one per cent mean export intensity during the sample period. In the second stage, the value of mean and standard deviation of an individual variable representing particular characteristic of a firm is calculated for the each group. Third stage compares the mean value of individual variables by conducting Welch's t-test using two-samples having possibly unequal variances. T-statistics for individual variables are obtained by using following formula:

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

Where $\overline{X}_1$ and $\overline{X}_2$ are the sample means of the exporting and non-exporting firms respectively; s_1^2 and s_2^2 are the sample variances of exporting and non-exporting firms respectively; n_1 and n_2 are number of observations in each group. The degrees of freedom (ν) associated with variance estimates are approximated using the Welch-Satterthwaite equation. Once t and ν are computed, these statistics are used with t-distribution to test the null hypotheses (H_o) for each variable that the difference in mean between the groups of exporting and non-exporting firms is zero (using a two-tailed test) against the alternative hypothesis (H_a) that the groups have different means. We prefer to use two-tail test because of the possibility that mean of a variable for exporting firms may be less or more than that of non-exporting firms. The tests yields t-value that may (or may not) provide evidence sufficient to reject null hypothesis.

Results of the univariate mean comparison of firm-level characteristics of the exporters and non-exporters belonging to the sample are summarized in Table-14 below:

Table-14: Relative Characteristics of Exporters and Non-exporters

Variables	Exporters			Non-exporters			Diff in Mean
	Mean	SD	Obs.	Mean	SD	Obs.	t-stat
SZ	4.807	1.751	7523	3.970	1.505	6149	30.60*
AGE	3.119	0.701	7523	2.839	0.694	6149	23.40*
CAPI	0.546	0.579	7523	0.502	0.657	6149	4.08*
IMDT	0.002	0.006	7523	0.001	0.018	6149	2.43*
MI	0.139	0.221	7523	0.072	0.169	6149	19.97*
PDIFF	0.054	0.056	7523	0.032	0.048	6149	24.57*
Sales (Rs. crore)	747	3059	7523	159	359	6149	16.53*
RDI	0.002	0.006	7523	0.001	0.008	6149	5.77*

Note: * denotes that the t-statistics is significant at 1 per cent level.

The table also offers the results of Welch's t-statistics with their significance levels for testing the hypothesis that there exists no difference in the mean values of each of the firm characteristics between exporters and non-exporters. These results indicate that the exporters as compared to non-exporters have greater size (SZ) and sales turnover, learning by doing or business experience (AGE), capital intensity (CAPI), intensity in the import of intermediate goods (MI), intensity in the import of foreign disembodied technology (MTI), R&D intensity (RDI) and product differentiation advantage (PDIFF).

The univariate mean comparison method provides important clues about differences in the characteristics of exporters and non-exporters. However, the findings of this analysis cannot be considered conclusive since univariate method compares one characteristic at a time while ignoring a large number of other discriminants. We thus estimate a multivariate random effect probit model, as discussed in section 4.2, which considers a profile of firm level characteristics along with several control variables. To estimate the model, we employ popular software STATA that allows us to employ maximum likelihood (ML) estimation technique.

5.2 ***Econometric Estimation and Results***

The results of the ML estimates of the model explaining decision to export based on at least 1 per cent of export intensity are presented in Table-15. Results based on remaining criterion, which are similar, are presented in Appendix. The likelihood-ratio (LR) ch^2 statistics shows that the model is significant.

Table-15: Determinants of Decision to Export: Estimation Results

Explanatory Variable	Coefficient	Std. Error	Z-Value
CRC	-0.213	0.060	-3.54*
RDI	1.077	2.919	0.37
FDI	0.279	0.119	2.36**
IMDT	-3.192	2.925	-1.09
MI	1.147	0.152	7.56*
PDIFF	3.550	0.639	5.56*
CAPI	0.337	0.052	6.53*
AGE	0.436	0.074	5.88*
SZ	0.556	0.034	16.55*
NIC242	1.280	0.301	4.25*
NIC243	2.181	0.263	8.28*
NIC250	1.678	0.239	7.03*
NIC260	2.227	0.264	8.43*
NIC270	1.664	0.326	5.10*
NIC271	1.899	0.294	6.47*
NIC273	0.313	0.364	0.86

NIC281	2.687	0.324	8.29*
NIC282	2.571	0.238	10.78*
NIC290	1.017	0.467	2.18**
NIC300	1.769	0.210	8.44*
FY02	0.172	0.094	1.83***
FY03	0.388	0.095	4.1*
FY04	0.308	0.095	3.25*
FY05	0.332	0.095	3.48*
FY06	0.325	0.096	3.39*
FY07	0.349	0.097	3.58*
FY08	0.306	0.100	3.05*
FY09	0.384	0.102	3.77*
FY10	0.061	0.103	0.59
FY11	-0.159	0.113	-1.41
FY12	-0.176	0.122	-1.45
Constant	-5.771	0.272	-21.19*
lnsig2u	1.672	0.069	
Sigma_ u	2.307	0.080	
Rho	0.842	0.009	
Log likelihood			-4837.22
Number of observation (groups)			13672 (1835)
LR Chi^2 (31)			943.05*
Likelihood-ratio test of rho=0: $chibar^2$ (01) = 6002.66 Prob >= chibar2 = 0.00			

*significant at 1%, ** significant at 5% and *** significant at 10%

Table-15 shows that among the explanatory variable capturing access to foreign technological capabilities, knowledge and other resources and connections needed for realizing exports, FDI and MI bear positive and statistically significant coefficients. Coefficient of IMDT turns out to be insignificant, indicating that the arms length import of disembodied technology is not important in helping Indian firms in exporting to the international market. The coefficient of RDI turns out statistically insignificant in the equation, indicating that the firms' R&D is also unimportant in overcoming barriers to export. The coefficient of CAPI carries a significant and positive sign signifying that the firms using more capital-intensive techniques of production are successful on export front. The result probably suggests that the firms spending more on ICT, modernisation and automation of plants and machinery are helping in producing the products efficiently that is also suitable for export market. In line with the prediction of RBV's dynamic capability approach, learning by doing (or experience) captured by AGE is found to have favourable impact on decision to export. The study also finds that the firms spending higher amounts on advertising, marketing and selling activities for creation of market assets or product

differentiation advantage are also successful in overcoming sunk cost barriers to export. The coefficient of SZ turns out to be statistically significant and positive in the equation, suggesting that the resource advantages associated with larger size helps in taking decision to export. As expected, the coefficient of CRC turns out to be statistically significant and negative. This shows that the capacity to raise credit from the banks and financial institutions is a crucial factor in overcoming sunk cost barriers to export.

Among the 11 industry specific dummy variables, the coefficients of only one dummy variable capturing electric motor, generator, turbines, etc. (NIC271) is insignificant. Other ten industry groups show greater likelihood of exporting with reference to base iron and steel (NIC241). Among the year-specific dummy variables, only the coefficients related to FY10, FY11 and FY12 are statistically insignificant.

8. Conclusions

Major conclusions of this study are that technological and knowledge resources acquired through two foreign channels (i.e. FDI and imports of intermediate goods), learning by doing (or experience), employment of capital intensive technique of production, have favourable impact on the decision to export by a firm in the inward oriented Indian industries. Besides, overall resource advantage, capacity to raise debt and product differentiation advantage also influence firms' decision to export favourably. Thus, the Indian firms based in these industries need to be encouraged to tap these foreign channels for acquiring unique *resources and capabilities* for attaining export status. Moreover, firms should invest more on product differentiation strategy, adopt capital intensive technique of production, improve their resource raising capacity and achieve growth in size to attain export status. These finding have important implication for developing a long term strategy for strengthening the international competitive advantage of inward oriented Indian firms with the help of technological and knowledge based resources so that the inward oriented industries too become export oriented. Increased export orientation of these industries would contribute towards reducing the overall trade deficits of the Indian economy besides strengthening their own technological and knowledge based resources and capabilities.

Table-2: Industry-wise year-wise number of firms

Industry groups	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Basic iron & steel (NIC241)	166	182	199	207	249	279	287	291	305	284	164	123	2736
Basic precious & non-ferrous metal (NIC242)	45	48	47	54	60	66	75	74	75	78	54	41	717
Casting of metals (NIC243)	80	78	84	81	87	94	97	98	109	107	63	56	1034
Fabricated metals (NIC250)	89	84	88	105	120	129	129	133	135	133	87	70	1302
Computer, electronics & optical products (260)	80	84	97	106	107	102	102	105	109	100	68	53	1113
Misc. electrical equipment (NIC270)	37	41	46	46	52	55	59	64	63	61	37	30	591
Electric motors, generators, turbines, distribution and control equipment (NIC271)	44	53	62	64	64	71	76	78	79	81	63	45	780
Wiring and wiring devices (NIC273)	34	38	41	39	39	42	45	45	41	36	32	23	455
General purpose machinery (NIC281)	40	45	50	54	60	56	60	63	61	59	42	29	619
Special purpose machinery (NIC282)	111	117	125	140	140	150	157	158	154	138	109	80	1579
Automobiles:Two, three and 4-whelers (NIC290)	18	19	19	20	20	21	22	22	23	25	22	20	251
Auto ancillaries and parts (NIC300)	179	181	205	222	227	232	239	236	238	224	171	141	2495
Total	923	970	1063	1138	1225	1297	1348	1367	1392	1326	912	711	13672

Source: Calculated from the data drawn from PROWESS

Table-3: Industry-wise year-wise sales turnover

(Rs. Crore)

Ind.	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Avg
241	49625	49492	72946	91869	135779	145278	185517	222583	245477	237124	259745	281275	164726
242	15853	17290	18065	22391	27914	39127	63614	64882	59403	66379	80781	82735	46536
243	5618	6387	7533	10541	14266	18915	24495	30870	38788	37169	36813	41461	22738
250	5119	5204	4873	5903	8635	11260	17426	20777	22938	25444	27691	29378	15387
260	9620	9595	9839	12877	14003	14659	17831	19141	22820	23340	20611	19527	16155
270	3912	4330	5217	6132	8037	10965	14670	19888	20081	21807	21792	23673	13375
271	14549	16769	18399	22929	30087	42408	59285	71120	81117	86105	105513	110318	54883
273	5616	5598	3539	3444	5045	7197	10757	14020	14591	14429	16865	13788	9574
281	4519	4776	5658	6563	8337	9781	13058	15294	16257	16243	17617	16723	11236
282	12850	12354	12902	17449	21233	27762	37973	47789	44342	45059	52494	44765	31414
290	38288	40546	46161	61556	79167	90610	112858	130592	132856	171241	212326	242132	113194
300	16152	17482	21634	28554	35805	44857	58016	66422	67186	76978	90678	85144	50742
Total	181720	189824	226767	290208	388309	462819	615502	723378	765855	821318	942927	990919	**549962**

Source: Calculated from the data drawn from PROWESS

Table-4: Industry-wise year-wise share of number of exporters in total number of firms

(per cent)

Industry group	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Basic iron & steel (NIC241)	27	33	31	31	32	31	36	35	36	33	41	43
Basic precious & non-ferrous metal (NIC242)	44	54	49	46	45	53	51	54	55	60	54	66
Casting of metals (NIC243)	54	53	58	62	60	63	62	60	57	59	65	70
Fabricated metals (NIC250)	36	44	59	51	49	55	56	53	56	52	57	57
Computer, electronics & optical products (260)	58	62	61	67	69	74	74	68	69	65	65	72
Misc. electrical equipment (NIC270)	43	51	59	52	54	55	53	61	59	56	59	60
Electric motors, generators, turbines, distribution and control equipment (NIC271)	61	58	66	56	55	59	57	60	66	56	54	67
Wiring and wiring devices (NIC273)	32	34	44	41	41	38	33	47	54	53	50	52
General purpose machinery (NIC281)	53	67	76	74	70	73	73	78	80	83	81	86
Special purpose machinery (NIC282)	64	71	67	71	75	71	69	71	74	65	71	73
Automobiles:Two, three and 4-whelers (NIC290)	56	47	63	75	70	71	73	64	70	60	68	70
Auto ancillaries and parts (NIC300)	51	54	53	51	52	53	60	64	64	63	66	70
Avg	47	52	54	54	53	54	56	57	58	55	59	64

Note: Exporters are having at least 1% of export intensity in a year

Source: Calculated from the data drawn from PROWESS

Table 5: Industry-wise and year-wise share of number of FFs in total firms in the corresponding industry
(per cent)

	Avg	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Basic iron & steel (NIC241)	08	06	06	06	05	06	06	08	09	07	09	15	14
Basic precious & non-ferrous metal (NIC242)	11	09	08	09	09	10	12	09	12	11	10	13	15
Casting of metals (NIC243)	07	03	03	01	04	08	09	10	09	07	09	13	14
Fabricated metals (NIC250)	07	07	07	07	06	06	07	07	08	07	05	08	06
Computer, electronics & optical products (260)	48	49	52	44	45	45	45	46	42	40	46	60	74
Misc. electrical equipment (NIC270)	51	62	63	57	57	46	45	42	41	40	46	65	70
Electric motors, generators, turbines, distribution and control equipment (NIC271)	46	57	55	48	48	48	42	38	40	39	40	49	71
Wiring and wiring devices (NIC273)	58	71	66	59	54	49	52	51	53	54	56	66	77
General purpose machinery (NIC281)	57	65	60	58	50	48	57	55	52	52	51	67	77
Special purpose machinery (NIC282)	52	57	60	53	51	49	45	46	45	45	49	66	71
Automobiles:Two, three and 4-whelers (NIC290)	67	83	79	79	75	75	71	68	59	57	52	55	55
Auto ancillaries and parts (NIC300)	41	40	40	39	37	37	37	38	39	39	42	51	61
Total	33	34	31	30	29	28	29	28	27	29	40	47	31

Table-6: Industry-wise year-wise export intensity (export as % of sales)

Industry group	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Avg
241	6	7	7	7	6	7	7	7	8	6	8	8	7
242	8	10	9	7	7	10	11	11	12	12	10	11	10
243	12	14	16	15	17	17	16	16	18	14	20	21	16
250	9	11	14	11	12	11	12	13	15	13	11	14	12
260	18	17	18	20	20	21	21	20	21	19	20	24	20
270	6	8	9	10	10	8	7	9	13	11	11	8	9
271	8	11	12	12	10	12	13	13	15	10	11	13	12
273	4	4	7	6	5	7	6	6	10	8	9	4	6
281	9	11	17	15	14	16	16	17	20	20	15	17	16
282	9	12	14	13	15	14	13	12	13	11	10	10	12
290	3	3	3	5	5	5	4	5	10	7	7	7	6
300	9	10	10	9	10	10	11	11	12	10	11	11	11
Avg	**9**	**10**	**12**	**11**	**11**	**11**	**12**	**12**	**13**	**11**	**11**	**13**	**11**

Source: Calculated from the data drawn from PROWESS

Table-7: Industry-wise year-wise import intensity of intermediate goods (import as % of sales)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Avg
241	6.6	6.3	5.6	9.4	7.5	10.9	7.8	7.3	8.8	8.6	10.1	10.3	8.3
242	11.4	13.3	14.8	12.6	17.2	21.1	19.7	25.5	17.2	20.0	21.6	20.7	18.4
243	4.3	4.6	4.0	6.6	6.3	8.0	6.6	7.0	8.0	7.9	13.2	11.5	7.1
250	4.1	5.9	5.5	7.1	5.7	5.1	6.7	6.5	7.9	6.6	6.4	7.0	6.3
260	28.6	24.5	21.6	21.3	21.7	22.3	24.9	32.6	26.2	30.9	25.9	26.3	25.5
270	11.5	10.2	11.9	13.4	12.3	14.0	14.9	17.5	19.3	21.1	19.4	19.1	15.6
271	9.6	10.3	9.7	12.6	11.8	11.4	11.1	10.3	12.6	13.5	15.9	16.4	12.1
273	7.2	11.3	12.3	9.9	8.1	13.4	10.8	11.6	13.3	15.8	13.3	13.4	11.6
281	5.8	6.2	6.9	8.1	8.8	8.4	9.6	10.1	11.2	10.9	11.2	12.6	9.2
282	8.1	7.8	7.7	7.9	9.3	8.5	9.3	9.7	11.0	9.0	9.8	11.2	9.1
290	9.4	8.4	7.7	10.5	7.5	8.1	7.6	9.9	13.8	14.2	5.8	8.8	9.4
300	8.2	6.6	7.2	7.9	7.8	9.2	9.8	11.2	11.5	9.7	11.0	10.8	9.2
Avg	**9.2**	**8.9**	**8.8**	**10.1**	**9.7**	**11.0**	**10.8**	**12.0**	**12.2**	**12.2**	**12.8**	**13.0**	**10.9**

Source: Calculated from the data drawn from PROWESS

Table-8: Industry-wise year-wise intensity to import of disembodied technology

(per cent)

Ind	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Avg
241	0.02	0.02	0.02	0.03	0.01	0.01	0.01	0.00	0.02	0.01	0.02	0.01	0.01
242	0.03	0.08	0.09	0.20	0.10	0.05	0.02	0.07	0.10	0.16	0.03	0.04	0.08
243	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.07	0.03	0.01	0.01	0.04	0.02
250	0.04	0.05	0.02	0.04	0.05	0.03	0.04	0.03	0.03	0.07	0.18	0.06	0.05
260	0.14	0.15	0.17	0.17	0.33	0.21	0.07	0.08	0.18	0.18	0.11	0.30	0.17
270	0.23	0.27	0.15	0.29	0.10	0.13	0.10	0.11	0.13	0.10	0.08	0.17	0.15
271	0.14	0.33	0.15	0.09	0.13	0.17	0.10	0.10	0.12	1.79	0.45	0.31	0.35
273	0.02	0.03	0.06	0.01	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.02	0.02
281	0.38	0.21	0.25	0.19	0.16	0.15	0.12	0.15	0.13	0.13	0.21	0.20	0.18
282	0.24	0.23	0.25	0.20	0.21	0.14	0.18	0.21	0.16	0.20	0.20	0.25	0.20
290	0.58	0.59	0.71	0.54	0.69	0.84	0.77	0.74	0.97	0.42	0.93	0.24	0.67
300	0.39	0.41	0.41	0.39	0.35	0.30	0.24	0.27	0.31	0.34	0.35	0.33	0.34
Avg	**0.17**	**0.18**	**0.18**	**0.17**	**0.16**	**0.13**	**0.11**	**0.12**	**0.13**	**0.24**	**0.19**	**0.17**	**0.16**

Source: Calculated from the data drawn from PROWESS

Table-9: Industry-wise year-wise R&D intensity

(per cent)

Ind	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Avg
241	0.02	0.02	0.02	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.01
242	0.10	0.08	0.08	0.11	0.10	0.08	0.05	0.05	0.04	0.08	0.07	0.07	0.08
243	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.03	0.04	0.04	0.05	0.03	0.02
250	0.01	0.02	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.01
260	0.15	0.27	0.25	0.29	0.35	0.54	0.45	0.48	0.56	0.63	1.40	1.10	0.50
270	0.09	0.10	0.07	0.07	0.06	0.10	0.13	0.22	0.21	0.27	0.21	0.48	0.16
271	0.13	0.10	0.10	0.07	0.10	0.08	0.11	0.20	0.28	0.32	0.35	0.23	0.18
273	0.04	0.03	0.04	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.10	0.03	0.03
281	0.01	0.02	0.05	0.04	0.04	0.02	0.05	0.09	0.12	0.16	0.27	0.29	0.09
282	0.08	0.09	0.11	0.11	0.10	0.13	0.11	0.18	0.23	0.23	0.24	0.32	0.16
290	0.06	0.23	0.29	0.20	0.26	0.21	0.43	0.55	0.66	0.84	1.10	1.56	0.55
300	0.07	0.05	0.06	0.06	0.10	0.09	0.11	0.17	0.20	0.23	0.23	0.27	0.13
Avg	0.06	0.07	0.07	0.07	0.08	0.09	0.09	0.13	0.15	0.18	0.27	0.28	0.12

Source: Calculated from the data drawn from PROWESS

Table-10: Industry-wise year-wise capital intensity

(per cent)

Ind	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Avg
241	47.8	49.4	49.8	51.7	41.0	48.2	43.7	40.9	42.1	53.7	59.5	62.4	47.9
242	51.7	54.3	58.0	50.2	43.8	43.4	46.0	37.7	39.6	56.3	52.4	48.2	47.8
243	69.7	69.3	71.4	49.1	41.5	40.0	35.6	44.6	46.5	59.3	54.6	55.3	52.3
250	64.4	68.8	57.3	52.7	44.7	44.9	45.2	44.8	50.0	53.0	50.5	52.5	51.4
260	63.5	72.2	79.0	70.9	68.2	67.8	68.6	73.4	84.3	77.2	89.4	67.8	73.5
270	54.8	59.1	58.5	50.8	47.1	51.6	52.8	42.6	44.2	56.4	57.8	55.1	51.8
271	39.9	40.4	49.1	53.4	36.6	37.4	28.8	26.3	27.9	44.9	33.7	35.4	37.4
273	40.4	54.9	89.3	101.7	72.7	65.3	57.8	46.1	39.3	45.2	57.1	83.7	62.3
281	64.7	65.4	60.7	55.6	43.0	35.3	33.7	33.1	44.1	49.7	41.6	42.3	46.6
282	61.7	73.6	67.9	61.4	51.3	46.9	40.9	47.8	49.3	51.5	50.2	56.4	54.1
290	50.3	50.3	46.2	42.8	31.0	33.2	47.5	34.3	46.8	78.1	53.3	71.3	49.2
300	65.7	67.3	60.7	52.7	48.1	45.7	46.8	49.1	61.5	60.1	50.6	50.1	54.6
Avg	**58.4**	**62.0**	**61.7**	**56.5**	**47.4**	**47.3**	**45.1**	**45.0**	**49.9**	**56.5**	**54.4**	**55.4**	**52.6**

Source: Calculated from the data drawn from PROWESS

Table-11: Industry-wise year-wise product differentiation

(per cent)

Ind	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Avg
241	2.5	2.6	2.4	2.6	2.3	2.4	2.3	2.0	2.0	2.1	2.1	2.3	2.3
242	2.8	2.8	2.6	2.8	2.4	2.5	2.2	2.3	2.3	2.4	1.7	1.7	2.4
243	4.4	4.6	4.1	4.0	3.6	4.0	4.1	3.6	3.7	3.2	3.3	2.9	3.8
250	4.5	4.7	5.2	4.6	4.2	4.4	4.1	4.0	3.9	4.1	4.6	4.6	4.3
260	6.3	6.1	6.2	6.7	7.1	6.5	5.3	5.7	5.5	6.1	4.3	4.6	6.0
270	6.8	7.2	8.0	7.3	7.1	7.9	7.8	6.8	5.9	5.6	6.2	5.2	6.9
271	5.0	5.5	6.1	5.3	5.1	5.2	4.9	4.3	4.7	4.2	4.8	4.9	4.9
273	4.1	3.4	4.2	4.3	2.9	3.4	2.9	3.3	3.2	3.1	4.4	2.8	3.5
281	5.2	5.5	5.1	5.5	5.3	4.9	4.6	4.8	4.4	4.8	4.5	5.0	4.9
282	6.2	6.0	7.0	7.5	7.0	6.7	6.3	6.2	5.7	5.2	5.8	5.5	6.3
290	7.6	9.9	10.2	9.8	7.5	7.7	8.7	7.9	7.8	7.5	6.5	7.4	8.2
300	5.0	4.9	4.9	4.8	4.5	4.6	4.2	4.0	4.3	4.2	4.2	4.2	4.5
Avg	**4.7**	**4.8**	**5.0**	**5.0**	**4.5**	**4.5**	**4.2**	**4.1**	**4.0**	**3.9**	**4.1**	**4.0**	**4.4**

Source: Calculated from the data drawn from PROWESS

Table-12: Descriptive Statistics of Variables, 2000/01-2011/12

Variable		Mean	Std. Dev.	Min	Max
CRC	overall	0.230	0.421	0.000	1.000
	between		0.353	0.000	1.000
	within		0.276	-0.687	1.147
XI	overall	0.114	0.199	0.000	1.919
	between		0.183	0.000	0.997
	within		0.084	-0.711	1.540
FDI	overall	0.312	0.464	0.000	1.000
	between		0.421	0.000	1.000
	within		0.111	-0.604	1.229
SZ	overall	4.43	1.70	0.70	10.99
	between		1.57	0.73	10.37
	within		0.61	0.43	7.81
AGE	overall	2.993	0.712	0.000	4.710
	between		0.744	0.347	4.659
	within		0.199	1.327	3.917
CAPI	overall	0.526	0.615	0.006	11.441
	between		0.641	0.013	8.101
	within		0.337	-4.701	7.761
IMDT	overall	0.002	0.013	0.000	1.371
	between		0.013	0.000	0.514
	within		0.010	-0.499	0.858
MI	overall	0.109	0.202	0.000	8.493
	between		0.183	0.000	3.456
	within		0.130	-2.903	6.246
PDIFF	overall	0.044	0.054	0.000	0.678
	between		0.048	0.000	0.537
	within		0.025	-0.189	0.507
SALES	overall	482.70	2301	2	59199
	between		1626	2	34666
	within		1123	-18800	32487
RDI	overall	0.001	0.007	0.000	0.450
	between		0.005	0.000	0.121
	within		0.005	-0.120	0.330

Source: Calculated from the data drawn from PROWESS

Table-13: Variance Inflation Factor for detecting colinearity

Variable	VIF	1/VIF
FY09	2.3	0.43
FY08	2.27	0.44
FY10	2.26	0.44
FY07	2.25	0.44
FY06	2.2	0.46
FY05	2.13	0.47
FY04	2.05	0.49
FY03	1.99	0.50
FY11	1.93	0.52
FY02	1.91	0.52
NIC300	1.83	0.55
FY12	1.76	0.57
NIC282	1.74	0.57
NIC260	1.63	0.61
SZ	1.44	0.69
NIC250	1.44	0.69
FDI	1.4	0.72
NIC271	1.32	0.75
NIC243	1.32	0.76
NIC281	1.31	0.76
NIC270	1.3	0.77
NIC242	1.24	0.81
CAPI	1.21	0.83
NIC273	1.2	0.84
MI	1.18	0.85
NIC290	1.17	0.85
AGE	1.16	0.86
PDIFF	1.15	0.87
RDI	1.06	0.94
IMDT	1.05	0.95
CRC	1.04	0.96
MEAN VIF	1.56	

Source: Calculated from the data drawn from PROWESS

Figure 1: Industry-wise and year-wise distribution of number of sample firms

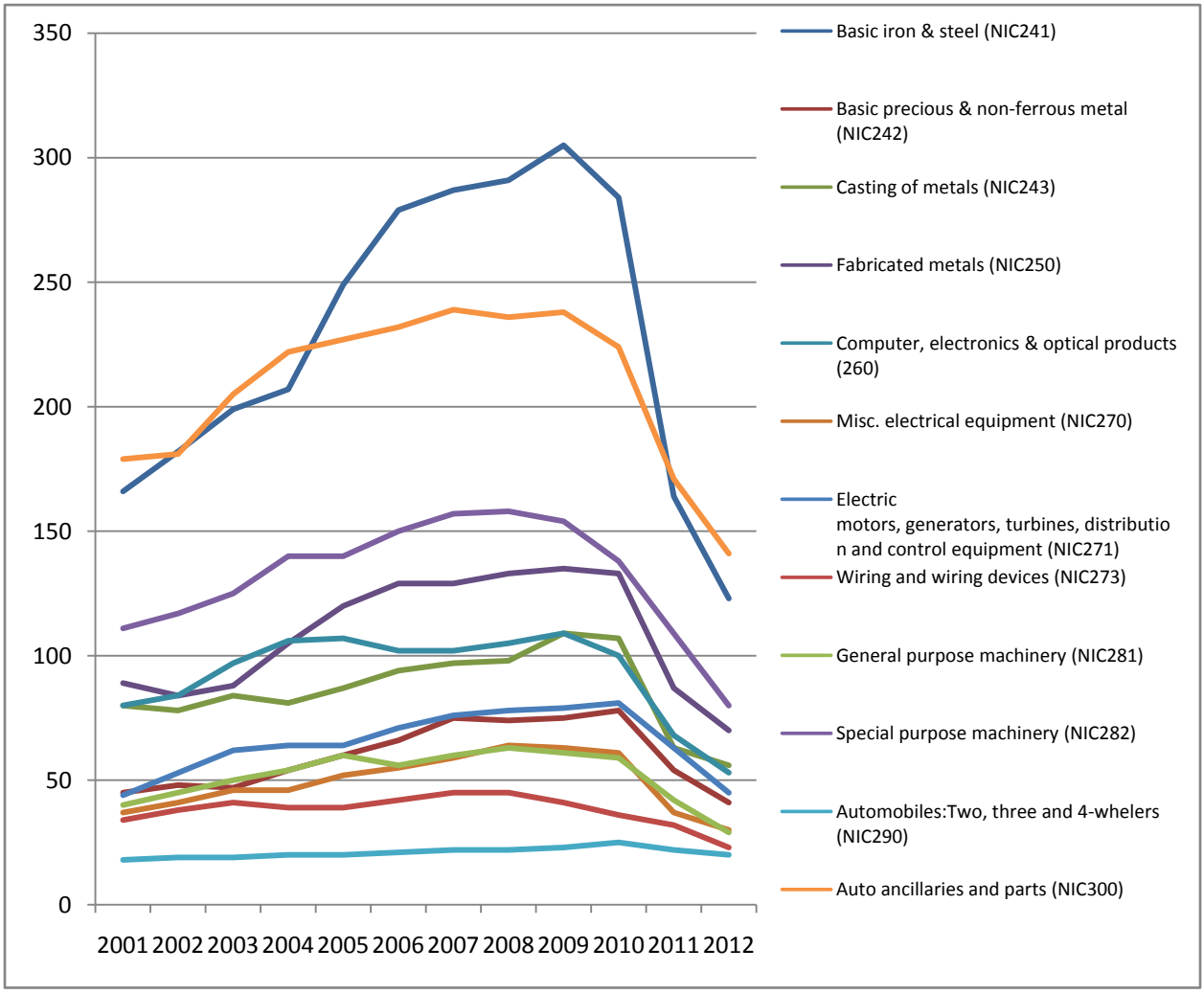


Figure 2: Industry-wise year-wise share of number of exporting firms

(Per cent)

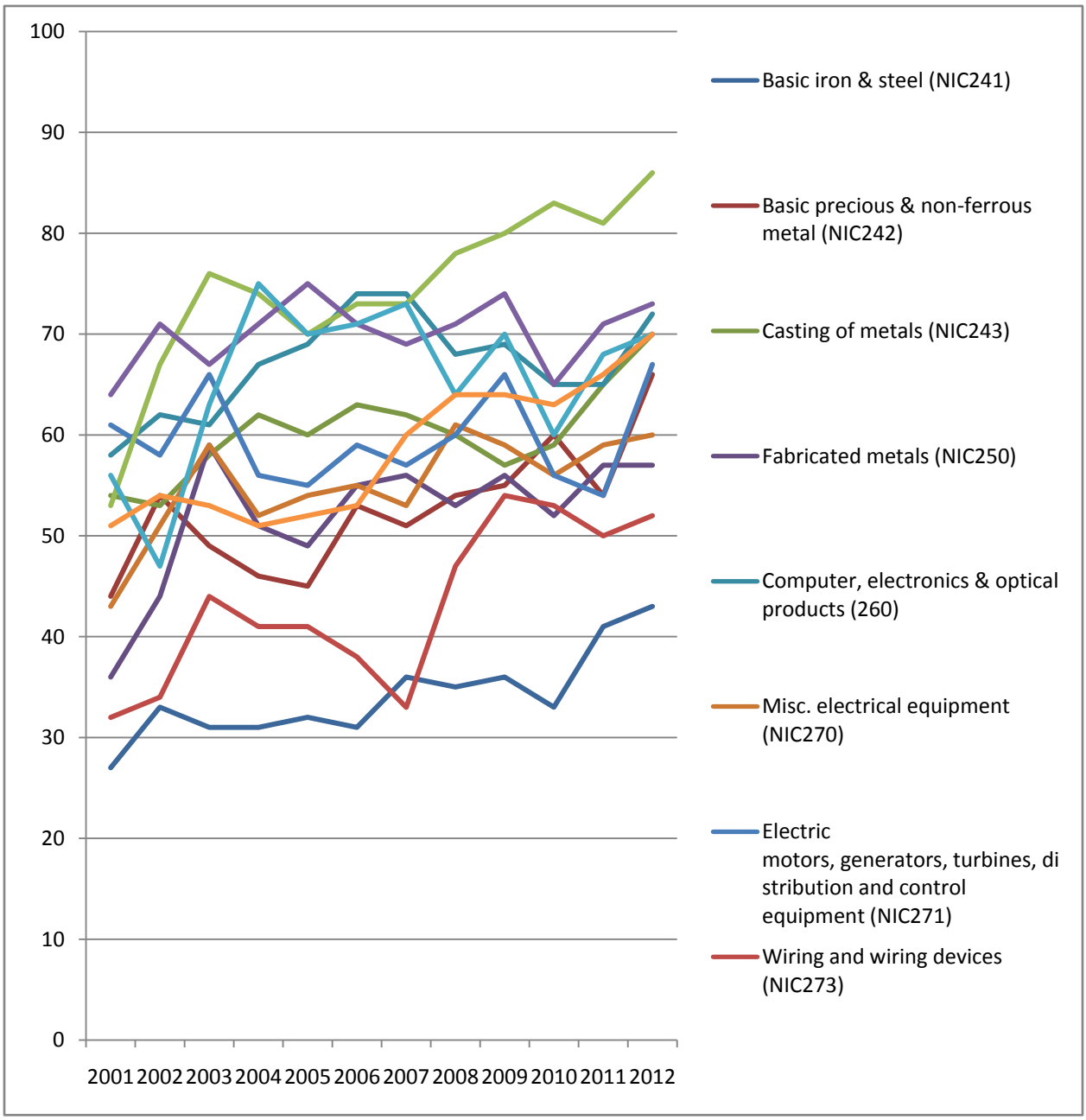


Figure 3: Share of FFs in total number of sample firms, 2001-2012

(ratio)

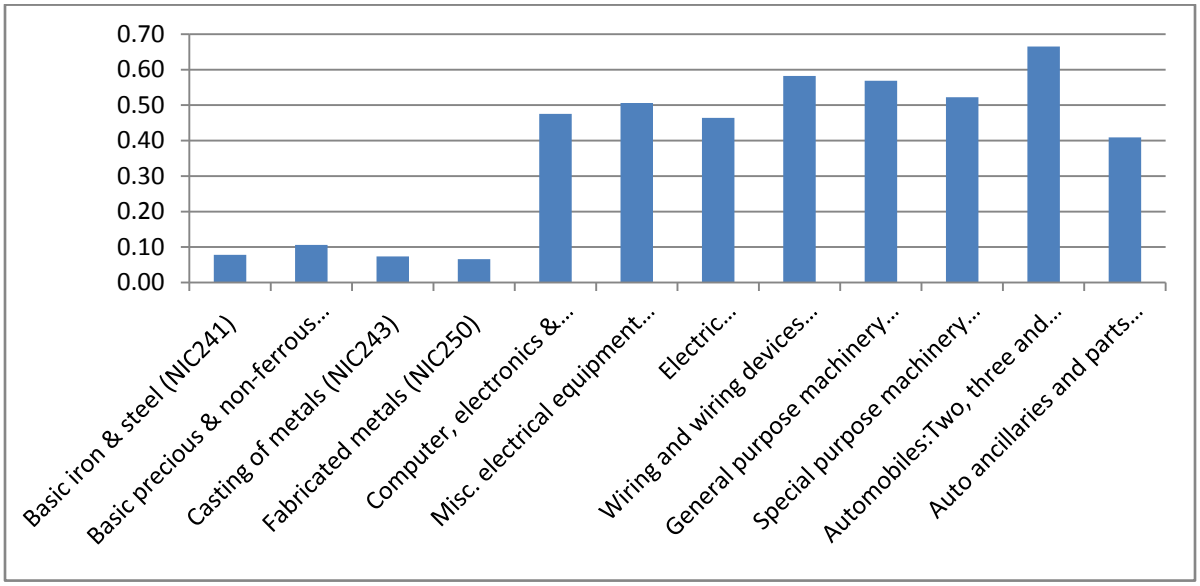


Figure 4: Share of industry groups in average sales turnover, 2001-2012

(Per cent)

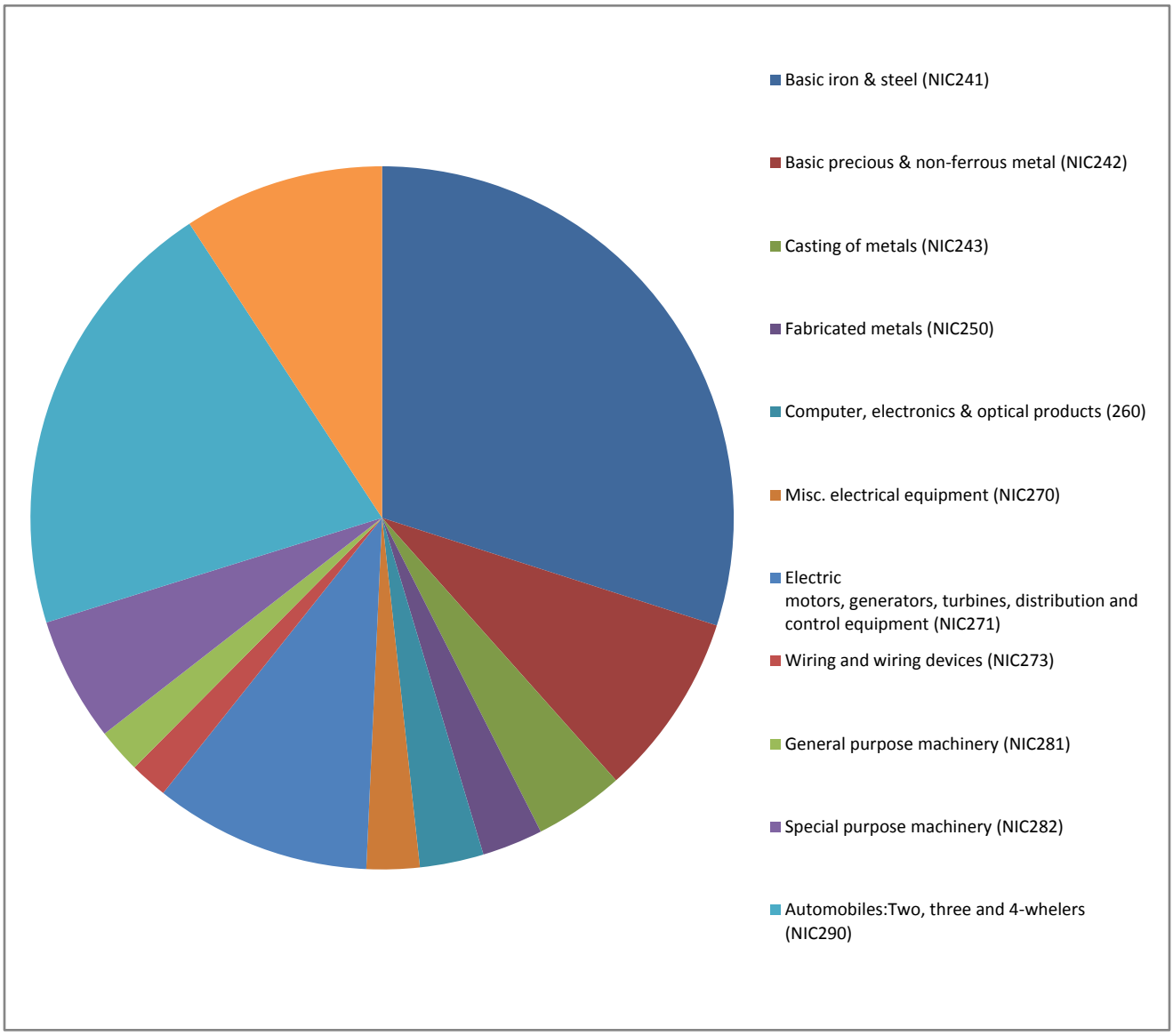


Figure 5: Industry-wise distribution of average exports, 2001-2012

(Percent)

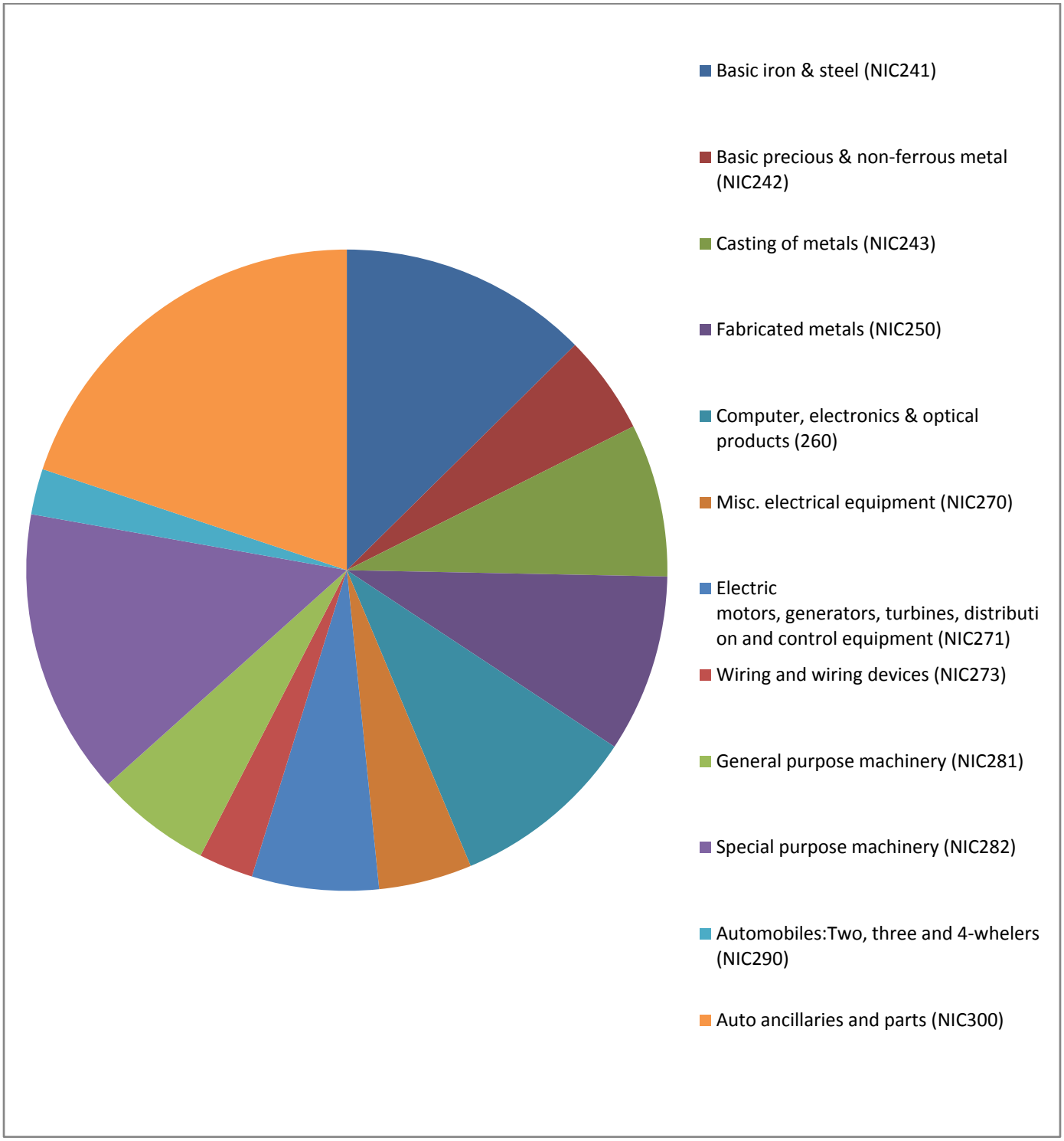


Figure 6: Industry-wise average export intensity, 2001-2012

(Per cent)

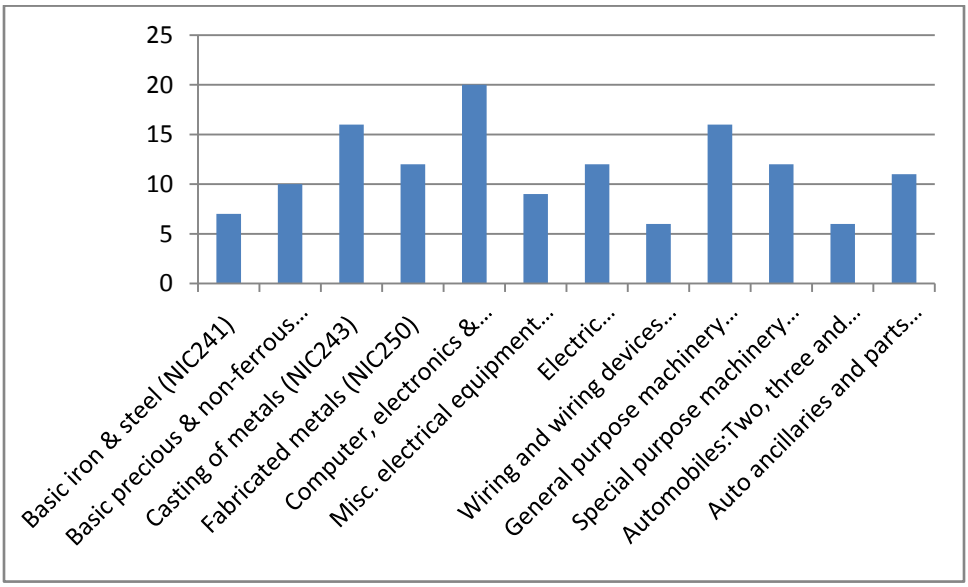


Figure 7: Industry-wise average import intensity, 2001-2012

(Per cent)

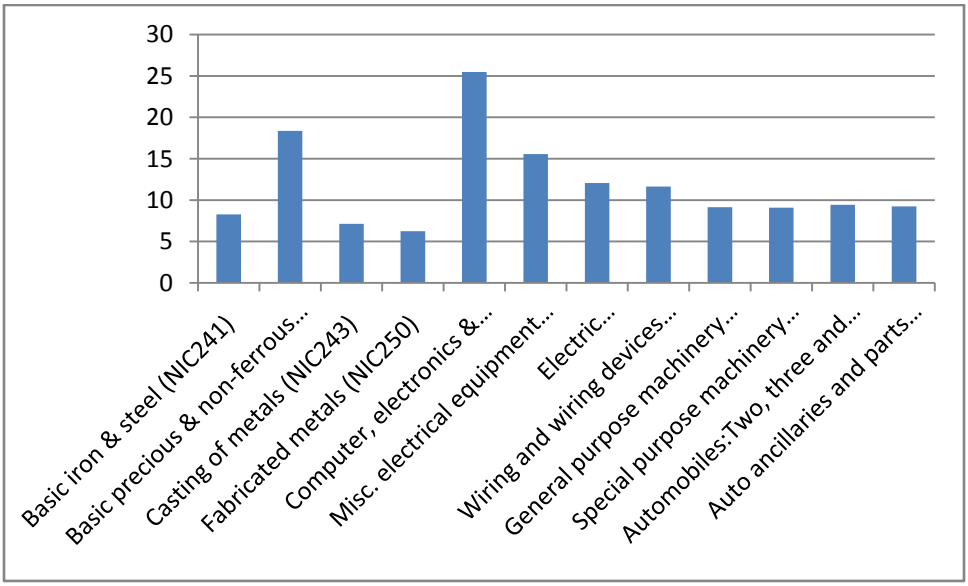


Figure 8: Industry-wise average intensity of disembodied technology, 2001-20012

(Per cent)

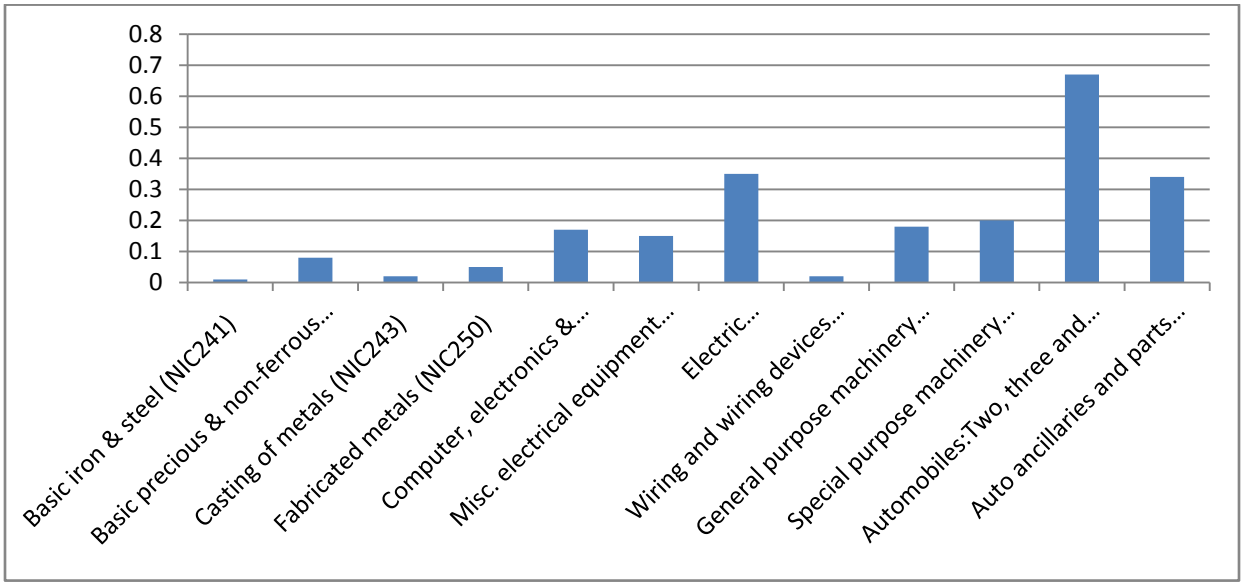


Figure 9: Industry-wise average R&D intensity, 2001-2012

(Per cent)

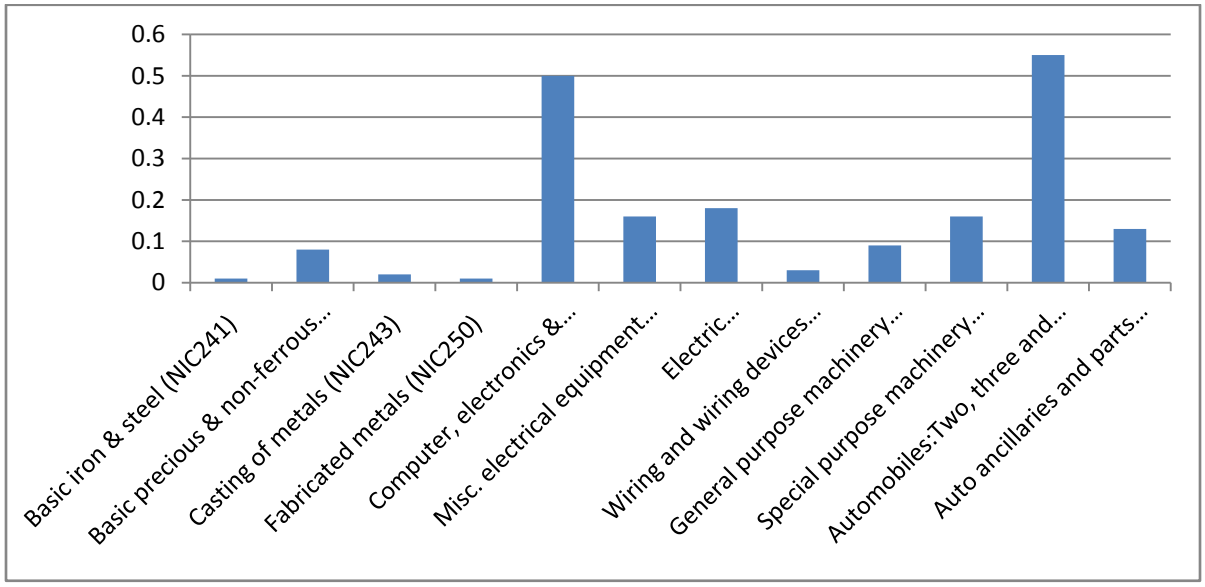


Figure 11: Industry-wise average capital intensity, 2001-2012

(ratio)

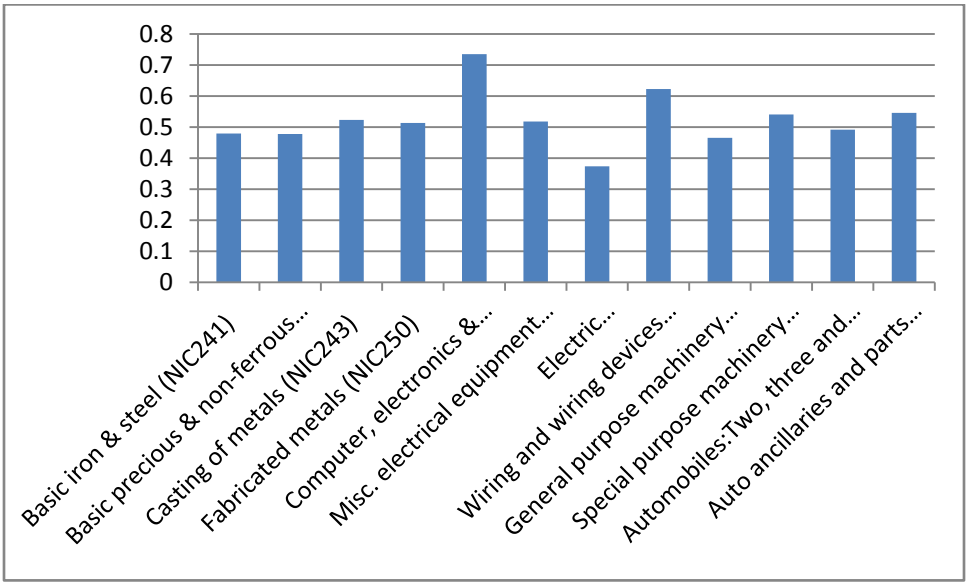
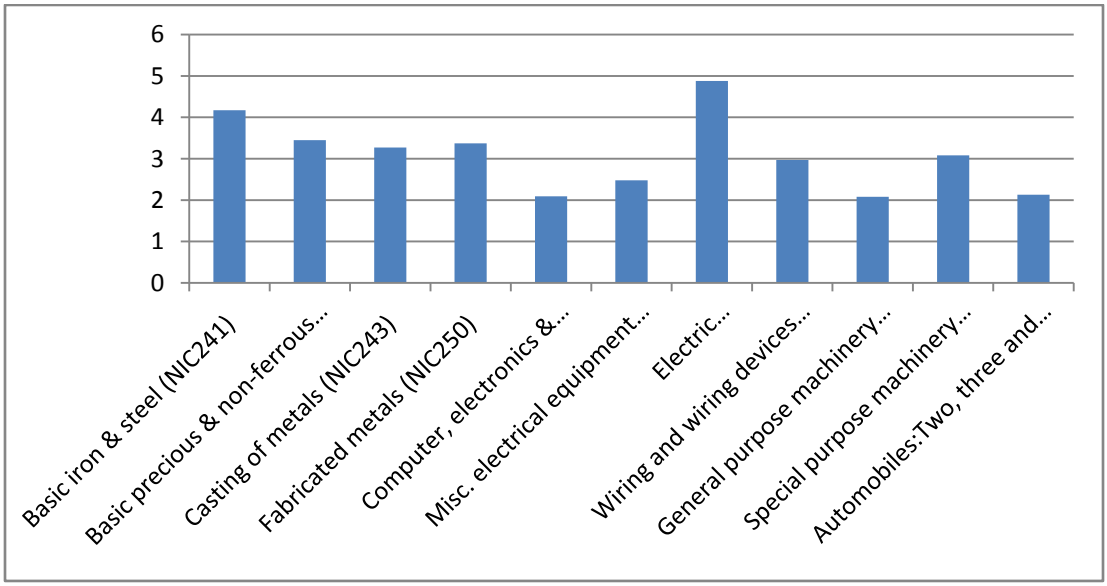


Figure 12: Industry-wise average leverage (TOL/TNW)

(ratio)



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Appendix

Random-effects probit regression — Number of obs = 13672
Group variable: cocode — Number of groups = 1835
LR chi2(31) = 764.20
Log likelihood = -4886.138 — Prob > chi2 = 0.0000

xd2	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
crc	-.1998873	.0601985	-3.32	0.001	-.3178741	-0819004
rdi	3.396527	2.705497	1.26	0.209	-1.90615	8.699203
fdi	.2766829	.1219203	2.27	0.023	.0377235	.5156422
imdt	-1.978592	1.943834	-1.02	0.309	-5.788436	1.831251
mi	1.104858	.1511727	7.31	0.000	.8085648	1.401151
pdiff	3.990551	.6304712	6.33	0.000	2.75485	5.226252
capi	.3297299	.0520154	6.34	0.000	.2277816	.4316783
age	.3921423	.0771685	5.08	0.000	.2408948	.5433897
sz	.4939922	.0344171	14.35	0.000	.4265358	.5614486
nic242	1.302763	.3155937	4.13	0.000	.6842111	1.921316
nic243	2.081886	.2756345	7.55	0.000	1.541652	2.62212
nic250	1.522335	.2487657	6.12	0.000	1.034763	2.009907
nic260	2.108137	.2750513	7.66	0.000	1.569047	2.647228
nic270	1.319713	.3392831	3.89	0.000	.6547309	1.984696
nic271	1.770478	.3094339	5.72	0.000	1.163999	2.376957
nic273	.1926289	.3759289	0.51	0.608	-.5441783	.9294361
nic281	2.56901	.3417163	7.52	0.000	1.899258	3.238762
nic282	2.397883	.2474879	9.69	0.000	1.912816	2.88295
nic290	.9298565	.4910983	1.89	0.058	-.0326785	1.892392
nic300	1.643836	.2190486	7.50	0.000	1.214508	2.073163
fy02	.0590379	.094594	0.62	0.533	-.1263629	.2444387
fy03	.1806673	.0943397	1.92	0.055	-.0042351	.3655697
fy04	.2622351	.0950303	2.76	0.006	.0759791	.4484911
fy05	.2226068	.0950729	2.34	0.019	.0362672	.4089463
fy06	.1819775	.0957575	1.90	0.057	-.0057037	.3696586
fy07	.2536746	.0978225	2.59	0.010	.061946	.4454031
fy08	.1703415	.1004444	1.70	0.090	-.0265259	.3672088
fy09	.2975402	.1022517	2.91	0.004	.0971306	.4979499
fy10	-.0798691	.1036768	-0.77	0.441	-.2830718	.1233336
fy11	-.2226961	.1133278	-1.97	0.049	-.4448146	-.0005777
fy12	-.2396867	.1220916	-1.96	0.050	-.4789817	-.0003916
_cons	-5.537034	.2791116	-19.84	0.000	-6.084083	-4.989985
/lnsig2u	1.757595	.0698122			1.620765	1.894424
sigma_u	2.408002	.084054			2.248768	2.578511
rho	.8529082	.0087584			.8349006	.8692592

```
Random-effects probit regression              Number of obs      =     13672
                                              LR chi2(31)        =    720.52
Log likelihood  = -4888.1545                  Prob > chi2        =    0.0000
         xd3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
         crc |  -.1821168   .0606979    -3.00   0.003    -.3010826    -063151
         rdi |   3.427428   3.203119     1.07   0.285     -2.85057    9.705426
         fdi |   .2329153   .1219475     1.91   0.056    -.0060974    .4719279
        imdt |  -2.168848   1.993522    -1.09   0.277    -6.076079    1.738383
          mi |   1.157686   .1513125     7.65   0.000     .8611187    1.454253
       pdiff |   4.902464     .62246     7.88   0.000     3.682464    6.122463
        capi |   .3482096   .0509798     6.83   0.000      .248291    .4481283
         age |   .3701908   .0784353     4.72   0.000     .2164604    .5239212
          sz |   .4451195   .0348141    12.79   0.000     .3768852    .5133539
      nic242 |   1.224966   .3202948     3.82   0.000     .5971995    1.852732
      nic243 |   2.059616   .2809836     7.33   0.000     1.508898    2.610334
      nic250 |   1.440461   .2528906     5.70   0.000     .9448041    1.936117
      nic260 |   1.894344   .2803286     6.76   0.000      1.34491    2.443778
      nic270 |   1.035757   .3428392     3.02   0.003     .3638044    1.707709
      nic271 |   1.624918   .3156573     5.15   0.000     1.006241    2.243595
      nic273 |   .2610363    .380534     0.69   0.493    -.4847967    1.006869
      nic281 |   2.450358   .3532171     6.94   0.000     1.758065    3.142651
      nic282 |   2.183423   .2527592     8.64   0.000     1.688024    2.678822
      nic290 |   .6675687   .5078602     1.31   0.189    -.3278189    1.662956
      nic300 |    1.58085   .2227096     7.10   0.000     1.144347    2.017353
        fy02 |  -.0347212   .0952047    -0.36   0.715    -.2213191    .1518767
        fy03 |   .1650943    .094928     1.74   0.082    -.0209612    .3511498
        fy04 |   .1563291   .0953462     1.64   0.101    -.0305459    .3432042
        fy05 |   .1790619   .0955784     1.87   0.061    -.0082682     .366392
        fy06 |   .1367958   .0961468     1.42   0.155    -.0516484      .32524
        fy07 |   .1816534   .0983473     1.85   0.065    -.0111038    .3744106
        fy08 |    .096019   .1009142     0.95   0.341    -.1017692    .2938072
        fy09 |   .3541783   .1026743     3.45   0.001     .1529404    .5554163
        fy10 |   -.010567   .1043916    -0.10   0.919    -.2151708    .1940367
        fy11 |  -.1596037   .1141656    -1.40   0.162    -.3833641    .0641567
        fy12 |  -.1563383   .1227886    -1.27   0.203    -.3969996     .084323
       _cons |  -5.498815   .2833523   -19.41   0.000    -6.054176   -4.943455
-------------+----------------------------------------------------------------
    /lnsig2u |   1.797441   .0699221                     1.660396    1.934486
     sigma_u |   2.456458   .0858804                     2.293773    2.630681
         rho |   .8578371   .0085272                     .8402912    .8737451
------------------------------------------------------------------------------
```

```
Random-effects probit regression              Number of obs      =     13672
Group variable: cocode                        Number of groups   =      1835
                                              LR chi2(31)        =    682.77
Log likelihood  = -4931.3519                  Prob > chi2        =    0.0000
------------------------------------------------------------------------------
         xd4 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         crc |  -.2694586   .0607343    -4.44   0.000    -.3884956   -1504215
         rdi |   4.286796   3.192089     1.34   0.179    -1.969583    10.54317
         fdi |   .2481586   .1211257     2.05   0.040     .0107567    .4855605
        imdt |  -1.591844   1.917018    -0.83   0.406    -5.349131    2.165442
          mi |   1.195435   .1519438     7.87   0.000     .8976308     1.49324
       pdiff |   5.300469   .6075206     8.72   0.000     4.109751    6.491187
        capi |   .3034948   .0499608     6.07   0.000     .2055735    .4014162
        age |   .3311665   .0783094     4.23   0.000      .177683      .48465
          sz |   .3855102   .0346153    11.14   0.000     .3176654    .4533549
      nic242 |   1.073748   .3142565     3.42   0.001     .4578162    1.689679
      nic243 |   2.015601   .2781352     7.25   0.000     1.470466    2.560736
      nic250 |   1.295388   .2504071     5.17   0.000     .8045996    1.786177
      nic260 |   1.639505   .2776963     5.90   0.000      1.09523    2.183779
      nic270 |   .7419404   .3402508     2.18   0.029     .0750612     1.40882
      nic271 |     1.3583   .3137519     4.33   0.000     .7433575    1.973242
      nic273 |   .1993229   .3786455     0.53   0.599    -.5428085    .9414544
      nic281 |   2.188053   .3556253     6.15   0.000      1.49104    2.885065
      nic282 |   2.001315   .2500069     8.01   0.000      1.51131    2.491319
      nic290 |   .3753047   .5074227     0.74   0.460    -.6192255    1.369835
      nic300 |   1.449903   .2197845     6.60   0.000     1.019134    1.880673
        fy02 |   .0118015   .0947754     0.12   0.901    -.1739549    .1975578
        fy03 |   .1577466   .0949369     1.66   0.097    -.0283263    .3438194
        fy04 |   .2486885   .0950175     2.62   0.009     .0624575    .4349195
        fy05 |   .2693465   .0954026     2.82   0.005     .0823609    .4563322
        fy06 |   .1717097   .0959962     1.79   0.074    -.0164393    .3598588
        fy07 |   .2162397   .0981132     2.20   0.028     .0239413    .4085381
        fy08 |   .1759961   .1005866     1.75   0.080    -.0211501    .3731423
        fy09 |   .4176187   .1021697     4.09   0.000     .2173697    .6178677
        fy10 |   .0533969    .104346     0.51   0.609    -.1511175    .2579113
        fy11 |  -.0668572   .1139713    -0.59   0.557    -.2902368    .1565224
        fy12 |  -.0017312   .1221626    -0.01   0.989    -.2411656    .2377031
       _cons |  -5.249432   .2829877   -18.55   0.000    -5.804077   -4.694786
-------------+----------------------------------------------------------------
    /lnsig2u |   1.786201   .0699078                      1.649184    1.923218
     sigma_u |   2.442691   .0853816                       2.28095    2.615902
         rho |   .8564609   .0085942                      .8387808    .8724968
```

```
Random-effects probit regression              Number of obs      =     13672
Group variable: cocode                        Number of groups   =      1835
                                              LR chi2(31)        =    610.84
Log likelihood  = -4887.2079                  Prob > chi2        =    0.0000
------------------------------------------------------------------------------
         xd5 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         crc |  -.2000405   .0615518    -3.25   0.001    -.3206798   -0794012
         rdi |   5.217857   3.161375     1.65   0.099    -.9783245    11.41404
         fdi |   .2882466    .122806     2.35   0.019     .0475513    .5289419
        imdt |  -1.558752   1.929678    -0.81   0.419    -5.340852    2.223347
          mi |   1.223398   .1537194     7.96   0.000     .9221131    1.524682
       pdiff |   5.156666   .5995766     8.60   0.000     3.981517    6.331814
        capi |   .2949691    .050376     5.86   0.000      .196234    .3937042
        age |   .2845953   .0784587     3.63   0.000     .1308191    .4383716
          sz |   .3686693   .0349744    10.54   0.000     .3001207    .4372179
      nic242 |   1.061631   .3157603     3.36   0.001     .4427526     1.68051
      nic243 |   2.083182   .2836015     7.35   0.000     1.527333     2.63903
      nic250 |   1.296671   .2536494     5.11   0.000     .7995274    1.793815
      nic260 |   1.618553   .2811614     5.76   0.000     1.067486    2.169619
      nic270 |   .7430781   .3443201     2.16   0.031     .0682231    1.417933
      nic271 |   1.344639   .3186788     4.22   0.000     .7200403    1.969238
      nic273 |   .1442033   .3823164     0.38   0.706    -.6051232    .8935298
      nic281 |   2.131356   .3655699     5.83   0.000     1.414852     2.84786
      nic282 |   1.847682   .2538797     7.28   0.000     1.350087    2.345277
      nic290 |  -.2353336   .5046436    -0.47   0.641    -1.224417    .7537498
      nic300 |   1.361503   .2221126     6.13   0.000     .9261707    1.796836
        fy02 |   .0026005   .0958091     0.03   0.978    -.1851818    .1903828
        fy03 |    .153553   .0958626     1.60   0.109    -.0343342    .3414401
        fy04 |   .1587678   .0960117     1.65   0.098    -.0294116    .3469472
        fy05 |   .2381598   .0964166     2.47   0.014     .0491868    .4271328
        fy06 |   .1702573   .0971096     1.75   0.080    -.0200741    .3605886
        fy07 |   .1430443   .0991495     1.44   0.149    -.0512853    .3373738
        fy08 |   .1720767   .1015444     1.69   0.090    -.0269467       .3711
        fy09 |   .3758181    .102852     3.65   0.000     .1742318    .5774044
        fy10 |   .0173782   .1052544     0.17   0.869    -.1889166    .2236729
        fy11 |  -.0896809   .1148065    -0.78   0.435    -.3146975    .1353356
        fy12 |  -.0968477   .1230855    -0.79   0.431    -.3380909    .1443955
       _cons |   -5.20683   .2839847   -18.33   0.000     -5.76343    -4.65023
-------------+----------------------------------------------------------------
    /lnsig2u |   1.810593   .0701132                      1.673174    1.948013
     sigma_u |   2.472665   .0866832                      2.308475    2.648534
         rho |   .8594336   .0084702                      .8419985    .8752298
```