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E-business and Export Behaviour

Evidence from Indian Firms

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Abstract

The paper identifies and analyses the factors that influenced the export performance of firms in the post-liberalization era of the Indian economy. The study is based on primary data collected from fifty-one firms located in the national capital region. Entrepreneurial characteristics, historical data of firms, and other firm-specific factors such as size of operation, export intensity, international orientation, wage rates, and profit margins were included in the analysis. The findings of the study suggest that the performance of firms that have adopted more advanced e-business tools has been better than others in international markets, as also that size of operation has played an important role in the export performance of firms. It is found that export-oriented firms employ more skilled workforce and the labour productivity of these firms is higher than others.

Keywords: E-business, international orientation, India

JEL classification: O33, F15, O53

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1 Introduction

The outward-looking policies of many developing countries have in recent years played a crucial role in their social and industrial development. Comparative advantages based on natural resource endowments have been replaced by the acquired advantage (Helleiner 1995). Many developing countries have been able to strengthen their comparative advantage by focusing on the building of technological capability, on the adoption of new technologies, and on the development of skills to use these new technologies effectively and efficiently (Noland 1997).

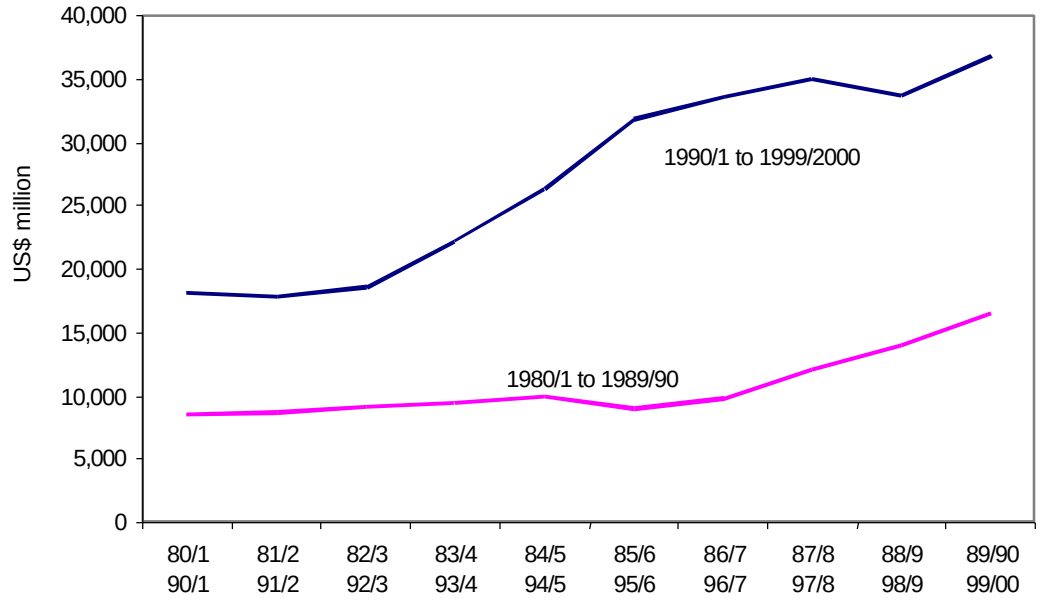
There has been a major emphasis on the role of technology and skill in influencing international trade. Several studies (Trefler 1993 and 1995; Moreno 1997) have demonstrated the importance of technological differences in international trade. Moreno (1997) found that technology had a significant effect on the evolution of Spanish industrial exports. Moreno's study (1997) suggests that non-price factors such as product quality and product differentiation exert a significant influence on international competitiveness.

The last decade of the twentieth century has witnessed technological changes that by and large have been led by information and communication technologies (ICTs). These are considered to be the most pervasive technologies. Their applications are not limited to shop floors only. ICTs can be used for the non-production processes such as product design, marketing, after-sales support, etc. and these are considered a major source of non-price factors of competitiveness. It has been argued in the literature that the adoption of ICTs allows a reduction in coordination costs and leads to efficient electronic markets (Malone *et al.* 1987; Lee and Clark 1997).

It has been argued by several scholars (Kaplinsky 1982; James 1994; Doms *et al.* 1997) that ICTs can substantially contribute to an augmentation in the product quality and product differentiation, and can hence influence the global competitiveness of firms. ICTs, the most recent developments in technological evolution, are being widely adopted by all types of firms engaged in the manufacturing and service sectors of developing and developed nations. Adoption of ICTs is usually for productivity gains (Kraemer and Dedrick 1994; Greenan and Mairesse 1996; Lichtenberg 1995) and for an improvement in the product quality and flexibility in manufacturing processes (Lal 1996). A great deal of literature on ICTs is concerned with the factors that determine its adoption (Brynjolfsson and Hitt 1996; Doms *et al.* 1997; Lal 1999a). In contrast, we propose to analyse in this paper the consequences of the adoption of ICTs on the export performance of firms in India.

The export performance of the Indian economy in two decades, that is, the 1980s and 1990s is shown in Figure 1. It is important to distinguish these two because the decade of the 1980s was dominated by a controlled and regulated economic regime, while the latter decade has witnessed major economic reforms, including easy access to foreign technology and capital goods.

Figure 1
Export performance during 1980s and 1990s



Source: Government of India (2000).

The export performance in the 1990s has been better not only in terms of its magnitude, but also in terms of its growth. The 1980s experienced a compound annual growth rate (CAGR) of 6.74 per cent whereas exports have grown at the rate of 9.78 per cent annually during the 1990s. The leapfrogging in the growth rate of exports can be attributed to THE liberalization of Indian economy that started in 1991. Apart from several other benefits, Indian firms have taken advantage of the easy access to the latest technological developments in the north. The most visible technological change that has taken place in the 1990s is led by ICTs. More recently it is the electronic business (e-business), a component of ICTs, that has experienced the highest growth in the latter years of last decade of the twentieth century. According to International Data Corporation (IDC) data sources, the CAGR of e-business in the global market has been 105 per cent since 1995. An effort is being made in this paper to establish the link between the export performance of firms and the adoption of e-business technologies.

There are many descriptions of e-business. In essence, e-business is about business innovation, about serving new and changing markets. E-business is meant to reshape the way companies go to markets, the way customers buy products and services. It can also be defined as a tool that forward-looking enterprises are racing to adopt. E-business technologies are meant to help adopters reach new customers more efficiently and effectively. E-business transforms the exchange of goods, services, information, and knowledge through the use of ICTs. There are several models of e-business, namely, (i) business-to-business (B2B), (ii) business-to-consumer (B2C), (iii) consumer-to-consumer (C2C), (iv) business-to-government (B2G), and (v) government-to-business (G2B).

Broadly defined, there are three modes of e-business transactions. These are offline, online, and e-business using shared or individual portals. First and comparatively less effective than other forms of e-business tools, that is, offline e-business is enabled by

electronic messaging systems. Offline e-business is normally done through e-mail systems while online e-business transactions take place with uniform resource locators (URLs) of companies. Having a URL does not necessarily mean that an enterprise is able to process online e-business transactions. The URL must be dynamic and should have online transaction facilities such as active server pages (ASPs) that allow online transactions. The third and most effective way of doing e-business is through portals. Portals are essential additions in network technologies. They fulfil the important role of aggregating contents, services, and information on the net. Broadly speaking, their position on the net is between users (buyers) and web contents. This unique position enables portals to leverage marketing and referrals as they are intermediaries between web users and companies.

Although there are several models of e-business, only two models, namely B2B and B2C, have experienced the highest growth. Within these two, B2B has grown from US$ 3.5 billion in 1995 to US$ 34.0 billion in 1998 while the growth of B2C has been US$ 1.0 billion in 1995 to US$ 4.0 billion in 1998. The share of B2B has increased from 77.78 per cent in 1995 to 89.47 per cent in 1998. These data suggest that B2B has grown faster than B2C worldwide. The e-commerce scenario in India is more or less similar to global trends. As far as the share of B2B to the total e-business is concerned, it is static having maintained a constant share (90 per cent) since 1998. According to an estimate by NASSCOM (2000), the growth of e-business is expected to be the same, if not more, than in the global market.

The paper is organized as follows. The analytical framework is discussed in section 2. The data and methodology used for identifying the factors that influenced the export performance are discussed in section 3 whereas the hypotheses are formulated in section 4. Section 5 presents the statistical results while the findings of the study are summarized in section 6.

2 Analytical framework

Several economic approaches to the diffusion and adoption of new technologies have been used and discussed in the literature (Silverberg *et al.* 1988; Geroski 2000). Silverberg *et al.* discuss three approaches, i.e., epidemic, equilibrium, and evolutionary approaches while Geroski finds that the probit approach is more appropriate for empirical analysis of the diffusion process. The major problem with the epidemic approach is that the diffusion is determined at the end points, whereas the equilibrium models (rank effect, stock effect, and order effect) require comprehensive data on the demand and supply side of innovations. The evolutionary approaches to the adoption of new technologies stress more on the strategic and organizational behaviour of firms. It is assumed that the internal inertia of the firm determines the adoption of new technology (Muller-Falcke 2002).

The diffusion of any new technology depends on several factors such as the potential benefits of technology, absorptive capacity of firms, and the institutional environment prevalent in the country. Potential benefits need not necessarily be related only to manufacturers of products and services that use new technologies but may affect consumers of products and services as well. E-business technologies have the potential to benefit not only producers but also users of services and products. The explosive

growth of internet is a case in point. The worldwide number of internet users has increased from 16 million in 1995 to 250 million in 2000 (NASSCOM 2000).

The adoption of e-business technologies is a function of several factors. Many times these factors mutually reinforce each other. The interaction between the export performance and the adoption of e-business technologies is depicted in Figure 2.

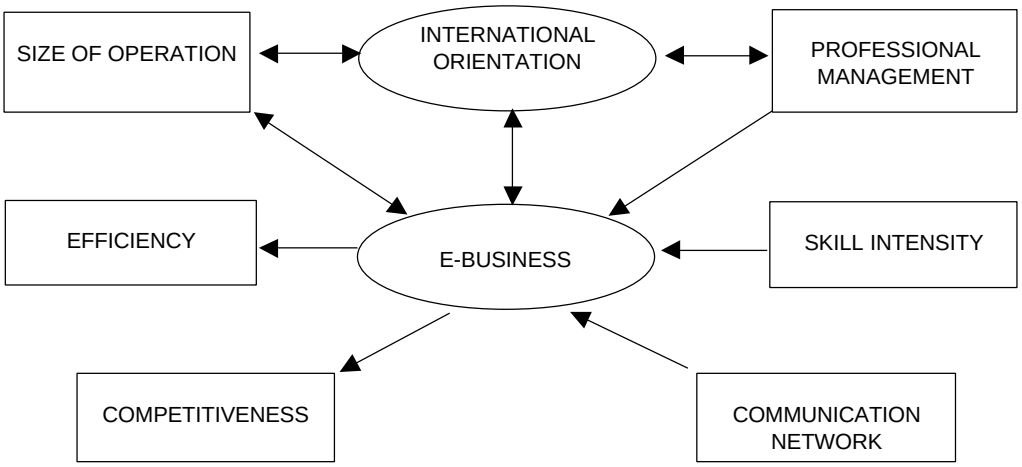
It can be seen from Figure 2 that international orientation, which is represented by imports, exports, technological and financial collaboration and the adoption of e-business mutually reinforce each other. This is because the use of ICTs, in general, results in the death of distance (Soete 1997). Moreover, e-business is expected to result in fundamental changes in the market landscape. Similarly, sales turnover and the adoption of e-business are expected to influence each other. This holds true not only for adoption of e-business but for any innovative activity carried out on the shop floor.

One of the major prerequisites for the success of e-business is the existence of a very strong and reliable communication network. Access to a higher bandwidth is not within the control of individual firms. It forms a part of the institutional infrastructure provided by governments. Realizing the important role that the availability of higher bandwidth plays in the success of web-enabled services, greater emphasis has been laid on the privatization and de-regulation of telecommunication services in developing and developed countries. Conduct variables such as skill intensity of firms, investment on R&D, wage rates are important factors that are expected to have bearings on the adoption of e-business. Higher remuneration is always a major incentive for the workforce to create and adopt innovations effectively and efficiently.

Numerous benefits that flow from the adoption of e-business have been cited in the literature (Gray and Prahalad 1994). Many firms adopt e-business because of low coordination costs. However, as depicted in Figure 2, many more benefits exist. Due to the inexpensive access to global markets and information that internet enables, it is fast becoming the world's largest and most versatile marketplace for services, products, and information. E-business has the potential to redefine the existing business infrastructure organizations and to re-evaluate the way in which they do business. It has capabilities in re-engineering business processes across the boundaries that have traditionally separated suppliers from their customers. Previously separated activities such as order processing, payments, and after-sales services may be merged into a single process. This results in reducing the costs of creating, moving, processing, and managing documents.

E-business is also expected to reduce operational costs since electronic information tends to be more accurate, timely and easily available. Another benefit of e-business could be the higher efficiency obtained in business transactions due to a fast and accurate processing of information. Web-enabled services are likely to strengthen the competitiveness of firms as these technologies may change the relationship with customers by creating a stronger link between firms and its clients.

Figure 2
Export performance and e-business linkages



3 Data and methodology

The study is based on primary data collected from firms located in the New Okhla Industrial Development Area (NOIDA). This is a newly developed industrial town near the national capital, New Delhi. There are four main ISPs (Internet Service Providers), namely, Videsh Sanchar Nigam Limited (VSNL), Software Technology Park of India (STPI), Satyam, and Mantraonline operating in NOIDA. Satyam and Mantraonline are private sector ISPs whereas VSNL and STPI are state-owned public sector companies that are involved in providing internet services. In addition, M/s India Markets is another private sector e-business solution-providing company located in NOIDA. We approached all ISPs and India Markets to get information about the firms that have adopted e-business technologies in NOIDA. We could obtain a list of 68 firms, which included the name of MD and address of firm. The product profile of firms is presented in Appendix I.

It may be safely assumed that all the firms that are using some form of e-business model and are located in NOIDA have been covered in this study. We approached all the sixty-eight firm during the survey. However, we could get data from fifty-one firms only, a response rate of 75 per cent. The survey was conducted during December 2000 and February 2001. Historical, financial, and technological data were collected through a semi-structured questionnaire. Historical data included background of the managing directors and age of firm whereas financial data (1999-2000) consist of sales turnover, investment on ICTs, wage bill, exports, imports, profit after tax, and value added, etc. Technological data include the type of e-business tool adopted and bandwidth being used by firms. Data on technological and financial collaborations with multinational companies were also collected.

The sample firms have been classified according to their market preferences. Firms doing business in the domestic market are labelled ‘non-exporting units’ (NEUs) while those present in the domestic as well as in export markets are classified as

'exporting units' (EUs). Other firms operating only in international markets are labelled as 'export-oriented units' (EOUs).

This paper uses the censored regression model, that is, TOBIT analysis to identify the factors that influenced the export performance of firms. Censored regression model was used because the dependent variable, i.e. export intensity takes values between 0 and 1. Export intensity was computed as the ratio of exports to total sales turnover.

4 Hypotheses

Drawing upon the theoretical and empirical evidence on the adoption of ICTs and the consequences thereof, we now proceed to formulate the hypotheses concerning the export intensity of firms and other variables. The hypotheses concerning all the variables included in the analysis are discussed below in detail.

4.1 Type of e-business technology adopted (EB_TYPE)

All the sample firms have been grouped into three categories depending on the type of e-business technologies adopted by them. The first category of firms were doing e-business through offline technologies. Firms that were using electronic mail systems for business activities have been categorized as firms using offline e-business technology. During the survey, it was found that many firms have their presence on the net. They have Uniform Resource Locators (URLs) with some degree of online e-business facilities such as ASPs. All those firms that have dynamic URLs have been categorized as online e-business doing firms. The third category of firms were those doing e-business using the latest technology, that is, portal based e-business. The distribution of firms according to the use of e-business technology and market preference is presented in Table 1.

It can be seen from Table 1 that the type of e-business technology used by firms is related to the market preferences. For instance, 64.86 per cent of NEU firms were using offline technologies for business activities, while not a single EOU falls in this category of e-business technology. On the other hand a fairly large number of EOUs (66.67 per cent) adopted the most modern e-business tools and just 10.81 per cent of NEUs have adopted portal based e-business technologies. Similarly, 9.09 per cent of EUs were using offline technologies, while other EU firms were doing business through online or portal based technologies. Table 1 suggests that export intensity is related to the type of e-business technology adopted by these firms.

Empirical findings on the relationship between exports and the adoption of new technologies have been mixed. Lall (1986) used expenditure on R&D as a proxy of technology and found it significant with a negative sign in explaining export performance of engineering and chemical firms in India. Although neo-technology theory highlights the role of the technology gap in determining a country's international trade (Posner 1961; Vernon 1966; Krugman 1979), the empirical findings of several studies suggest that the technology variable has no role to play in export performance. In these analyses, Cotsomitis *et al.* (1991) used technology stock and Kumar (1990) used R&D intensity as a technology variable. In recent years, however, several studies (Kumar and Siddharthan 1994; Basile 2001) have concluded that the technology

variable, measured in terms of R&D expenditure, emerged as an important factor in explaining export performance. In view of the findings of recent studies and the characteristics of sample firms presented in Table 1, we hypothesize that e-business technology is expected to emerge as an important factor that influences the export performance of firms.

Table 1
Distribution of firms by use of e-business and export intensity

Type of e-business technology	NEU (non-exporting units)		EU (exporting units)		EOU (export-oriented units)		Total	
Offline	24	(64.86)	1	(9.09)			25	(49.02)
Online	9	(24.32)	5	(45.45)	1	(33.33)	15	(29.41)
Portal	4	(10.81)	5	(45.45)	2	(66.67)	11	(21.57)
Total	37	[72.55]	11	[21.57]	3	[5.88]	51	(100.00)

Note: The figures in parentheses are column percentages while the square brackets present row percentage.

4.2 Firm size (STO)

Sales turnover in Rs million has been used as a proxy of size of firms. In the multivariate analysis, however, the size has been converted into Rs billion. Table 2 presents the export intensity and size distribution of firms.

Table 2 shows that the size of operation in general has an increasing trend with the export intensity of the sample firms. For instance, the average sales turnover of NEU firms is Rs 139.745 million while in the case of EOUs, it is Rs 1,056.667 million. We find a similar trend in offline- and portal-using firms.

In the literature, size has been treated as the resource which enables a firm to venture into international markets. Firms with a larger size of operation enjoy greater risk-bearing capacity, brand names, and price-setting power (Krugman 1979; Siddharthan and Nollen 2000). Several studies (Patibandla 1995; Glejser *et al.* 1980) have reported a negative impact of size on exports while several other studies (Haddad *et al.* 1996; Abd-el-Rahman 1991) have found positive effects on exports. A study by Hughes (1986)

Table 2
Exports intensity and size of operation

Type of e-business technology	NEU (non-exporting units)	EU (exporting units)	EOU (export-oriented units)	Total
Offline	54.842 (94.436)	102.300		56.740 (92.933)
Online	147.156 (155.270)	107.000 (115.083)	25.000	125.627 (136.768)
Portal	632.500 (873.628)	954.300 (999.831)	1,572.50 (2,018.790)	949.682 (1,074.345)
Total	139.745 (326.275)	491.709 (775.450)	1,056.667 (1,684.045)	269.596 (608.976)

Note: Average sales turnover is in Rs million and the figures in parentheses are standard deviations.

found no effect of size on export performance of firms. Several other studies (Kumar and Siddharthan 1994; Soete 1987; Lall 1986) found mixed effects, depending on the industry and measure of export, whereas studies by Wakelin (1997), Kumar and Siddharthan (1994), and Willmore (1992) concluded that the size-export relationship was an inverted 'U' in which the gains from size diminish with increasing size. The sample firms are neither very small nor large corporations. Hence we hypothesize that size might emerge as an important determinant of the export performance of firms.

4.3 Skill intensity (SKILL)

Skill intensity has been computed as the ratio of workers with professional degrees such as BE, MBA, and CA[1] to the total workforce. The distribution of firms according to worker skill composition is presented in Table 3, where it can be seen that skill intensity increases with the export intensity of the sample firms. For instance, NEU firms employ only 5.8 per cent professional workers, whereas in the EOUs the ratio of formally trained workers goes up to 46.5 per cent. This trend is true in all categories of firms classified by the adoption of e-business technologies except those that are using online technologies. It can be seen from Table 3 that in the EU category URL-using firms employ as high as 46.2 per cent professional workers compared to 30.3 per cent of the skilled workforce by portal using firms in the same exports category. This is because there were few PCB[2] manufacturing firms operating in the domestic or in international markets. PCB, being a very high-tech product, requires trained and professional personnel for production and marketing.

Table 3 also includes an EOU using URL-based e-business technologies which employed only 1.3 per cent skilled workers, the lowest in all categories of firms. This was actually a garments-manufacturing firm doing business in international markets. Garments manufacturing is considered a low-tech industry and requires very few formally trained persons in all business activities. Hence despite being an EOU, the skill intensity of the firm was very low.

Lucas Jr. (1988) and Azariadis and Drazen (1990) have built theoretical models in which export performance is driven by human capital. However, conflicting results have been reported by several empirical studies with regard to the relationship between skill intensity and export performance. Kumar and Siddharthan (1994) did not find any impact of skill on exports in several industries in India. However, they found skill was an important factor that affected the export performance in food processing and the transport equipment industry. A macro level study by Levin and Raut (1997), on the other hand, found a positive and significant relationship between export performance and investment on education in developing countries. The findings of several studies (Lal 1996; Bernard and Wagner 2001) also suggest that plants intensive in skilled workers are more likely to export. In view of the theoretical and empirical evidence, we hypothesize a positive relationship between export performance and skill intensity.

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1 BE is Bachelor of Engineering; MBA corresponds to Master of Business Administration; and CA is a Chartered Accountant.

2 Printed Circuit Board.

Table 3
Export intensity and skill intensity of firms

Type of e-business technology	NEU (non-exporting units)		EU (exporting units)		EOU (export-oriented units)		Total	
Email	24	(0.046)	1	(0.0485)			25	(0.046)
URL	9	(0.064)	5	(0.462)	1	(0.013)	15	(0.193)
Portal	4	(0.119)	5	(0.303)	2	(0.692)	11	(0.307)
Total	37	(0.058)	11	(0.352)	3	(0.465)	51	(0.146)

Note: The figures in parentheses represent average skill intensity of firms.

4.4 Labour productivity (LABPROD)

The variable has been computed as the ratio of value added to total workforce. However, in the probit analysis, value added in Rs thousands has been considered. The distribution of labour productivity according to market preferences of firms is presented in Table 4. It seems that labour productivity follows a similar trend as skill intensity and size of operation. Labour productivity is he lowest (Rs 148,735) in NEUs whereas it is Rs 379,389 in EOUs, which is the highest in all categories of firms classified by the market preferences. A similar trend is revealed in online- and portal-technology using firms. In URL-using firms, the labour productivity of an EOU firm is very low, that is Rs 97,500. As explained earlier, this firm belonged to the garments manufacturing sector, which is a low-tech and labour intensive industry. Hence the labour productivity of this firm is expected to be lower than other firms.

Empirically, the relationship between labour productivity and export performance has been found ambiguous. Lal (1999b) in his study of export performance in the Indian garment industry did not find any evidence of a significant difference in the labour productivity of exporting and non-exporting plants. The author attributed this phenomenon to the low-tech nature of the garments industry. Sjoholm (1999), however, found that establishments participating in exports have relatively high productivity levels in Indonesia. A recent study by Bernard and Wagner (2001) suggests that labour productivity was positively significant in influencing the export behaviour of firms. As argued in the theoretical framework presented in section 2 and in view of the findings of earlier studies, we expect that the export-oriented firms are likely to be more productive.

Table 4
Export intensity and labour productivity

Type of e-business technology	NEU (non-exporting units)	EU (exporting units)	EOU (export-oriented units)	Total
Email	91.810 (68.004)	231.068		97.381 (72.163)
URL	240.489 (173.451)	265.790 (212.507)	97.500	239.390 (178.275)
Portal	283.834 (120.478)	318.057 (146.729)	520.333 (41.955)	342.390 (145.405)
Total	148.735 (130.930)	286.390 (166.418)	379.389 (245.919)	191.993 (160.477)

Note: Average labour productivity is in Rs '000 and the figures in parentheses are standard deviations.

4.5 Technological collaboration with foreign firms (COLL_TECH)

This variable was measured on a binary scale. It was assigned value 1 for firms that had a technological collaboration with foreign firms and 0 otherwise. The distribution of firms by technological collaboration and export behaviour is presented in Table 5, where it can be seen that market preference is positively correlated with the technological collaboration. Roughly 46 per cent of the NEU firms had collaboration with foreign firms while 100 per cent EOUs had tie-ups with multinational firms.

In the era of controlled economic regime of the 1980s, it was extremely difficult to collaborate with foreign firms whereas hardly any permission is needed during 1990s for tie-ups with multinationals. Firms operating in the domestic markets might survive without collaboration with multinationals, but it might not be possible to compete with other firms that have access to latest technologies in the overseas markets. Hence we hypothesize that technological collaboration might emerge as an important factor that influences the export performance of firms.

Table 5
Distribution of firms by technological collaboration with foreign firms

Foreign collaboration	NEU (non-exporting units)		EU (exporting units)		EOU (export-oriented units)		Total	
Yes	17	(45.95)	6	(54.55)	3	(100.00)	26	(50.98)
No	20	(54.05)	5	(45.45)			25	(49.02)
Total	37	(100.00)	11	(100.00)	3	(100.00)	51	(100.00)

Note: The figures in parentheses are column percentage.

Following several studies (Aitken 1997; Moreno 1997; Hughes 1986), the form of the export function used in this study is presented in Equation 1.

$$Exi = a + b1\ EB\_TYPEi + b2\ SKILLi + b3\ STOi + b4\ LABPRODi + b5\ COLL\_TECHi + ei\ (i=1,nf), \quad (1)$$

Where

nf	= No. of sample firms
Exi	= Export intensity
EB_TYPEi	= Level of IT adoption
SKILLi	= Monthly wages paid
STOi	= Sales turnover
LABPRODi	= Expenditure on raw material
COLL_TECHi	= Flexibility in designs.

5 Statistical results

All the variables discussed in section 4 were analysed in a univariate framework. The mean value and standard deviation of these variables are presented in Table 6, along with the F-value and the level of significance.

It can be seen from Table 6 that the mean value of variables such as SKILL and EB_TYPE differs very significantly among the three types of firms. Table 6 also shows that technological collaboration does not differ significantly between export-oriented firms and those that are doing business in the domestic market. Other variables such as STO and LABPROD also differ significantly among these categories of firm.

Subsequently, a censored regression model, i.e. TOBIT was used to identify the determinants of the export performance. A censored regression model was used because the dependent variable, i.e. export intensity has values between 0 and 1. Table 7 presents the maximum likelihood estimates of the model. As can be seen, four equations were tried and results are shown in Table 7. We had to try several equations because of multicollinearity in independent variables. The correlation matrix is presented in Appendix 2. In Equation I all the variables were included in the analysis. The results show that SKILL was the only variable that has emerged as a significant factor that influenced the export intensity of firms. In the second equation, SKILL was dropped and the parameters were re-estimated. The results show that EB_TYPE, which was not significant in Equation I due to the correlation with SKILL, has emerged significant. Similarly in Equation III, two variables, that is, SKILL and EB_TYPE were dropped because of a high correlation with LABPROD. It can be seen from Table 7 that LABPROD has become significant after removing SKILL and EB_TYPE. In the last equation, we estimated the parameters by retaining STO that is correlated with EB_TYPE and LABPROD.

Table 6
Univariate analysis of variables

Mean and SD of variables						
Variable	Firms			F-value	Probability	Remarks
	NEU	EU	EOU			
SKILL	0.058 (0.074)	0.352 (0.343)	0.465 (0.407)	14.871	0.0000	Ratio of BE+MBA to total workers
STO	139.746 (326.275)	491.709 (775.450)	1056.667 (1684.045)	4.679	0.0139	Sales turnover in Rs millions
EB_TYPE	1.459 (0.691)	2.363 (0.674)	2.667 (0.577)	10.451	0.0002	Exports/sales turnover
LABPROD	148.735 (130.930)	286.391 (166.418)	379.389 (245.919)	6.446	0.0033	Value added per worker in Rs '000
COL_TECH	0.459 (0.505)	0.545 (0.522)	1.000 (0.000)	1.669	0.1992	Technological collaboration

Note: Figures in parentheses are standard deviations.

Table 7
Maximum likelihood estimates of export performance
(Tobit model)

	Equation (I)				Equation (II)			
	coeff.	z-ratio	mar. eff.	z-ratio	coeff.	z-ratio	mar. eff.	z-ratio
Constant	-0.971	-3.178*	-0.190	-3.943*	-1.366	-3.386*	-0.268	-4.156*
SKILL	1.125	3.680*	0.220	2.506**				
EB_TYPE	0.146	0.997	0.029	1.046	0.399	2.326**	0.078	2.376**
LABPROD	0.666	1.162	0.130	1.131	1.145	1.615	0.224	1.525
SIZE	0.048	0.401	0.009	0.394				
COLL_TECH	0.158	0.902	0.031	0.890				
Log likelihood	-15.988				-22.256			

	Equation (III)				Equation (IV)			
	coeff.	z-ratio	mar. eff.	z-ratio	coeff.	z-ratio	mar. eff.	z-ratio
Constant	-0.818	-3.277*	-0.191	-4.768*	-0.528	-2.723*	-0.134	-4.627
SKILL								
EB_TYPE								
LABPROD	1.952	2.685*	0.457	2.611*				
SIZE	0.115	0.727	0.027	0.723	0.358	2.109**	0.091	2.069**
COLL_TECH								
Log likelihood	-25.259				-29.111			

Note: Significant * at 1% and ** at 5%.

The emergence of SKILL as an important factor in influencing the export behaviour of firms is in accordance with our expectation. Several earlier studies (Helleiner 1995; Bernard and Wagner 2001) have also found that firms that employ skilled workforce are likely to export more. The marginal effect of skill intensity suggests that the unit change in skill intensity from its mean value, i.e., 0.146 can result in higher exports intensity by 22 per cent. Export-oriented firms need skilled workers not only at the manufacturing stages but also for other business activities such as marketing and business development activities. In the era of globalization, non-price factors such as modular and flexible product designs, market specific products, and delivery schedules are a very important source of competitiveness. Firms need to employ skilled workers to incorporate these features in products in order to survive in international markets, whereas in the domestic market firms face stiff price competition rather than non-price sources of competition. They can survive in the domestic market by employing less skilled workers that are not to be paid high wages.

It can be seen from Table 7 that the intensity of e-business technology adoption has played a significant role in influencing the export performance of firms. Wakelin (1997) argued and found that export performance is determined by the firm- and industry-specific characteristics. The arguments neither dispute the factor intensity theory nor challenge the theory of comparative or competitive advantage. However, technological innovations and adoption have been widely used to explain the variations in export

performance. For instance, in science-based sectors, innovative capabilities are very important, whereas in labour-intensive industries such as footwear and clothing, the adoption of new technologies plays a crucial role (Dosi *et al.* 1990; Abd-el-Rahman 1991). Therefore, considering the type of the sample firm, the findings of this study are in line with the existing literature that explains the differential export performance in terms of technological capabilities.

The competitiveness of firms has become pivotal to their survival in the domestic as well as in international markets since the liberalization of Indian economy in 1991. Consequently, firms have adopted new technologies to a great extent during 1990s. These new technologies are either adopted from outside or developed in-house. A firm-level study of Lal (1999a) also suggests that the adoption of ICTs strengthened the competitiveness of electrical and electronic goods manufacturing firms in India.

The competitors of export-oriented Indian firms are those that have access to latest technological developments. These technologies are often aimed at augmenting labour productivity. A study by Kraemer and Dedrick (1994) suggests that new technologies are aimed at improving productivity, particularly in the developed countries. Several recent studies (Lal 1996; Bernard and Wagner 2001) have found evidence that the labour productivity of export-oriented firms is higher than others. The productivity gains mainly come from the adoption of advanced technologies in general and ICT-led technologies in particular. A partial survey of literature by Bedi (1999) on the role of ICTs in economic development suggests numerous benefits of its adoption. These benefits range from employment, to productivity gains, consumer surplus, and improvement in product quality, etc. Pohjola (2001) in his cross-country study of ICT and productivity also found evidence of productivity gains due to the adoption of ICTs. Mohnen (2001) concluded that widespread use of e-business would lead to a greater participation in the globalization process. The emergence of a higher productivity in the export-oriented firms considered in this study supports the findings of the earlier studies. The marginal effect of labour productivity suggests that an increase in labour productivity by Rs one million from its mean value, i.e. Rs 191.993 thousand can augment the export intensity by 45.67 per cent.

The emergence of STO as a significant variable in determining the export performance of the three groups of firms is in line with the existing literature. It can be seen from Table 7 that a change in STO by Rs one billion from its mean value, i.e. Rs 269.596 million can increase exports intensity by 9.1 per cent. Several studies (Pavitt *et al.* 1987; Siddharthan 1992) also found a positive relationship between the adoption of new technologies, which is a prerequisite for better export performance, and the size of operation. Firms with large size operations are comparatively better off than other firms where the investment in new technologies is concerned. Moreover, large firms are in a better position to appropriate the benefits of new innovations in both domestic and in overseas markets. Sound financial position and appropriability conditions have a strong bearing on the adoption of latest technologies and in the investment on innovative activities, which are very important to remain competitive in the international markets.

The results of the study also suggest that the technological collaboration of Indian firms with foreign companies does not play any role in influencing the export performance of these firms. This is contrary to our expectations. It is quite possible that even firms that are doing business in the domestic market might have had technological collaboration

with multinational corporations (MNCs) to strengthen competitiveness. Moreover it has become quite easy to tie-up with the MNCs after liberalization of Indian economy.

6 Summary and conclusion

The paper identifies and analyses the factors that influenced the export performance of firms. The data were drawn from fifty-one firms located in NOIDA. Historical, financial, and technological data were collected through a semi-structured questionnaire. Historical data included the background of the managing directors and age of firm whereas financial data (1999-2000) consist of sales turnover, investment on ICTs, wage bill, exports, imports, profit after tax, and value added, etc. Technological data include the type of e-business tool adopted and bandwidth being used by firms. Data on technological and financial collaborations with multinational companies were also collected. The survey was conducted during December 2000 and February 2001. Sample firms are dominated by SMEs, as 73 per cent of these firms employed less than 150 persons. Firm-specific factors such as size of operation, intensity of the adoption of e-business technologies, skill intensity, labour productivity, international orientation, wage rates, profit margins were included in the analysis.

The sample firms have been classified according to their market preferences. Firms doing business in the domestic market are labelled 'non-exporting units' (NEUs), while those present in the domestic as well as in export markets are classified as 'exporting units' (EUs). The other firms operating only in international markets are labelled 'export-oriented units' (EOUs).

A censored regression model, i.e. TOBIT, was used to identify the determinants of export performance of firms. The results of the study show that the type of e-business technology used by firms and skill intensity of the workforce were the most significant factors that influenced the export performance of firms. Scale of operations has also emerged as a significant determinant of export performance. The study reveals that the labour productivity of export-oriented firms was higher than non-exporting units. The findings of the study are by and large similar to other studies (Doms *et al.* 1997; Bedi 1999; Siddharthan 1992; Cohen 1995; Pavitt *et al.* 1987; Soete 1997; Bernard and Wagner 2001).

The study captures the important role played by the type of e-business technology adopted by the sample firms in influencing their export performance. A very crucial factor, which is a driving force behind the diffusion of e-business technologies, is the communication technology network. This has not been included in the analysis because it is part of the institutional infrastructure rather than a firm-specific factor. Moreover, the communication network is beyond the control of the individual firms and is provided by the local government. A study by Lal (2001) found that the diffusion of e-business technologies is strongly associated with the bandwidth. A study by NASSCOM (2000) suggests that availability of higher bandwidth is a prerequisite for the penetration of internet and web-enabled services in India. A very reliable and affordable telecommunication network has to be in place to harness the potentials of ICTs. Although the telecommunication network is an external factor to firms, they can access different modes of the communication such as public switched telecom network (PSTN), integrated service digital line (ISDN), radio link, very small aperture terminal

(VSAT), and dedicated leased lines. In principle, every firm has equal access to these communication technologies. However, technologies other than PSTN are very costly compared to rates as international tariff. The impact of a reliable and high-speed telecommunication network on the export performance of firms is beyond the scope of this paper. It requires further research on linkages between export performance, bluetooth technology, and diffusion of e-business.

Appendix 1: Product profile of firms

S. No.	Industrial classification	Products	No. of firms	%
1	Auto components	Auto locks; door handles; speakers; electronic systems for cars	5	9.80
2	Electrical equipment	Electrical stamping; special transformers	2	3.92
3	Electronics	Telecommunication equipment; cable TV hardware; CTVs; CTV components; printed circuit boards (PCB); PCB design of electronic components; software products	17	33.33
4	Garments	Ladies; children; socks	5	9.80
5	Machinery	Construction equipment; electrical panels; industrial equipment	8	15.69
6	Plastic products	Plastic injection and blow mould; components for TV; plastic bottles	7	13.73
7	Others	Adhesive; polypack; rexene, vibration-shock absorbers; footwear	7	13.73

Appendix 2: Correlation matrix

	EXPOINT	EB_TYPE	SKILL	SIZE	LABPROD	COLL_TECH
EXPOINT	1.00					
EB_TYPE	0.41	1.00				
SKILL	0.67	0.45	1.00			
SIZE	0.28	0.52	0.18	1.00		
LABPROD	0.45	0.62	0.41	0.48	1.00	
COLL_TECH	0.21	0.35	0.13	0.16	0.11	1.00

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