Information Technology Investments and Export Performance of Firms: A Study of Pharmaceutical Industry in India

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The objective of the study is to understand the role of investments on information technology on export performance of firms. The data used for the analysis is secondary data extracted from Prowess database of Centre for Monitoring Indian Economy. Econometric analysis is carried out on a panel data consisting of regular exporting firms from the pharmaceutical industry in India for a period of four years (2010-2013). Other factors that affect export performance like size of the firm, age of the firm, labour-capital ratio, and import of raw materials have also been included as control variables. Results indicate that investment on information technology has a positive effect on the export performance of the firms in this industry. Age of the firm and size of the firm also turn out to be important factors in determining export performance of firms in this industry.

Keywords

Information Technology Investments; Export Performance; Pharmaceutical Industry; India

Introduction

International competitiveness is a well-researched topic in the areas of industrial economics and international business. Some of the popular theories on international trade recognize the importance of technology as a determinant of trade (Posner, 1961; Vernon, 1966; Krugman, 1979; Fagerberg, 1988). In the context of developed countries, several empirical studies have emphasized that adoption of new technology and innovation enables firms to enter foreign markets and also improve their export performance (see for example Basile, 2001; Roper and Love, 2002; Dhanaraj and Beamish, 2003; Rodriguez and Rodriguez, 2005). Even in the context of developing country like India, researchers have explicitly analyzed the role of technological efforts in determining export competitiveness of firms (Bhaduri and Ray, 2004; Siddharthan and Nollen, 2004; Narayanan, 2006; Bhat and Narayanan, 2009). However, these studies have invariably considered the role of in-house research and development (R&D), imported embodied/disembodied technology and/or intra-firm transfer of technology in determining exports. These technological efforts and innovative activities are concerned directly with the production techniques and processes of the firms.

Information technology (IT) is often considered to be a general purpose technology that can be used by varied industries for improving communication, collaboration and innovation (Kretschmer, 2012). Information technology can be a complementary investment for firms that are interested in increasing their geographical scope (Chari, Devraj and David, 2007). For these firms, investments on various IT applications like enterprise resource planning (ERP), intranet and other communication systems can facilitate global collaboration and operations. The empirical literature on firms in India has largely ignored the role of investments on a general purpose technology like information technology in improving the export competitiveness of the firms in non-IT industries. This study attempts to fill this gap in the existing literature.

Hence, the objective of this study is to understand the role of investments of information technology by the firms in determining the inter-firm differences in export performance of firms in India. The industry chosen for the study is pharmaceutical industry, which is one of the important high tech industries in India. Some of the recent studies on pharmaceutical industry in India have focused on importance of productivity (Goldar, 2013) and mergers and acquisitions (Vyas, Narayanan and Ramanathan, 2013) in explaining export competiveness of firms. This study explores the role of information technology, which has been largely ignored by empirical studies, in explaining export competitiveness of pharmaceutical firms. The data for the analysis has been extracted from the Prowess database provided by Centre for Monitoring Indian Economy (CMIE). The time period considered is from 2010 to 2013. The study focuses on only the regular exporters during the period, that is, the firms that have exported during all the four years of the study.

Literature Review

This section gives an overview of studies that have explored the factors that determine export competitiveness of the firms. As mentioned earlier, this study specifically considers the role of investments on information technology as a determinant of export performance of firms. Other factors that have been considered include in-house R&D, size of the firm, age of the firm, labour-capital ratio, and import of raw materials.

Information Technology Investments and Exports

According to the resource based view (RBV) in the strategic management literature, to compete successfully in any market, a firm must possess some firm-specific tangible or intangible assets that can be successfully exploited by the owner to create entry-barriers for others (Wernerfelt, 1984). Often these resources need to be rare and difficult to imitate by the competitors to provide sustained competitive advantage (Barney, 1991).

Information technology can be considered to be one such strategic resource that can contribute towards creating value for the firm (Rivard, Raymond and Verreault, 2006). When the information technology investment is aligned with the firm's competitive strategies, it can contribute towards better market performance of the firm. Information technology can bring in efficiencies like better inventory management (Mishra, Modi and Animesh, 2013) and better marketing capabilities (Wang, Hu and Hu, 2013). In a study on international diversification of US firms, Chari, Devraj and David (2007) noted that information technology helps in leveraging firm specific assets across countries and thus contributes towards firm performance. In a study on garment manufacturing enterprises in India, Lal (1999) did find intensity of adoption of information technology to be an important determinant of export performance of the firms.

In developed countries, the high costs of drug development and patent expiration is driving the pharmaceutical companies to seriously consider information technology enabled productivity (Biswas, 2007). However, the information technology used in pharmaceutical industry has to comply with various regulations, including those from food and drug administrator (FDA) and health insurance portability and accountability act (HIPPA). According to PwC (2011), many pharmaceutical companies in the world have entered into strategic partnerships with Indian information technology companies like Accenture, Tata Consultancy Services, and Infosys in the areas of pharmacokinetic modelling, data management and validation, pharmacovigilance, etc.

In developing countries like India, information technology can be used in pharmaceutical industry for improving the quality of decision making process (Ranjan, 2007). The companies that are into drug discovery can make use of data mining techniques to extract patterns from

existing pharmaceutical information like pharmacological properties, dosages, contraindications, warnings etc. Thus, by using the latest information technologies, Indian pharmaceutical companies can provide higher value added product and services to the global world.

Size of the Firm and Exports

Size of the firm is one of the most commonly used variables in the analysis of export competitiveness of firms. Export is a risky activity, which may require high amount of investments on various resources. Large firms would have these organizational resources and enable the firms to enter the export market (Dhanaraj and Beamish, 2003).

However, the findings of the empirical studies on the effect of size of the firm on export competitiveness are mixed. While some studies like Aggarwal (2001), Basile (2001), Zhao and Zou (2002) and Narayanan (2006) report a strong positive effect of firm size on exports, other studies like Athukorala *et al.* (1995) and Siddharthan and Nollen (2004) find only a weak support for firm size favourably affecting exports. In the context of basic chemical industry in India, Bhat and Narayanan (2009) note that once the firms enter the export market, larger size of the firm favourably affects the export intensities. Similarly, in a recent study on Indian pharmaceutical industry, Rentala and Anand (2014) found a positive effect of size of the firm on export sales.

In-house R&D and Exports

Technological efforts like in-house R&D enable firms to become proprietary owners of both product and process innovations. In terms of empirical evidences across the world, while some studies (Basile, 2001; Ozcelik and Taymaz, 2004) do find a favourable effect of R&D on exports, others find only a weak support for a favourable effect (Wakelin, 1998; Zhao and Zou, 2002, Rodriguez and Rodriguez, 2005).

In the context of India, the evidences are mixed. Aggarwal (2001) did not find R&D to be statistically significant in explaining exports in the high tech industries in India. Similarly, Narayanan (2006) did not find R&D to be important in determining exports in automobile industry in India. In the context of basic industrial chemicals and dyestuff industry in India, Kumar and Siddharthan (1994) noted that R&D was a relatively unimportant factor in determining exports.

However, in a more recent study on basic chemical industry in India, Bhat and Narayanan (2009) did find R&D to be a favourable factor in determining exports. In the context of pharmaceutical industry in India, the study by Bhaduri and Ray (2004) revealed that large firms with large R&D units succeeded in the export markets. Goldar (2013) and Vyas, *et. al.* (2013) also found that R&D had a favourable effect on export intensity of pharmaceutical firms in India. Vyas *et. al.* (2013) observed that the firms in Indian pharmaceutical industry produce and export majorly generic drugs and active pharmaceutical ingredients (APIs), which is supported by in-house R&D in terms of process development and reverse engineering.

Import of Raw Materials and Exports

Import of raw materials can be considered as one of the modes through which latest technology is transferred in embodied form from one firm to another (Vyas *et. al.*, 2013). In the context of pharmaceutical industry, raw materials consist of basic chemicals for production of API used in formulations (Bhaduri and Ray, 2004). If the imported raw materials are produced using the state-of-art technology then it would be meeting the world standards. Thus, use of these imported raw materials can improve the quality of the end

products and enable the firms to compete successfully in the export markets (Bhat and Narayanan, 2009). In their study on firms from Indian industries, Kumar and Siddharthan (1994) did not find raw materials to be favourable for exports during the deregulation period.

However, for a sample of pharmaceutical firms from India during 1994-95, Bhaduri and Ray (2004) did find raw materials import to be having a statistically significant positive effect on exports. Bhat and Narayanan (2009) too found favourable effect of imported raw materials on export intensities of firms in the case of basic chemical industry in India. In a recent study on pharmaceutical industry Vyas *et. al.* (2013) also found import of technology in the form of raw materials import to be important in determining export competitiveness of the firms.

Age of the Firm and Exports

Age of the firm can determine the ease with which the firm can get access to capital. It also acts as a proxy variable for the accumulated tacit operational capabilities of the firm (Bhat and Narayanan, 2009). However, in developing countries like India, younger firms with latest technology rather than the older firms from the industry may find it easier to enter the foreign markets (Bhaduri and Ray, 2004).

In the context of pharmaceutical industry in India, Bhaduri and Ray (2004) did not find age of the firm to be a significant determinant of export performance. However, in a recent study on export success of pharmaceutical firms, Rentala and Anand (2014) did report a negative effect of age of the firm on export sales. Even in the context of basic chemical industry in India, Bhat and Narayanan (2009) noted that younger firms are more export intensive compared to older ones.

Labour-Capital Ratio and Exports

Labour capital ratio indicates the nature of production technique used by the firm. Empirical studies like Athukurala *et al.* (1995) and Ozcelik and Taymaz (2004) have found capital intensity to have a positive effect on exports.

However, in a developing country like India where labour is abundant, adoption of labour-intensive technique can give a competitive edge to the firm over its competitors in the export market (Kumar and Siddharthan, 1994). For industrial and other chemicals industry in India, Kumar and Siddharthan (1994) did find a negative relationship between capital intensity and exports. Bhat and Narayanan (2009) also found labour-intensive technique to be favourably affecting the decision to export in the context of basic chemical industry firms in India. In the same study the variable was not statistically significant for export intensity of the firms. However, for information technology industry in India, Siddharthan and Nollen (2004) found a positive relationship between capital intensity and export performance suggesting capital intensive technique rather than labour intensive technique to be more relevant for export competitiveness of the firms in a high technology industry.

Data and Methodology

For the purpose of the study secondary data has been extracted from the Prowess database provided by Centre for Monitoring Indian Economy (CMIE). The data correspond to firms belonging to national industrial classification (NIC) 2008 division 21, which corresponds to manufacture of pharmaceuticals, medicinal chemical and botanical products. In this study this data is considered to be belonging to Pharmaceutical industry. The time period is four years from 2010 to 2013.

The focus of the study is regular exporters. Hence, only those firms with non-zero export values on all four years have been retained. After removing the outliers, 123 firms remain in the sample. Table 1 gives the definitions of the variables used in the study. All the variables

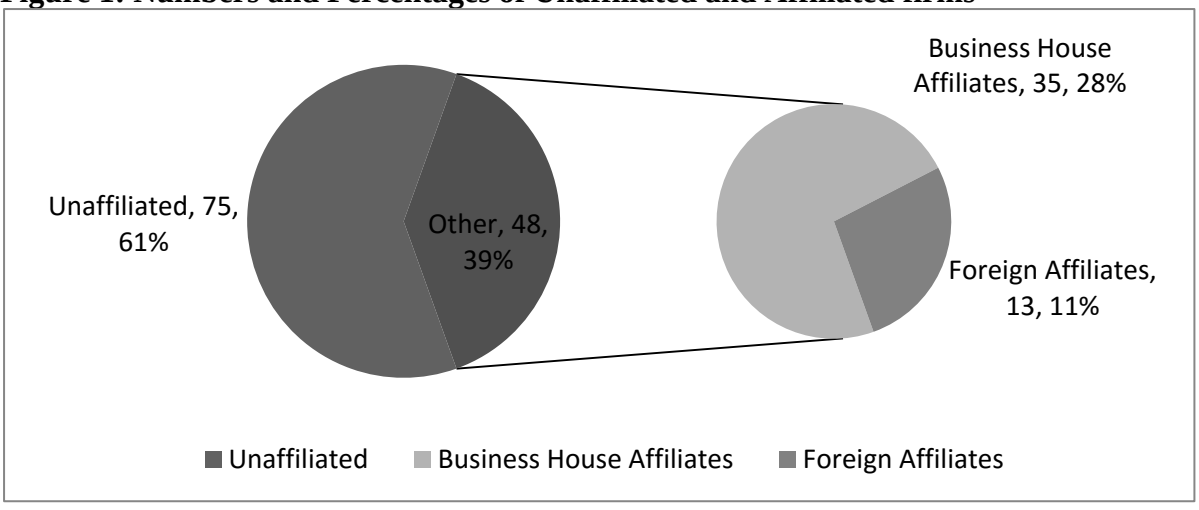
except size of the firm, age of the firm and labour-capital ratio are normalized using sales of the firm in the denominator.

The sample consists of both affiliated and unaffiliated firms. The numbers and percentages of affiliated and unaffiliated firms are presented in figure 1. Around 61 percent of the firms in the sample are unaffiliated, 28 percent of the firms are affiliated to business houses and 11 percent of the firms are affiliated to foreign entities. Affiliation of the firms to domestic business groups can provide favourable conditions like access to the pool of resources and infrastructure, thereby encouraging them to undertake export activities (Pradhan and Das, 2013). However, in the context of small and medium enterprises (SMEs) in India, Pradhan and Das (2013) observed that affiliated SMEs are more likely to supply low-cost components to group-affiliated companies rather than to enter export market. Hence, in the present study, separate regressions are run for unaffiliated and affiliated sub-samples (especially for the business house affiliates) to explore whether the factors affecting export performance differ between the sub-groups.

Table 1: Definitions of the Variables

Sl.	Variables	Symbol	Definition
1.	Export Intensity	**EXPI**	Exports (in Rs. Million) as a percentage of sales (in Rs. Million)
2.	Information Technology Investment Intensity	**ITI**	Net Investments on software, computers and information technology systems (in Rs. Million) as a percentage of sales (in Rs. Million)
3.	Size of the Firm	**SIZE**	Logarithm of sales (in Rs. Million)
4.	Age of the Firm	**AGE**	Year of observation – year of incorporation
5.	R&D Intensity	**RDI**	Research and development expenses (in Rs. Million) as a percentage of sales (in Rs. Million)
6.	Labour-Capital Ratio	**LC**	Employee compensation (in Rs. Million) as a percentage of net fixed capital (in Rs. Million)
7.	Raw Material Import Intensity	**IRAW**	Import of raw materials (in Rs. Million) as a percentage of sales (in Rs. Million)

Figure 1: Numbers and Percentages of Unaffiliated and Affiliated firms



The total and average investments on information system by the sample firms during the period of study are presented in Figures 2 and 3. As is clear, the investments have been steadily increasing over the periods from 2010 to 2013. Companies with large investments on

information technology (in absolute terms) include Ranbaxy Laboratories Ltd., Mylan Laboratories Ltd., Piramal Enterprises Ltd., Wockhardt Ltd., and Cadila Healthcare Ltd. These companies have in general implemented organization-wide information systems modules provided by leading IT companies like SAP. For example, Ranbaxy Laboratories Ltd. has implemented SAP enterprise resource planning (ERP) system for efficient use of its resources and Pirmal Enterprises Ltd. has implemented SAP Advanced Planning and Optimization (APO) component to boost its supply chain.

Figure 2: Total Investments on IT by the sample firms during the period of study

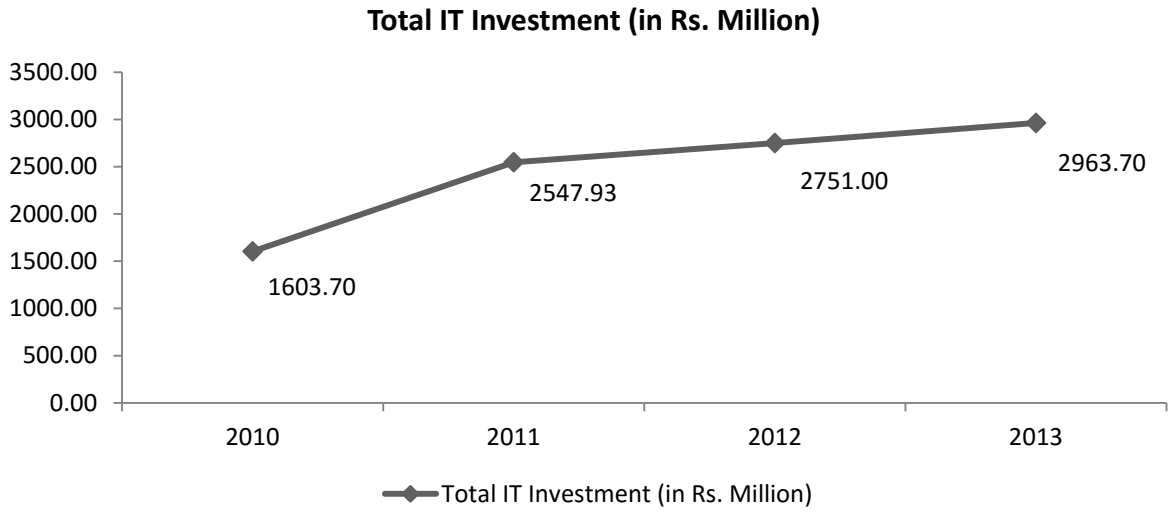


Figure 3: Average Investments on IT by the sample firms during the period of study

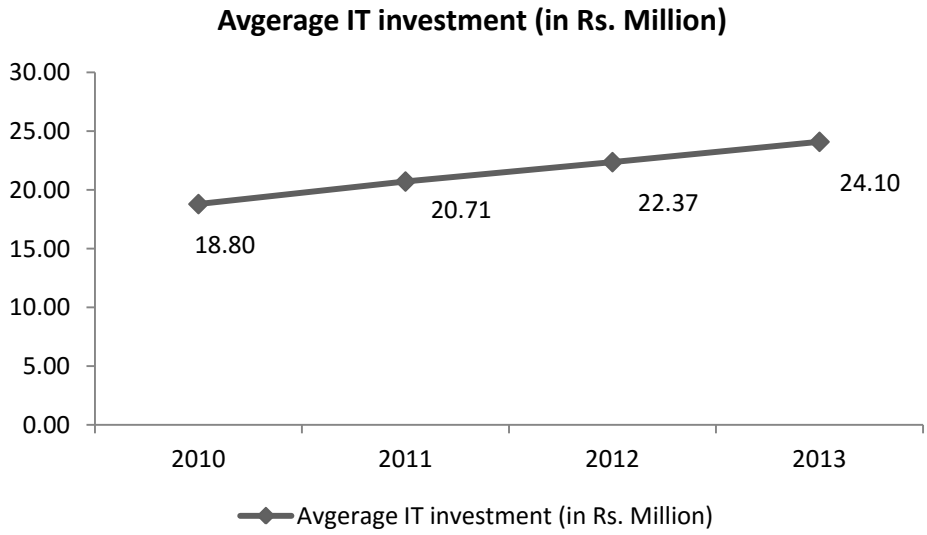


Table 2 presents the mean and standard deviation for the full sample and select sub-samples. The average export intensity of the sample is around 34 percent. Information technology investment intensity is less than 1 percent at around 0.31 percent. The average value of labour-capital ratio is quite high for foreign affiliated firms. However, the standard deviation of the variable for this sub-sample is also large. With respect to import of raw materials, on an average, the unaffiliated firms seem to be more import intensive than the affiliated firms.

Table 2: Descriptive Statistics*

Sl. Variables	Full Sample	Un-affiliated	Affiliated		
			All	Business House	Foreign
1. EXPI	33.89 (26.94)	34.57 (27.28)	32.83 (26.44)	34.10 (21.90)	29.41 (35.99)
2. ITI	0.31 (0.57)	0.33 (0.63)	0.27 (0.45)	0.26 (0.48)	0.30 (0.36)
3. SIZE	7.79 (1.67)	7.32 (1.47)	8.53 (1.70)	8.47 (1.64)	8.69 (1.86)
4. AGE	32.35 (18.90)	28.10 (16.39)	38.98 (20.61)	36.21 (19.15)	46.42 (22.68)
5. RDI	2.22 (3.65)	1.67 (3.22)	3.09 (4.10)	3.31 (4.09)	2.49 (4.12)
6. LC	57.41 (146.12)	31.08 (40.35)	98.55 (222.60)	38.77 (34.68)	259.49 (382.20)
7. IRAW	29.51 (140.37)	43.31 (176.87)	7.94 (30.23)	8.23 (34.14)	7.18 (15.69)
Num. of Obs.	492	300	192	140	52

* Mean with standard deviation in parenthesis

Econometric Specification

The data is a balanced panel data consisting of 123 firms and 4 years from 2010 to 2013. Hence, panel data regression model has been used for the analysis. Following Baltagi (2005), the econometric model is specified as follows:

$$y_{it} = \alpha + X'_{it}\beta + u_{it}$$

where y is the explained variable, namely, export intensity (EXPI) and X is the vector of relevant explanatory variables as defined in Table 1. The value of i ranges from 1 to 123 for full sample and differs for other sub-samples. The value of t ranges from 1 to 4 for all econometric models. α is a scalar, β is coefficient on the explanatory variables and u is the stochastic error. Hausman specification test (Baltagi, 2005) is used to choose between fixed and random effects model. Statistical analysis has been carried out in STATA version 10 statistical package.

Analysis and Results

Table 3 presents the correlation matrix between the variables for full sample. All the variables except import of raw materials are correlated with export intensity. Both, age and labour-capital ratio, are negatively correlated with export intensity. Size of the firm, age of the firm, R&D intensity, labour-capital ratio and import of raw materials are also correlated to information technology investment. Some other pairs of variables (for example, SIZE and RDI) also have statistically significant correlation coefficient. However, the values of the correlation coefficients are small.

The results of the econometric models are presented in Table 4. In all the econometric models information technology investments is statistically significant with positive sign in explaining export intensities of the firms. For the pharmaceutical firms in India, investments on latest software and information technologies like enterprise resource planning and customer relationship management software are important for achieving better export competitiveness in the pharmaceutical industry. One of the unaffiliated companies that have high IT

investments is Vivo Bio Tech Ltd. The company is into contract research and manufacturing services (CRAMS) and discovery and development of new chemical entities (NCE) for other companies across the world. It has a state-of-the-art preclinical research facility which is equipped with robust building management system (iBMS) provided by Siemens, Inc. and tiered biometric access control.[1]

Table 3: Correlation Matrix

	EXPI	ITI	SIZE	AGE	RDI	LC	IRAW
EXPI	1.00						
ITI	0.09*	1.00					
SIZE	0.24*	-0.13*	1.00				
AGE	-0.25*	-0.11*	0.21*	1.00			
RDI	0.31*	0.24*	0.35*	-0.09*	1.00		
LC	-0.26*	-0.10*	0.10*	0.33*	-0.11*	1.00	
IRAW	-0.05	0.16*	-0.24*	-0.11*	-0.01	-0.05	1.00

* indicates statistical significance at 10% level.

Table 4: Results of Econometric Models with EXPI as Explained Variable[2]

	Model 1 Fixed Effects	Model 2 Fixed Effects	Model 3 Fixed Effects	Model 4 Fixed Effects	Model 5 Fixed Effects	Model 6 Fixed Effects
	Full Sample	Unaffiliated Firms	All Affiliated Firms	Business House Affiliates	All Affiliated Firms	Business House Affiliates
Constant	-5.48 (-0.48)	9.19 (0.62)	-36.22 (-2.10)[b]	-30.78 (-1.26)	-15.19 (-0.90)	-22.49 (-0.87)
ITI	4.89 (4.25)[a]	5.26 (3.33)[a]	4.32 (2.60)[a]	3.61 (1.85)[b]	6.94 (4.42)[a]	7.22 (3.95)[a]
SIZE	-3.09 (-2.32)[b]	-3.02 (-1.83)[c]	-1.97 (-0.73)	-5.33 (-1.27)	5.27 (2.68)[a]	6.12 (1.94)[c]
AGE	1.95 (5.50)[a]	1.62 (3.35)[a]	2.20 (3.68)[a]	3.02 (3.85)[a]	-	-
RDI	-0.08 (-0.36)	-0.27 (-0.82)	0.17 (0.53)	0.23 (0.58)	0.60 (1.91)[c]	0.88 (2.31)[b]
LC	-0.01 (-0.70)	0.04 (0.89)	-0.01 (-1.37)	-0.02 (-0.23)	-0.004 (-0.45)	0.01 (0.08)
IRAW	-0.01 (-2.09)[b]	-0.01 (-1.85)[c]	-0.03 (-1.00)	-0.03 (-0.97)	-0.03 (-1.05)	-0.03 (-0.83)
F Statistic	11.19[a]	5.77[a]	7.42[a]	7.35[a]	5.67[a]	5.14[a]
No. of Obs.	123 × 4 = 492	75 × 4 = 300	48 × 4 =192	35 × 4 = 140	48 × 4 =192	35 × 4 = 140

[a, b, c] indicate statistical significance at 1%, 5% and 10% respectively. t-statistics in parenthesis.

Even in the case of the business house affiliated sub-sample (Models 4 and 6 in Table 4), the firms that are investing more on IT seem to be having better export competitiveness. Ajanta

[1] Information obtained from company website http://www.vivobio.com/infrastructure.php (accessed 31 July 2015)

[2] Due to small sample size of foreign affiliates, the econometric model was not estimated for this sub-sample.

Pharma Ltd., which belongs to Ajanta Pharma Group, is into specialty therapeutic segments of cardiovascular, dermatology, ophthalmology and musculoskeletal. Around two-third of its goods are exported (Datta, 2015).

Unlike the findings of earlier studies on pharmaceutical industry in India (Bhaduri and Ray, 2004; Goldar, 2013; Vyas *et. al.*, 2013), in the present study R&D intensity is not statistically significant in the first four econometric models. However, after dropping age of the firm (AGE), for the sub-sample of affiliates, especially business house affiliates, R&D variable becomes statistically significant (Models 5 and 6 in Table 4). In these two econometric models, size of the firm (SIZE) also becomes statistically significant with positive sign. Thus, it seems that the variable AGE is capturing the effects of both SIZE and RDI for the affiliated sub-sample of regular pharmaceutical product exporters.

Again, unlike the findings of the earlier empirical studies, age of the firm is statistically significant with positive sign in the first four econometric models. This implies that for regular exporters in the pharmaceutical industry, experience of the firm is quite important for better export performance.

The nature of production technology, represented by labour-capital ratio did not turn out to be statistically significant in determining export intensity in all the four econometric models. This finding is in line with that of Bhat and Narayanan (2009) where nature of production technology is important only for decision to export and not for export intensity of the firms belonging to Indian basic chemical industry.

In the case of unaffiliated sub-sample, firms with lower intensities on import of raw materials seem to be having better export performance. This is especially true for the unaffiliated firms. In the case of affiliated firms, raw material imports is not statistically significant in determining exports. Earlier studies on pharmaceutical industry in India (Bhaduri and Ray, 2004; Vyas *et. al.*, 2013) did find raw material intensity to be statistically significant in determining exports. In the present study, the regular high intensity exporters are likely to be those firms which have either already acquired the in-house capabilities for producing world-class pharmaceutical raw materials or are procuring the raw materials from indigenous suppliers. For example, Natural Capsules Ltd. is an Indian public limited company which has a well-equipped modern manufacturing plant to manufacture hard gelatin capsule shells and hard cellulose capsule shells to cater to the needs of both domestic and export markets. The main raw material for the product is pharmaceutical grade gelatine which it acquires indigenously.[3] Another Indian company, Wintac Ltd. is into custom pharmaceutical contract manufacturing. It produces wide range of ophthalmic preparations and injectables for diversified areas including anaesthetic, diuretic, and cardiovascular. It has a state-of-the-art manufacturing plant located at the outskirts of the city of Bangalore and has been awarded the ISO 9001 certification from DNV Germany. All the products manufactured at the plant conform to stringent quality control, recommended and specified in the U. S, British and Indian pharmacopoeia. Majority of its raw materials are sourced from India.[4]

Interestingly, smaller sized firms in the pharmaceutical industry seem to have better export performance. This is especially true in the case of unaffiliated firms. For example, Fredun Pharmaceuticals Ltd. which had sales of around Rs. 16 Crore during the financial year 2012-13, regularly exports generics to African and the Southeast Asian countries. During the

[3] Information obtained from company website http://www.naturalcapsules.com/quality.htm (accessed 31 July 2015)

[4] Information obtained from company website http://www.wintaclimited.com (accessed 31 July 2015)

financial year, the company also globally launched 36 new products and filed 60 new products for registrations.[5]

Conclusion

This study tried to understand the role of information technology investments on international competitiveness of the firms. The sample for the study was regular exporting firms from pharmaceutical industry in India. The analysis indicated that investment on information technology has a positive effect on the export performance of the firms in this industry. Thus, the regular exporter firms that invest on information technology for efficient storage, retrieval, analysis and distribution of data and information are able to have better export intensities.

The study also found that the smaller and older firms among the unaffiliated ones are having better export performance. To further improve exports in this industry, the government and information technology industry players may provide support and exposure to the unaffiliated young pharmaceutical firms to encourage them to make use of information technology to reach out to the global markets and further increase their exports.

One could further extend this study to include the non-exporters and the irregular exporters to understand whether information technology investments has a favourable effects on the export competitiveness of all the firms in this industry.

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[5] Information obtained from annual report 2012-13 of Fredun Pharmaceuticals Ltd. and Prowess database

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