The Impact of Information and Communication Technology (ICT) on the Firms' Export Behavior in Manufacturing Firms of Iran Using Tobit and Heckman Method

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Abstract: The studies conducted in the field of foreign trade in recent decades gradually have been distanced far away from firm's homogeneity assumption and more have dealt within tentioned heterogeneity among manufacturing enterprises. Most of these studies are based on the fact that within a certain industry only some parts of firms have entered into the export markets and the rest only been limited to sell their products in the domestic market. The theoretical studies justify this phenomenon in a way that entry into export markets requires some capacities in firms. Recognizing these factors can help to improve export performance. So, in the this study using Tobit and Heckman Censored Regression Model and information of manufacturing firms in Iran, the role of investment in information and communication technology in behavior of Iran's export enterprises have been investigated. The obtained results of the current study showed that investment information and communications technology has significant and positive impact on both export propensity and intensity.

Key words: Information and communication technology, export propensity, export intensity, manufacturing firms of Iran, theoretical studies

INTRODUCTION

ICT is the product of the convergence of modern telecommunication technology and digital data processing technology. World of information and communications is rapidly changing and today their convergence with one another can be seen more than ever so that data is transferred quickly and incredibly be available to users of all over the world. Expanding of fixed lines telephone and mobile subscribers and internet users is among the objective visual representations of information and communication technologies development so that the United Nations Conference on Trade and Development (UNCTD, 2010) in its report in 2006 entitled Information Economy reported that the level of mobile phone penetration has increased overly. It is the only information and communication technology which is growing rapidly and the only technology that its growth rate in developing countries is higher than developed countries. Although, the internet penetration has not reached the same level as mobile phone has its penetration is far higher than that of the fixed line telephone. The policy maker's awareness towards potential areas of development through Information and Communication Technology (ICT) in less developed countries is increasing gradually. The rapid growth of internet has attracted the public interest to information and communication technology that previously only being used by a small number of technology experts. Totally, ICT at the present time is located at the center of many social sciences research projects.

In recent years, the factor thatleads togreater importanceof investment in ICT is its efficacy in the field of export through the e-Commerce channel. In addition to e-Commerce, information and communications technology and information can also be used through other channels in business. For example, a mobile phone can be useful in the trade field including trade coordinating using text and verbal messages that leads to decrease of costs and increase of trade transaction.

Despite the importance of ICT in export development, the empirical studies that have investigated the effects of this variable on exports, especially in developing countries such as Iran are not very considerable. The present study examines the impact of ICT on export and export orientation and export intensity among manufacturing firms using Tobit and Heckman's Censored Models. To this end, the theoretical and empirical studies in this area first have been reviewed and then introduce the research model and methodology will be presented and finally, the empirical results will be presented and the conclusions will be drawn.

Theoretical framework: In situations that business firms are looking to stabilize their position in the international markets, the benefits of ICT usage can be manifold. In addition to the indirect effects of ICT on exports through

improved productivity and innovative performance, one of the direct effects of ICT on exportsis through providing immediate and direct relationship with customers where there is no need to physical presence in overseas markets that both lead to decrease of the deal costs. Many marketing activities can also be done through ICT (such as international advertising, customer relationship order management). Using the internet can also be a form of foreign market entering for smaller companies as compared with large companies and corporations that have more quick access to external parallel markets have less power to physical presence. Studies that considered the speed of globalization in small and medium companies have found a strong relationship between the ICT use and the speed of internationalization (Morgan-Thomas and Jones, 2009).

The major part of studies related to "companies globalborn" also shows that the internet helps to the rapid growth of sales and solve problems related to the "liability of newness and foreignness" and the lack of resources (Reuber and Fischer, 2011). Different theoretical channels to explain the mechanisms of information and communication technology ICT effect on export orientation that should distinguish between them. To do this it is important to consider the development levels of technology. Before the widespread diffusion of internet in the private sector in the mid-1990s, ICT was mainly used to improve the performance of internal business processes and the accounting systems. Then, if ICT had effected on export trends this impact was indirect. For example, the use of ICT for internal purposes may reduce production or administrative costs and improve productivity and accordingly enhance competitiveness in domestic and foreign markets which may enhance the company export direction. ICT Systems before internet extension facilitate the communication between firms via Electronic Data Interchange (EDI). EDI Systems require a high degree of customization in their design and therefore they are very expensive. In general, large companies use EDI to keep their present business relationship with the suppliers. Therefore, businesses firms are forced to adopt the same system to maintain existing business relationships. The main use is in exchange orders in long-term customer and supplier relationships. Therefore, the EDI System cannot beused to facilitate access to information about new customers or suppliers and it needs internet (Kalakota and Whinston, 1997).

However, it seems to be reasonable that the changing cost of communicating via EDI with external business partners is less than any other traditional communication methods. However, EDI high cost of installation prevent it from being spreaded among SMEs (Kalakota and Whinston, 1997), therefore, the EDI impact on export orientation of SMEs is negligible.

Internet as an international media reduces major costs of information obtaining in companies and foreign markets (Lal, 1999). Equally or more, the cost of introducing the company to the potential customers inabroad has been decreased. Before the internet creation, the relationship between the companies in one country was more economical than the relationships between companies in different countries because contact through phone calls and faxes in the border was much cheaper. In addition, finding information about local companies was easier and chipper than obtaining information about foreign companies through intermediaries such as the Chamber of Commerce. This cost difference is now reduced via the internet. Because the internet provides cheap alternative methods and international communication through email and web it offers access to the database and widespread information to potential global customers and suppliers.

Even more while in the past a company may be forced to have an office in the exporting country to export, now it may be the only forced to pay cost of setting up a website in the national language of the country. The result is that will be eliminated information brokers such as Chambers of Commerce and dealers who bring the products from one country and give it to the customer in another country sell will be eliminated. Prior to the establishment of internet, intermediaries were considered as bridges in the international value chain they implemented supply of the product in one market with demand in another market.

Previously, if the media did wasnot available or sufficient, firms, especially Small and Medium Enterprises (SME) could not export due to the high cost of information gathering specially about foreign markets. Currently, SME using the internet without intermediaries are considered to sell their products to the loops of the value chain which are closer to end customer, outside or inside the borders. According to the results of the study by Petersen *et al.* (2002) one of the main obstacles in the path of international development is asymmetric information and uncertainty from foreign markets and the internet can be an effective tool to reduce the problem of asymmetric information and uncertainty. Also, the internet enables firms to identify new market opportunities leading to business expansion. Specifically, it allows SMEs to gain deeper knowledge of target markets, select suppliers and to establish direct contact with clients using a low cost medium. The internet makes it easier for firms to expand internationally (Nieto and Fernandez, 2005). Due to access to markets information, a firm finds itself in a better position to meet the segment needs of specific clients and to tailor its products and services to conform those needs. Similarly, the internet reduces the entry barriers to international markets which

in turn encourages the firm's international expansion and minimizes the importance of the local market (Nieto and Fernandez, 2005).

However, any empirical analysis should focus from the impact of information and communication technologies on export trend to statistical data from second half of 1990 and 1998 which was associated with the development of internet usage in the private sector.

Development of internet in all aspects of daily life leads to the introduction of the e-Commerce models in business. This development reduces the transaction costs in different ways. Not only information cost but also the cost of other exchanges and mainly cost of a valid contract has decreased through this innovation. Before the formation of e-Commerce, firms could receive market information via the internet but could not buy or sell viathat. These activities needed paper and more traditional means of communication.

e-Commerce business in both models of Business to Consumer (B2C) and Business to Business (B2B) has saving and yields benefits. In B2C, e-Commerce activities help to eliminate middlemen such as whole salers, retail stores or the extra. Either the production company or the final customer would have better condition. The first receive higher prices for their product and second pay less for the purchase and the benefits of saving money that intermediaries demanded before are divided among themselves.

In the B2B business, the purpose is to create intermediaries such as whole salers Dual. This business models are to be handled especially in companies that are produced for many different clients or order to large number of different suppliers. Without e-Commerce, it was impossible to overview all market's suppliers or demand. In addition, the contract costs and exchange orders reduce with e-Commerce in B2B Model.

Following, Tan *et al.* (2007), the introduction of ICT is a necessary but not sufficient condition to stimulate export behavior. This is due to the fact that the organization must ensure that information is properly processed and exploited to effectively reduce the uncertainty and risks associated with exporting.

The empirical literature: The empirical evidence on the ICT role in trade has so far been so scarce. Freund and Weinhold (2004), using data on bilateral trade from 1995-1999 have found that increasing the number of websites in one country helps to explain export development the following year. Wheatley and Roe discuss the potential positive effects of the internet on US trade in agricultural and horticultural products. They also present some econometric methods for measuring the effects of the internet on exports and imports. Clarke (2008), finally, investigated the question that whether internet access affects on export performance of enterprises in low and middle-income economies in Eastern Europe and Central Asia. He found that internet access stimulated export activities through industrial and service enterprises.

In Choi (2010), data for 151 countries from 1990-2006 was used to investigate the effect of the internet on service trade. The panel data estimation results indicated that a doubling of internet usage in a country was turned out to lead to a 2-4% increase in services trade.

Valderrama and Neme (2011) analyzed the effects of changes on purchase of computer equipment and peripherals (investment in Information and Communication Technologies (ICT) in Mexican manufacturing industry using data from the Annual Industrial Survey and during 2003-2006. They used a cross-section methodology to evaluate the effect of such technologies in each year of the period. The results indicated that investment in ICT had a positive effect on manufacturing exports, particularly in industries with low technological content that could integrate ICT with their export activities.

Thiemann generally tested the hypothesis that ICT effects on trading bananas oranges, tomatoes, vegetables and fruits. A Gravity Model of international trade between major exporting and importing countries was employed for the period of 1995-2009. The model explained the value of trade in terms of export and import countries' levels of internet and mobile phone penetration and alsoin terms of a broad range of factors that might also affect on bilateral trade. Results suggested that mobile phone penetration significantly stimulates trading vegetables, fruit and oranges by exporting countries but its impact is less than that of fixed telephone usage which has an unexpected negative influence on banana imports. Internet usage has only a positive effect on trade in imports of tomatoes. Internet usage in exporting countries is negatively associated with fruit and vegetables imports.

Portugal-Perez and Wilson (2012) have studied the impact of various types of infrastructure on the export performance of developing countries and showed that an ICT infrastructure is relevant and that its impact on exports seems to be increasingly important the richer a country becomes.

Ghalandari (2013) investigated the effects of information and communication technology in three domains of information search, sales and service activities and communicational development on export performance of Iranian firms in two dimensions of performance in international markets and new market knowledge. The results based on simple linear regression showed that ICT has a significant effect on export performance of export firms in the city of Tehran. But this effect varies depending on the way of using ICT. Using ICT for

searching information only influences the performance dimension in international markets but has no effects on new market knowledge dimension. Also, using ICT for sales activities does not influence these two dimensions and finally there is a significant relationship between using ICT for communicational development and both dimensions of export performance, i.e., performance in international markets and new market knowledge.

Zhou utilized zero-censored Tobit linear regression to examine whether Chilean Small and Medium Enterprises (SMEs) use of Information and Communication Technology (ICT) could indicate higher SME exports measured as a percentage of gross sales. It has been found that the use of email is a statistically significant predictor of higher Chilean SME exports. In the present research, no statistical evidence of a relationship between Chilean SMEs use of business websites, cell-phones or high-speed internet and SME exports has been found.

Hagsten and Kotnik based on linked firm-level data investigated the role of ICT capacities in the internationalization of small and medium-sized firms for a large group of European countries. Both the decision to export and the value of export are studied. The results show a positive relationship between the ICT capacities and the engagement in exporting activities, although, the capacity most efficient seems to vary across countries. In countries where the firms ICT intensity is less developed, more basic capacities such as online presence are of importance for the decisions related to export. There are also indications that expansion of international sales benefits from more advanced ICTs than the pure export decisions.

Other factors affecting the firms export performance: Other factors that could significantly impact on export growth can include the firm size, innovation and firm ownership. In this regard, several studies have been done in this field that here just some will be referred to.

Export activity has been related to firm size in a number of studies (Wagner, 1995). In general, export activity is found to be more common among large firms. Larger firms have more resources to access international markets. Given the higher entry cost into international than domestic market this is argued to make them more likely to be exporters. One of the variables affecting the firm export is the Research and Development (R&D) investment or innovation. Researchers such as Greenhalgh *et al.* (1994) in England Anderton (1999) in Germany, Sterlacchini (2001) in Italy and many other researchers have concluded that R&D have positive impact on the possibility of firms exporting. The impact of ownership on the firm's export performance begins since

the type of ownership structure effects on the firm's productivity. Results of a number of studies showed that companies with private ownership have higher productivity than state-owned firms which can be pointed out such as Gupta (2005), Claessens and Djankov (1999).

In contrast, there are other studies such as the Dosoglu-Guner (2001) that referred to some government agencies priorities such as tariff exemptions, discounts on transport costs and risk-taking of state-owned agencies and mentioned that export power of public firms is more than that of the private firms. In general, the impact of ownership on firms export performance would be uncertain.

MATERIALS AND METHODS

Based on the contents of the former sections, the model of the present study is as follows:

$$x = c_1 + c_2 ICT + c_3 Size + c_4 O + c_5 R\&D \qquad (1)$$

where, x represents the intensity and orientation towards the firm export. The firm's export intensity is measured using the ratio of each firm exports to the firm production and export propensity is measured by a dummy variable that is 1 for exporting firms and 0 for other firms.

Size measures the firm size and is equivalent to the logarithm of the number of employees of the firm. ICT represents the logarithm of spending on the firm information and communications. O is dummy variable which represents the firm ownership type and takes 1 for state-owned firms and 0 for other firms. The dummy variable of R&D will be used to show the status of research and development in the firm, R&D proposes the value of 1 for the firms with R&D and 0 for the other firms. All statistical data of this study have been collected from manufacturing firm's census project of statistic center of Iranin 2011. This project consists of 12310 active firms among which 1179 has had exports. For model estimation, Tobit and Heckman Method and Stata Software have been used and in this part, the reason for using these methods will be described briefly.

When a significant portion of the data related to dependent variable in the investigated sample are 0 and total of the sample information will be used in the estimation, two different categories of explanatory variables would be considered in the model. The first category is the variables that affect on the dependent variable being zero or non-zero and the second category of variables affect on the non-zero values of the dependent variable. In this case, using the OLS Method leads to biased results because the OLS Method does not distinguish between these two categories of explanatory

variables and thus the estimated coefficients will be biased. On the other hand, if the sample be limited to non-zero values of the dependent variable it will be involved with sample selection bias due to compliance with a particular standard (selecting enterprises with export) in sample selecting and in this case also using the OLS Method can lead to biased results (Wooldridge, 2002). Tobin (1958) to solve the problem of sample selection bias has proposed Tobit Method and Model estimating using Maximum Likelihood estimation (ML). In this method, both groups of companies present in the sample, whether exporting firms or firms with zero export which potentially could be exporters, enter into the model estimation and thus the problem of sample selection bias will be solved. However, Tobin Model is not able to discriminate between the explanatory variables affecting oninitial decision to participate in an activity (exports) and explanatory variables affecting on export amount or intensity of that activity (exports). Two-stage Tobit Method by Heckman (1979) solve this problem. This method is based on the assumption that the explanatory variables are divided into two categories, the first category is factors affecting the participation decision in the activity (e.g., exports) and the latter variables are affecting on the level of activity. It should be noted that these two categories of explanatory variables are not mutually exclusive and may be the same. In this method, there are two probit and linear regression. First, the effecting factors on participation probability in the desired activity have been estimated in Probit Model. In this model, the dependent variable takes the value 0 or 1. Then in the Linear Regression Model, the factors affecting the intensity of desired activity are estimated. To connect these two models based on the estimating results of the Probit Model, a variable called inverse Mills ratio is calculated and entered into the second model as an explanatory variable. Mills inverse ratio represents the error which caused by sample selecting. Thus, if the coefficient of this variable is non-significant, the removal of the dependent variable with zero values will lead to unbiased but inefficient coefficient estimation. To clarify the matter these two estimation methods will be explained briefly. Suppose Y_i^* indicates the export intensity (the ratio of exports to sales in firm) of firm and X_i is explanatory variables affecting the firm export. It is obvious that the amount of Y_i^* for enterprises that have no export is equal to zero and for exporting firms it is a positive value. If show positive values of Y_i^* by Y_i, Tobit's Model will be as follows:

$$Y_i = B'X_i + U_i \quad \text{if} \quad Y_i^* > 0$$
$$Y_i = 0 \qquad \qquad \text{if} \quad Y_i^* \leq 0 \qquad (2)$$

So that N is the number of total observations that is equal to N = N0+N1. N0 and N1, respectively show the number of observations where the dependent variable is 0 and 1. Y_i (latent or unobserved variable) in form of vector (N×1), Y_i revealed variable (in form of vector (N1×1), B vector (K×1) from model parameters, X a matrix with rank of (K×N) from explanatory variables, U_i classic error term and 0 is censorship threshold on top of which the latent variables can been seen and the unrevealed at the bottom of it. As can be seen, the Tobit Model structure is such that provides the possibility to let both group of observations that totally make up N observations enter. In other words, in Tobit Model the sample consisted ofactual and potential exporters and there will be no sample selection bias. To estimate Tobit Model, the MLE maximizing function method is used. The possibility of accruing zero or positive for each observation is calculated as follows:

$$P(Y_i = 0) = P(Y_i^* \leq 0) = 1 - \Phi\left(\frac{B'X_i}{\sigma}\right)$$
$$P(Y_i > 0) = 1 - P(Y_i = 0) = \Phi\left(\frac{B'X_i}{\sigma}\right) \qquad (3)$$

Where:
P = Presents the probability distribution
Φ = Presents the corresponding probability density function
σ = Standard deviation of Yi* (or error portion)

Thus, likelihood function that represents the simultaneous probability of all observations will be equal to multiply of the above probabilities. Assuming the probability density function to be normal, probability function for the simultaneous occurrence is as following:

$$L(B'X_i, \sigma) = \prod_{Y_i=0} \left\{ 1 - \Phi\left(\frac{B'X_i}{\sigma}\right) \right\} \times$$
$$\prod_{Y_i>0} \left\{ \left(2\pi\sigma^2\right)^{-\frac{1}{2}} \exp\left(-\frac{1}{2\sigma^2}\left(Y_i - B'X_i\right)^2\right) \right\} \qquad (4)$$

Through, taking log of the above function and maximizing that σ and B parameters will be calculated. McDonald and Moffitt (1980) showed that per one unit change in one of the explanatory variables for example x_j, changes in the expected value of the dependent variable will be calculated as follows:

$$\frac{\partial E\left(\frac{Y_i}{X_i}\right)}{\partial x_j} = B_j \Phi\left(\frac{B'X_i}{\sigma}\right) \qquad (5)$$

Where:

B_j = Estimated coefficient of explanatory variables of x_j

$\Phi (B'X_i/\sigma)$ = Represents the probability of Y being positive

In Heckman two-step Tobit Method, Tobit Model is analyzed into two models of probit and Linear Regression Model as follows:

Probit Model:

$$Z_i = \gamma'W_i + e_i \quad i = 1, ..., N$$
$$Z_i = 1 \qquad Y_i^* > 0 \qquad\qquad (6)$$
$$Z_i = 0 \qquad Y_i^* = 0$$

Where:

Z = Represents the participation and non-participation in the activities

W = Vector of variables affecting the participation decision of each sample member

Linear Regression Model:

$$Y_i = B'X_i + \mu_i \quad i = 1, ..., N \qquad (7)$$

Where:

Y = Indicates the intensity of considered activity (exports)

X = Vector of variables that affecting the amount of Y

First in Probit Model, the factors affecting on participation of sample elements in the considered activity is estimated using the MLE Method. In this model, the dependent variable takes the values of 0 and 1. Then in Linear Regression Model, the factors affecting the desired activity intensity are estimated. As mentioned earlier to connect these two models, based on the estimation results of the Probit Model, a variable named revers MILLS ratio is calculated as: $\lambda_i = \phi(\gamma'W_i)/\Phi(\gamma'W_i)$ for $Y\_i > 0$ and is entered as explanation variable into the second model:

$$Y_i = B'X_i + \delta\lambda_i + \mu_i \quad i = 1, ..., N \quad Y_i^* > 0 \qquad (8)$$

where, λ_i represents the error resulting from sample selecting. Thus, if the coefficient of this variable will be significant it can be concluded that deleting the non-positive values of the dependent variable will lead to bias. It should be noted that even if the coefficient of this variable is insignificant, deleting the non-positive values of the dependent variable leads to the estimation of unbiased but inefficient coefficients. In this study

regarding the fact that only a small number of manufacturing firms of Iran have non-zero exports and for large amounts of sample, the dependent variable is zero value therefore these two methods have been used.

RESULTS AND DISCUSSION

In this part before the model estimation, based on the firm level data, the relationship of some explanatory variables with exports of firms is described. In Table 1, export intensity average and it's standard deviation is shown in three categories of small businesses (with 1-10 employees), medium (11-50) and large firms (>50). As can be seen as the firm size increases in terms of the employee's number, the firm export intensity average also increases considerably. In Table 2, the export intensity average compared between firms that have R&D expenditures and firms that do not have R&D expenditures. According to this table, export intensity average of exporting firms with R&D expenditure was higher than the other firms. Table 3 also showed that the firms being private unexpectedly does not lead to higher export but also as compared to the public sector, private firms have lower export intensity average. In Table 4, the average annual expenditure of communications and information in two categories of exporting and non-exporting firms is compared. As can be seen, the costs rate are obviously higher in exporting firms.

Table 1: Firm's size and export

| | | Export to sale ratio | |
| | Firms number | --- | --- |
Employee number	in sample	SD	Average
1-10	637	0.11	0.013
11-50	7752	0.14	0.031
51 employee and more	3912	0.16	0.047

Table 2: R&D expenditure and export

| | | Export to sale ratio | |
| | Firm number | --- | --- |
Firm R&D status	in sample	SD	Average
Firms with R&D expenditure	4276	0.15	0.040
Other firms	8025	0.14	0.026

Table 3: Firm's ownership and export

| | | Export to sale ratio | |
| | Firm number | --- | --- |
Ownership	in sample	SD	Average
Non-governmental	11883	0.14	0.030
Governmental	418	0.14	0.040

Table 4: Firm export and ICT expenditures (£)

Firm export status	Firm number in sample	ICT average costs
Non exporting	11131	17983756
Exporting	1179	45286094

Census of manufacturing firms statistic center of Iran 2011

Table 5: The estimating results of factors affecting on export using Tobit Method

Sample (variables)	Total sample		Large firms		Small and medium firms	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
ICT	0.21	10.05*	0.19	10.07*	0.21	5.21*
Size	0.26	18.59*	0.12	15.27*	0.37	8.34*
R&D	0.14	5.40*	0.11	4.18*	0.6	4.45*
O	0.08	1.25	0.03	0.89	0.18	2.90*
Intercept	-1.52	-2.86*	-1.72	-3.45*	-1.05	-0.78
LR χ^2	759.44		251.86		132.23	
Pseudo R^2	0.14		0.0		0.15	
Log likelihood	-3341.31		-58.87		-1687.41	
Observations number	Censored	11122.00	Censored	3119.00	Censored	7997.00
	Not censored	1179.00	Not censored	787.00	Not censored	392.00

*Significant at 99% confidence level

After descriptive analysis of the issue in this part, the study model is estimated by using Tobit Model. The results are reported in Table 5, column 1. Second and third columns of this table, respectively show estimation results in small and medium firms (under 50 people) and large firms (50 employees and more). The results are as follows:

- The ICT variable coefficient (logarithm of information and communication expenditure) has a positive and significant coefficient in all three examples that illustrate the significant effect of this variable on the firm entry probability into global markets
- Size variable (logarithm of the firm's workforce) in all three samples has positive and significant coefficient. This phenomenon shows that larger firms have more probability to enter into export markets
- The coefficient of research and development dummy variable in all three samples is positive and significant. This indicates R&D role in promoting innovation in firms and increase product quality and quantity and thus the firm profitability and competitiveness
- The coefficient of ownershipdummy variable indicates a positive but insignificant effect of firm ownership by non-governmental sector on export in the total sample and among large firms. In thefirms with <50 numbers of employees this variable has a significantly positive effect on exports. Therefore, the private sector only in smaller firms operates efficiently and in large firms ownership of private sector has had no significant effect on exports. In total of the sample, the effect of this variable is also insignificant

LR χ2 coefficient indicates significance of all variables in the estimations. Since, in Tobit Model the estimated coefficients reflect only the impact direction of the explanatory variables on the probability of the dependent variable and not have value interpretation, it is

Table 6: MarginalEffects of Tobit Method

Sample (variables)	Total sample	Large firms	Small and medium firms
ICT	0.021	0.016	0.029
Size	0.034	0.039	0.032
R&D	0.013	0.000	0.010
O	0.009	0.005	0.008

Table 7: Model estimating using Heckman Method

Sample (variable)	Probit Model		Linear Regression Model	
	Coefficient	t-statistic	Coefficient	t-statistic
ICT	0.26	6.93*	0.0040	8.75*
Size	0.47	16.74*	0.0050	2.39
R&D	0.21	9.32*	0.0008	1.02
O	0.12	1.08	0.0070	3.24
Intercept	-3.52	-3.37*	-1.9200	0.93
Revers MILLS ratio λ			1.05	1.90**
χ^2 statistic			8.7 prob. (0.1938)	

*Significant at confidence level of 99%; **Significant at confidence level of 95%

the marginal effectsthat can be interpreted in terms of value. To determine the effect rate of each explanatory variables on the probability of the firms exporting their marginal effectsis estimated as shown in Table 6. Marginal effects show amount of change probability of dependent variable per unit change in the explanatory variables. Therefore, based on this table for one percentage change in ICT, the firm's exports value of increased 0.021, respectively. This amount in large firms is 0.016 and in medium-sized firms is 0.029. Thus, the ICT impact on small and medium-sized firms is higher.

After model estimation by using Tobit Method in this section the research model is estimated using Hackman Method. This estimation results are presented in Table 7. As mentioned previously there are two regressions in this method. In probit regression, the factors affecting on export probability andin linear regression the factors affecting on export intensity are determined. Results of this estimation are as follows:

Probit regression: Among the explanatory variables, logarithm of communications and Information expenditure (ICT), the firm size and research and development

expenditures have significant and positive effect on the probability exporting. Effect of the dummy variable of ownership is positive and insignificant.

Linear regression: Among the explanatory variables, three variables of ICT, size and O have significant effect on the export intensity of firms. ICT positively affects on export intensity so that for one percent increase in information and communication expenditures, the firm export intensity increases 0.004. Size effect on export intensity is positive and with 1% increase in this variable, export intensity increases to the rate of 0.005. Thecoefficient of ownership dummy variableis equal to 0.007 and indicates that state-owned enterprises export intensity is higher.

Revers Mills ratio coefficient is significant in Linear Regression Model that indicates the need to use Heckman Method to avoiding sample selecting bias. Results of Wald test at the end of Table 7 shows there is no problem of variance heteroscedasticity in Hackman Model.

CONCLUSION

The present study, using statistic data from 12301 firms that have been resulted from the Census of manufacturing firms made by Iran Statistics Center and also applying estimating methods of discrete models has investigated the ICT expenditure effect along with some of the most important factors affecting export performance of manufacturing firms in Iran has come to the following conclusions:

- The firm's size has a significant and positive effect on the probability and intensity of firm export in the Iranian Manufacturing sector. This conclusion emphasized on the need for applying supportive policies to growth in small manufacturing firms
- The R&D expenditures have significant and positive impact on the probability of the firms exporting. As a result, financial and political support of research and development activities in manufacturing enterprises can be useful in enabling them to enter the global markets
- Unexpectedly, the private sector performance in the field of exports in comparison to the public sector is not only unsatisfying but also the state agencies have more average export than the non-governmental firms. Although, this phenomenon may be due to the larger size of the state agencies, it also indicates lack of efficiency of the private sector in the Iran industry. Regarding that a large number of manufacturing workshops administrate by NGOs including the

private sector and cooperatives, developing these sectors and doing appropriate actions to increase the efficiency of these sectors can be effective in increasing manufacturing exports.

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