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Effect of Productivity on Export: New Evidence from Iran's Manufacturing Industries

Saeed Rasekhi*
Department of Economics, Faculty of Economics and Administrative Sciences, University of Mazandaran, Babolsar, Iran
Zahra Mojdeh
Department of Economics, Faculty of Economics and Administrative Sciences, University of Mazandaran, Babolsar, Iran

Abstract
Based on the recent literature of heterogeneous firms, productive firms self select themselves into foreign markets. In this framework, there is a productivity rise prior to exporting. On the other words, different export performance across firms is linked to their heterogeneity.

The main purpose of the present paper is to examine the so-called hypothesis of heterogeneous firm in Iran. For this, we have used the last Iranian manufacturing industries data at 4 digit aggregation of ISIC classification during 2000-2010 and examined the hypothesis by using generalized method of moments. The obtained results show that productivity has a relationship with export in both short and long run. So, productivity enhances the competitiveness of the firms in international markets and then firms with high productivity enter global market and consequently export increases. Based on the results, the hypothesis is verified. Regarding to the importance of export in economic development, we suggest that it should be paid more attention to productivity in industrial development policies.

Keywords: Heterogeneous Firms, Total Factor Productivity, Exports, Manufacturing Industries, Iran.

JEL Classification: F12, L1.

* Corresponding Author, Email: srasekhi@umz.ac.ir.

1. Introduction

One of the most important objectives of any country is to achieve economic growth and development, among which the international trade expansion and entry to export markets are especially important as a means of optimizing the use of available resources. However, competitiveness, success in entering foreign markets and competition with different firms require increased productivity. Without continuous monitoring costs and improving product quality, it is not possible to compete in the world markets.

Under the heterogeneous firms hypothesis, better performance of firms especially as regards the exports is mainly attributed to their higher productivity, because it typically results in lower prices and better product quality, and ultimately, greater firm competitiveness in the international trade.[1] In addition, higher productivity enables firms to bear more costs in comparison to other firms and therefore have a greater ability to enter export markets (Aw et al., 2000). In contrast, unlike firms with high productivity, activities of firms with low productivity are expected to be limited to the domestic market (Melitz, 2003). Of course, in addition to productivity, exports are also possible to promote in other ways. For instance, research and development expenditure can be noted, which through the improvement and creation of technology, allow firms to produce more diverse, newer, and higher quality products, and to gain a greater share of the domestic and foreign markets (Aw et al., 2000).

Although valuable studies have been performed at the macro level on the relationship between productivity and exports, according to a review of domestic empirical studies, no study appears to have been performed on testing the hypothesis of heterogeneous firms in Iran. Komijani and Haji (2012) studied the country's economic growth for the period 1949-2010 and concluded that there is a significant positive relationship between productivity, economic growth and exports. Heyman et al. (2012) examined the productivity of exports and agribusiness specialization in ECO member countries during the period 1998-2007, and concluded that economic liberalization is the most important factor in the productivity of exports. Pourebadollahan Covich et al. (2010) examined the pattern of specialization in trade and export productivity in OPEC member countries. The results of the study for the period 1995 to 2006 reflect the concentration of the studied countries on exports with low productivity. Asnaashari et al. (2010) examined the relationship between foreign trade and factor productivity in Iran's agricultural sector. According to the study, which was conducted for the period 2006-2008, productivity has a positive effect on foreign trade of Iran's agricultural sector. Yavari et al. (2010) examined the relationship between export diversification and productivity, separated by the nine industries, and concluded that productivity and exports in Iran are similar to each other. Shahabadi (2007) examined the effect of foreign direct investment, international trade and human capital on the total factor productivity of the Iranian economy.

According to this study, the index of openness degree is among the factors that, compared to others, has a greater effect on the total productivity of factors of production. Lotfali-pour et al. (2007) examined the relationship between productivity, production and export of agricultural products during the period 1981-2004 and concluded that productivity growth has a positive effect on export growth in Iran's agricultural sector. Hosseininasab and Ghoochi (2007) have analyzed the impact of economic openness on the productivity of manufacturing industries in Iran, using the data from nine manufacturing industries during the period 1994-2000. Based on the generalized least squares (GLS) method, findings of this paper implicitly implies the foreign trade liberalization as an important factor in increasing productivity.

Fan et al. (2012) tested how the effect of credit constraints on the relationship between the price of exported goods and the firm productivity. According to the Melitz model (2003), these researchers found a U-shaped relationship between productivity of Chinese firms and the price of their exported goods. Also, in this study, credit constraints were found to have a significant effect on the relationship between the export prices and firm productivity. Thomas and Narayanan (2012) examined the heterogeneity and entry into exporting of Indian firms during the period 1990-2009. Their findings showed that exporters have higher productivity than other Indian firms. Using data from Portuguese firms during the period 1996-2003, Silva et al. (2010) found that firms with higher productivity can enter export markets. Shevtsova (2010) tested the relationship between productivity and exports, using a sample of Ukrainian manufacturing industries during the period 2000-2005. Based on the results obtained with the generalized method of moments, firms with higher productivity are more likely to enter the export market. Lu and Tao (2007) found different patterns of firm productivity and export behavior among Chinese local firms and foreign

[1] For more information, see Melitz and Ottaviano (2008).

multinationals in China, using the annual data of China's industrial enterprises for the period 2005-1998. They showed that although exporters have higher productivity than other local firms, the results were quite different for multinational corporations. Hiep and Ohta (2007) used panel data in the manufacturing sector in Vietnam, to examine factors affecting firms' decisions to export and showed that firm size, firm age and foreign ownership are positively related to the export probability of firms, while total factor productivity has no statistically significant effect. Damijan and Kostevc (2008) tested the effect of productivity on exports and foreign direct investment for Slovenian industrial workshops during the period 1994-2002. The results of the generalized method of moments indicate that firms with higher productivity can enter the export market. Biesebroeck (2006) tested the relationship between productivity and exports for nine African countries (including Ethiopia, Tanzania, Burundi, Zambia, Kenya, Ghana, Cote d'Ivoire, Cameroon and Zimbabwe) during the period 1992-1996. The results of this study, which used the generalized method of moments, show that exporters have higher productivity in these countries. Baldwin and Gu (2003) tested the relationship between productivity and exports for Canadian manufacturing industries during the period 1974-1996. The results of the generalized method of moments indicate that firms with higher productivity can enter the export market. Bernard et al. (2003) evaluated the performance of U.S. firms in response to changes in trade costs over the period 1987-1997. The results of the Probit model suggest that productivity growth is higher for firms that are faced with a reduction in trade costs, and these firms are more likely to export.

Given the importance of productivity in the export development of firms, the small number of relevant empirical studies, and the importance of export development for Iran, this paper examines the hypothesis of heterogeneous firms. For this purpose, the generalized method of moments (GMM) and the very last data for the manufacturing industry were used at the four-digit ISIC level during the period 2000-2010. Literature is presented in Section II, and Section III is devoted to model and analyze it. Results and policy implications will be presented in the final section of this paper.

2. Related Literature

The heterogeneity of firms, which arises from the difference in productivity between them, was added to the Krugman's intra-industry trade model (1980) by Melitz (2003), which was presented in the context of a dynamic partial equilibrium model, but assuming Imperfect competition market based on Hopenhayn (1992). He found that only firms with higher productivity can enter export markets, while firms with lower productivity only have the power to produce for the domestic market. At the same time, firms with the lowest productivity are forced to exit the market.

To prove his claim, Melitz (2003), on the demand side, considers the utility function with constant elasticity substitution (CES) for the typical consumer preferences, as follows:

$$U = \left[\int_{\omega \in \Omega} q(\omega)^{\rho} \, d\omega \right]^{\frac{1}{\rho}} \quad (1)$$

where, ω and Ω represent a chain of goods and collection of available goods. In this model, goods are deemed to be substituted together. Now, according to the characteristics of the CES utility function for substitutions can be written

$$\delta = \frac{1}{1-\rho} > 1 \Rightarrow 0 < \rho < 1 \quad (2)$$

where δ is the elasticity of substitution between goods.

According to the study of Dixit and Stiglitz (1977), he derived the optimal consumption (Equation 3) and the individual consumption expenditure (Equation 4) as follows, considering the aggregate expenditure as $R = PQ = \int_{\omega \in \Omega} r(\omega) d\omega$ and the general price index in the form of $P = \left[\int_{\omega \in \Omega} p(\omega)^{1-\sigma} \, d\omega \right]^{\frac{1}{1-\sigma}}$:

$$q(\omega) = Q \left[\frac{p(\omega)}{P} \right]^{-\sigma} \quad (3)$$

$$r(\omega) = R \left[\frac{p(\omega)}{P} \right]^{1-\sigma} \quad (4)$$

where, Q and $p(\omega)$ are total consumption and price of goods ω, respectively.

In the supply side, by assuming n countries and lots of foundations, and according to the rule of mark-up and by normalizing the rate of wage to 1, he provided the rule of pricing based on the equation below:

$$p(\varphi) = \frac{w}{\rho \varphi} = \frac{1}{\rho \varphi} \quad (5)$$

3e4r5twhere, φ denotes the productivity level of each firm.

Using the equations 3, 4 and 5, the equilibrium situation is obtained as follows:

$$r(\varphi) = R(P\rho\varphi)^{\sigma-1} \quad (6)$$

$$q(\varphi) = Q(P\rho\varphi)^{\sigma} \quad (7)$$

where, R and Q are the revenue and total production of firms in each country respectively; and *r(φ)* and *q(φ)* are the revenue and production rates of each firm, respectively, which is a function of the productivity level of the firm. Now, according to the Equations 5 and 7, it can be concluded that the ratio of products and revenues of two hypothetical firms depend on their relative productivity:

$$\frac{r(\varphi_1)}{r(\varphi_2)} = (\frac{\varphi_1}{\varphi_2})^{\sigma-1},\ \frac{q(\varphi_1)}{q(\varphi_2)} = (\frac{\varphi_1}{\varphi_2})^{\sigma} \quad (8)$$

In other words, firms with higher productivity will be bigger in terms of production rate and revenue and can make more profits than firms with lower productivity, with lower prices.

Then, Melitz derives the firm's profit function as follows, with the assumption of labor as an only factor of production, by normalizing the wage rate to one:

$$\pi(\varphi) = r(\varphi) - l(\varphi) \quad (9)$$

In this model, production cost is composed of two parts of fixed cost and variable cost, namely

$$l(\varphi) = f + \frac{q(\varphi)}{\varphi} \quad (10)$$

Assuming that $r(\varphi) = q(\varphi)p(\varphi)$ is considered as revenue of each firm, Equation (10) is rewritten as follows,

$$l(\varphi) = f + \frac{r(\varphi)}{\varphi p(\varphi)} \quad (11)$$

According to the equations 5 and 11, we have

$$l(\varphi) = f + \rho r(\varphi) \quad (12)$$

The following equation is obtained by combining the equations 2, 9 and 12,

$$\pi(\varphi) = r(\varphi) - \rho r(\varphi) - f = (1-\rho)r(\varphi) - f \quad (13)$$

$$\pi(\varphi) = \frac{r(\varphi)}{\sigma} - f \quad (14)$$

Now, by introducing *Φ* as break-even or threshold productivity, in which the firm profit rate is equal to zero, it can be written

$$\pi(\varphi^*) = 0 \quad (15)$$

Obviously, in the productivity level lower than the threshold level, or φ*, the firm is faced with a negative profit due to the presence of fixed cost f, and then, will stop production and exit the market. In this case, we can easily show that

$$r(\varphi^*) = \sigma f \quad (16)$$

Now, using the equations 6 and 16, the firm's revenue from the domestic market for the threshold level of productivity will include

$$r_d(\varphi^*) = (\rho\varphi^*)^{\sigma-1} RP^{\sigma-1} = \sigma f \quad (17)$$

According to Equation 5, the price in the domestic market will be equal to $p_d(\varphi) = \frac{1}{\rho\varphi}$. However, due to costs such as transport costs, tariffs and packaging costs, the exported goods will be priced by the exporter, with a higher rate, which is equal to τ times of goods in the domestic market. So, we have

$$p_x(\varphi) = \frac{\tau}{\rho\varphi} = \tau p_d(\varphi) \qquad \tau > 1 \quad (18)$$

By substituting Equation 18 into Equation 17, revenues from exports to each country will be equal to

$$r_x(\varphi_x^*) = \tau^{1-\sigma}(\rho\varphi_x^*)^{\sigma-1} RP^{\sigma-1} = \tau^{1-\sigma} r_d(\varphi^*) = \sigma f_x \quad (19)$$

where, φ_x^* is the break-even productivity in the export market and represents the threshold of exports. In other words, firms with the level of productivity lower than φ_x^* will not enter the export market. In the above equation, f_x is also the fixed cost of investment in export markets. Thus, the composition of the firm's revenue depends on its export status:

$$r(\varphi) = \begin{cases} r_d(\varphi) & x = 0 \\ r_d(\varphi) + nr_x(\varphi) & x > 0 \end{cases} \quad (20)$$

Profits from each firm can be also separated into two portions earned from domestic sales, ($\pi_d(\varphi)$), and export sales ($\pi_x(\varphi)$):

$$\pi_d(\varphi) = \frac{r_d(\varphi)}{\sigma} - f$$
$$\pi_x(\varphi) = \frac{r_x(\varphi)}{\sigma} - f_x \quad (21)$$

In this context, a firm that produces for its domestic market can export to all n countries if $\pi_x(\varphi) \geq 0$. Thus, combined profit of each firm can then be written as follows:

$$\pi(\varphi) = \pi_d(\varphi) + \max\{0, n\pi_x(\varphi)\} \quad (22)$$

From the equations 13 and 14, it can be concluded that

$$\pi_d(\varphi^*) = 0$$
$$\pi_x(\varphi_x^*) = 0 \quad (23)$$

Also, by combining the Equations 17 and 19, the relationship between break-even productivity for manufacturers in the domestic market and break-even productivity for producers that are active in export markets can be obtained as follows,

$$\varphi_x^* = \Lambda\varphi^* \qquad \Lambda \equiv \tau\left(\frac{f_x}{f}\right)^{\frac{1}{\sigma-1}} \quad (24)$$

If $*\varphi = \varphi x^*$, then all firms in the industry can export for productivity levels above the production threshold. In this case, according to Equation 22, the total profit will be equal to zero at the productivity threshold. However, If $^*\varphi > \varphi_x^*$ ($\Lambda > 1$), then firms with productivity levels between φ^* and φ_x^* only produce for their domestic market, earn nonnegative profits exclusively from their domestic sales and have negative export profits, so they cannot enter the export market. However, the firms with productivity levels above φ_x^* earn positive profits from both their domestic sales and export sales. Thus, such firms will enter the export market, in addition to producing for the domestic market. For productivity levels lower than φ^*, firms will never produce goods.

Thus, firms with high productivity can export, while firms with average productivity will only operate in the domestic market, and firms with low productivity exit the market.

Melitz and Ottaviano (2008) also provided a business model by assuming monopolistic competition market, the presence of heterogeneous firms (in terms of differences in productivity) and endogenous differences in the intensity of competition in the markets in different sizes. They argue that in markets of different sizes, the number of competing firms and their productivity are different from each other, which also provides feedback in the selection of heterogeneous firms. According to this model, the larger market size can result in more intense competition, which leads to lower prices and higher productivity. Increased productivity also leads to better performance of firms, especially as regards exports. Findings of the Melitz and Ottaviano model are very similar to the Melitz model.

3. Empirical Model: Estimation Results

Research model is based on the generalized Method of moment (GMM) as follows:

$$Export_{it} = \beta_0 + \beta_1 TFP_{it} + \beta_2 Capital_{it} + \beta_3 Labour_{it} + \beta_4 Open + \varepsilon_{it} \quad (25)$$

The dynamic form of the model is rewritten as below,

$$Export_{it} = \beta_1 Export_{it-1} + \beta_2 TFP_{it} + \beta_3 Capital_{it} + \beta_4 Labour_{it} + \beta_5 Open + \varepsilon_{it}$$
$$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5 > 0 \quad (26)$$

where $Export_{it}$ and $Export_{it-1}$ are exports of firm i in years t and t-1, respectively; TFP_{it}, the total factor productivity (Kendrick index) of firm i in year t; $Capital_{it}$, the capital stock of firm i in year t; $Labour_{it}$, the labor of firm i in year t; and $open_{it}$, the degree of economic openness of firm i in year *t*.

Based on the heterogeneous firms hypothesis, better performance of firms particularly for exports, is mainly attributed to their higher productivity. Specifically, higher productivity leads to lower prices and higher quality of product, and ultimately, greater competitiveness of firms in international trade (Melitz and Ottaviano, 2008). In addition, because of higher productivity, the firms of this kind are able to bear more costs compared to other firms and therefore will have a greater ability to enter the export market (Aw et al., 2000). In addition, capital stock results in increased production and thereby increased exports (Baldwin and Gu, 2003).The level of employment in firms is also an indicator of firm size. Larger firms will increase production and exports, and reduce production costs (Schor, 2004). The degree of openness, which is derived from the ratio of imports to sales of a firm, is considered in the studies as a catalyst for new technologies and leads

to better production and more exports (Silva et al, 2010).

The latest raw data at the four-digit ISIC classification level during the period 2000-2010 were used to collect the data. The data on exports and imports of Iran Customs were received at six-digit HS classification level and were processed and used after converting to four-digit ISIC classification level.

We used the Arellano-Bond (difference) method to estimate a model and the instrument matrix to eliminate the correlation of lagged variable and other explanatory variables. It should be noted that since the effect of productivity on exports is considered in both long and short run, the best approach is to use a two-step GMM estimator. In this method, the short-term effects can also be possible to examine by entering the lagged or time-lagged variable in the right side of the model.

Table (1) provides the results of estimating the model for the manufacturing industries in Iran during the period 2000-2010 using the GMM method. The model estimated in this table seems to be econometrically appropriate. Specifically, based on the Wald test, which is done for the validity of coefficients, the null hypothesis of zero coefficients is rejected. In addition, in the generalized method of moments, Sargan test is used for the validity of the instrument matrix and over identify test in which the null hypothesis indicates a lack of correlation between tools with disturbing elements.

$$J\text{-statistic} = \chi^2(r-k) \quad (27)$$

In the above equation, r is an instrumental variable rank; k is the number of estimated variables; and $J\text{-statistic}$ and χ^2 are the J-statistics and chi-square statistic of the Sargan test. According to this equation, the Sargan test statistic is equal to 0.968, which is indicative of the validity of the instrument matrix.

Table 1: Results of Estimating the Heterogeneous Firms Model for the Manufacturing Industries in Iran during the Period 2000-2010 Using the GMM Method

Variable	Coefficient	Standard error	t-Statistics	Prob
Export(-1)	1.071	0.0025	427.512	0.0000
TFP	0.131	0.0022	59.417	0.0000
Capital	0.05	0.0067	7.616	0.0000
Employees	0.029	0.0017	16.69	0.0000
Openness	47.393	5.786	6.984	0.0000
J-Statistics			30.003	
Instrumental Variable Rank			36	
Wald Test			0.0000	
Sargan Test			0.968	

***Source*:** Authors

According to Table (1), and as expected, the model variables (including the levels of productivity, investment, employment, and higher openness degree of firms) have a positive significant effect on their exports. Also, as shown in Table 1, the effect of productivity on exports has remained constant over time. It should be noted that, according to Arellano and Bond, two effects can be distinguished: short-term or contemporaneous effect, which is characterized by the coefficient of variables; and long-term effect, which is obtained from the sum of current variable rate and delay variable coefficients. If both coefficients have the same sign, it will indicate that the effect of productivity on exports has remained constant over time. The result also indicates that the dynamics of exports over time, so that the effect of exports in the current period will be extended to the next period.

Overall, the hypothesis of heterogeneous firms is confirmed for manufacturing industries in Iran, and firms with higher productivity are expected to enter the export market.

4. Conclusion

This paper has tested the hypothesis of heterogeneous firms for the manufacturing industries in Iran. For this purpose, the total factor productivity of industrial enterprises in Iran was measured at the four-digit ISIC classification level with Kondrick method; and, in addition to control variables, its effect on the exports of these firms during the period 2000-2010 was then estimated

and evaluated according to the GMM method.

According to the results obtained, the greater productivity of the firm will lead to higher exports, and firms with higher productivity are expected to be more likely to enter the export market. Other results of this paper show that firm size, the amount of capital stock and labor, as well as the degree of openness have positive significant effect on the exports of manufacturing industries in Iran.

In the context of the research, policies to improve productivity are needed to increase exports, given the world export growth and Iran's backwardness in these circumstances.

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