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DETERMINANTS OF TOTAL FACTOR PRODUCTIVITY OF INDUSTRIAL ENTERPRISES IN RED RIVER DELTA REGION OF VIETNAM

***Dong Thi Thuy Linh**

Institute for Indian and Southwest Asian Studies, Vietnam Academy of Social Sciences (VASS).

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ABSTRACT

The study uses the system-GMM two step to analyse the determinants of Total Factor Productivity of industrial enterprises in Red River Delta. The estimated results show that the factors that positively affect TFP of industrial enterprises in Red River Delta region are: export activities, firm size, Information and Communication Technologies index (ICT index), real average monthly salary per employees. The factor that negatively affects TFP of industrial enterprises in this region is the firm age.

Keywords: determinants, Total Factor Productivity (TFP), enterprise, Vietnam.

INTRODUCTION

Total factor productivity (TFP), which reflects how efficiently a firm uses all means of production (total inputs) to produce outputs. Therefore, TFP is a measure of production efficiency of enterprises, a basis for production expansion and an important factor to ensure the quality of growth in depth, to ensure sustainable development as well as to improve competitiveness of enterprises. In 2016, the Ministry of Industry and Trade of Vietnam approved the Industrial Development Planning of the Red River Delta Region to 2025, with a vision to 2035. The objective of the Plan to 2025 is to develop the industry in the Red River Delta with modern technology, having competitiveness in integration. Besides, the products of this region are of high quality and friendly to the environment; be able to basically meet the requirements of the economy and export. In order to achieve these goals, it is extremely necessary to analyze TFP and its determine of the industrial enterprises in the Red River Delta. Analysing TFP and its determinants enables the understanding of which factors policymakers and firm managers should target in order to improve TFP growth.

LITERATURE REVIEW

The assessment of factors affecting TFP growth at the micro level has been mentioned by many researchers. When studying the factors affecting TFP, most researchers point out the following key factors:

Export activities

One factor that affect TFP is export activity. Regarding this relationship, there seem to be two opposing views. The first view holds that TFP is likely to determine whether a firm exports into a new market or not because only the productive firms can able to pay the sunk costs when participating in the export market. It is the "self-selection" view. The opposite of "self-selection" is "learning by exporting" view. In this view, a firm learns how to be more productive and competitive through exporting. The more it exports, the more the firm is able to increase productivity. This is because by entering foreign markets, a firm faces a large number of competitors. To survive in such an environment, the firm will need to continuously improve productivity by taking measures to increase TFP. Furthermore, exporters can benefit from the trade interactions that exports bring, as noted by Grossman and Helpman (1991). De Loecker (2007) used a dichotomous dummy variable as proxy for the firm's probability to start exporting. By using firm-level data for 7,915 Slovenian manufacturing firms during the period of 1994-2000, he found that firms experienced productivity increases after starting to export, an effect that increased in the following years. Exporting firms were found to be 8.8% more productive on average. Ortega et. al (2013) studies the relationship between exports and the productivity of Chilean firms through four main hypotheses: self-selection hypothesis (where high productivity encourage exports), learning-by-innovating hypothesis (in which exports increase productivity), exporting-by-innovating hypothesis (where R&D is the determinant of exports)) and the Innovating-by-exporting hypothesis (whereby exports promote innovation practices). They find that exports affect productivity more than productivity affects exports.

Firm age

A firm is expected to become more productive as it ages, this is known as the "survival effect". As a firm matures, it accumulates knowledge according to a process defined by Arrow (1962) as "learning by doing", which create improvements in TFP. "Learning is the product of experience. Learning can only take place through the attempt to solve a problem and therefore only takes place during activity" (Arrow, 1962, p.155). This suggests that a firm's knowledge acquisition occurs not only through iterative processes in production, but also through solving problems encountered during operations. In addition, "as plants age, managers accumulate experience, gain from learning by doing, undertake new investments, or achieve economies of scale, all of which can improve plant-level productivity vel" (Jensen et al., 2001, p. 323). Furthermore, over time, firm become more knowledgeable about the markets in which they operate and learn how to better respond to customer needs, input sources and process them. Jensen et al. (2001) proposed a relationship between TFP and firm age. The authors argue that new firms entering an industry may be more productive than existing firms. This is because new firms can use more recent and innovative methods or technologies. As a result,

***Corresponding Author: Dong Thi Thuy Linh,**
Institute for Indian and Southwest Asian Studies, Vietnam Academy of Social Sciences (VASS).

older firms are less productive than younger firms because of the so-called "vintage effect." Marshall (1890) also indicatedthat older firms can stagnate, making it impossible for them to adjust as quickly to the dynamic market environment as their younger firms. Hannan and Freeman (1984) also suggest that a firm's negative actions are often due to the so-called "inertia effect", whereby firms are unable to adjust their structure and strategies in a dynamic environment, making it impossible for them to exploit the opportunities offered by the environment. In summary, the above arguments suggest that there is no unilateral relationship between firm age and TFP but rather a positive relationship due to the "survival effect" or a negative relationship due to the "vintage" or "inertia" effect. Majumdar (1997) studied a sample of 1,020 Indian firms to analyze the effects of firm size and firm age on productivity and profitability over the period of 1998-1994. Firm age is measured by the number of years that the firm's data has been recorded in the database. The results show that older firms are more productive than younger firms, while being less profitable. From these results, it is inferred that the more mature a firm becomes, the more efficient it becomes. This shows that older firms have learned a lot through the work process would become experienced. This is completely consistent with the study by Jensen et al (2001), which showed the existence of a "survival effect". However, India has a different institution from the United States, which is characterized by greater barriers to entry and exit of the industry. Another study in a developing country, Fernandes (2008) analyses 575 manufacturing companies in Bangladesh in five different manufacturing industries and found a non-linear relationship between firm age and TFP. This finding suggests that firms are likely to start off at a low level of productivity, then increase over time as firms "learn" by making investments, entering new markets and updating new technology. At a certain age, companies reach the "maturity stage", from which their productivity declines as their knowledge becomes obsolete. Coad et al. (2013) analyzed the relationship between firm age and various measures of productivity. This was done with a sample of 62,259 Spanish manufacturing firms from 1998 to 2006. Similar to Fernandes (2008), Coad et al. (2013) found that as firm become older, they improve their productivity levels in addition to increasing profits, growing in size, and using less leverage. On the other hand, at a certain age, firms begin to experience a decrease in efficiency in terms of increasing productivity, sales and profits.

Salary

The salary factor also has an impact on TFP growth. Gehringer et. al (2013) examines the factors that increase the TFP of 17 EU countries in the period 1995-2007. They find that wages (wage unit, salary per worker) are the main factor that impact on TFP growth. They assume that productive workers are paid more and therefore industries that employ higher productive workers also have higher TFP. Although the studies mentioned above provide quite in-depth analysis, these studies still have certain limitations. There are many factors that impact prodcutivity, and these factors often interact and create synergies. Studies that analyze multiple factors affecting productivity often differ from the studies mentioned above in terms of estimation methods, samples adopted, and influencing factors included in the analysis. Yao et al. (2007) considered factors affecting TFP including: firm size, company ownership, direct sales and human resources. Empirical results show that firm size, direct sales, and human capital have a positive effect on firm productivity. However, contrary to the previous studies on ownership, state-owned companies show better performance than non-state owned ones.

METHODOLOGY

Model

In this study, TFP is measured through a log- linear Cobb-Douglas production function, which includes fixed effects:

$$y_{it} = \beta_i + \beta_K k_{it} + \beta_L l_{it} + \beta_X X_{it} + \varepsilon_{it} \quad (1)$$

In which, y, k, l are the natural logarithm of the company's revenue, capital and labor, respectively for each company i at time t (where i = 1,..., N and t = 1,...,T). X_{it} is a vector including variables affecting TFP such as: export, firm age, firm size, Information and Communication Technologies index (ICT index) and real average monthly salary per employees. All of these variables are included in the model because the results of previous studies show that these factors positively or negatively affect TFP. Although one of these variables can be correlated, not including these variables will create the problem of omitted variable bias, leading to biased and inconsistent estimates. β_i time-invariable, unobserved, firm-specific fixed effect and ε_{it} is an observation-specific error term. When TFP is estimated through equation (1), the elasticity of output for each input factor (labor and capital) is measured. This allows the measurement of TFP as a residuals or the output levels that are not attributable to the level of factor inputs.

$$\ln\widehat{TFP_{it}} = y_{it} - \beta_K k_{it} + \beta_L l_{it} = \beta_i + \beta_X X_{it} + \beta_T t + \varepsilon_{it} \quad (2)$$

Harris and Moffat (2013) suggest that a common mistake in previous TFP studies lies in excluding the vector X_{it} in the regression when estimating equation (1) and then using equation (2) to measure TFP. In this case, the vector X_{it} becomes part of the error term ε_{it}. The TFP then tends to be regressed on the vector X_{it} to obtain the determinants of the TFP through two-stage estimation. Since X_{it} is omitted initially, this will cause the estimates to be biased, creating bias by omitting the variable. The original equation (1) is estimated through the SYS-GMM method. Compared with other method, the SYS-GMM method accepts fixed effects. Furthermore, SYS-GMM solves the problems of endogeneity and selection bias by using the lagged first-differential as instrument for the equation in level, besides the lagged level as instrument for the equation in first-differences. The use of instrumental variables makes the estimated results will be more efficient and statistically significant. Furthermore, the SYS-GMM method accepts both endogenous regressors and a first-order autoregressive error term and the SYS-GMM method also provides the results of three tests: Hansen test on the validity of the instrumental variable used and autocorrelation test, namely AR (1) and AR (2). To test the suitability of the SYS-GMM method, the study applies two tests namely Sargan (also known as Hansen test or J test) and Arellano-Bond. Hansen test determines the appropriateness of the instrumental variables in the model. This is a test of the overidentifying restriction of the model. The Ho of Hansen's test is that instrumental variable is exogenous, that is, it is not correlated with the error term. Therefore, the higher p-value is better. The Arellano-Bond test was proposed by Arellano-Bond (1991) to test the autocorrelation of the GMM model in the form of first difference. Therefore, the survey difference series is implicitly correlated order 1, AR(1), so the test results are ignored. The 2nd order correlation, AR(2) is tested on the difference series of the error to detect the autocorrelation of the error at order 1, AR(1). Because of the validity of lagged level dated t - 2 in first-differenced equations tends to be rejected by Hansen's test, the lagged level dated t- 3 (and before) are used, as these levels are tended to be accepted. This is combined with lagged first-differences dated t – 2 which are used as instrumental variables in the level equation and tends to be accepted by Hansen's test. To run the SYS-GMM model, this thesis uses Stata

software by performing the command xtabond2 which given by Roodman (2006).

Variables and descriptive statistics

Dependent variable is production output, in this study, this variable is measured by the company's revenue. Independent variable: as part of the production function, the vector X_{it} includes the following TFP determinants: exports activities, firm age, firm size, Information and Communication Technologies index (ICT index), real average monthly salary per employees

Export

By exporting, a company is expected to be more productive as it faces a large number of competitors, which in turn motivates the company to take measures to improve TFP. Moreover, the company is also likely to benefit from the commercial interactions that exports bring. Those interactions can include exposure to economic authorities abroad, learning from customer feedback, and observing modern technologies, innovative products, and how competitors work. To measure the impact of exports on TFP, a firm's export performance is determined by a dummy variable (EX). This variable takes a value of 1 when a company has export activity and takes a value of 0 if company has no export activity. Based on the experimental results published by Sun and Hong (2011) and Du et al. (2012b), EX is expected to have a positive effect on firms' TFP, which indicates that firms are likely to benefit in terms of higher TFP from exports.

Firm age

As discussed in the literature review, a company is expected to gain more knowledge and, therefore, become more productive over the years as it gains more experience through the process of "learning by doing". However, when a company has been existed for a long time, it can also become slower than others to adapt its strategies to the markets in which it operates and to keep its technology from being outdated compared to companies operating in the same industry. This can lead to a lower TFP. In this thesis, the variable of the firm age (Age) is calculated based on the year of establishment. In order to reduce the skewness of the firm age variable, the firm age variable will be squared since the correlation between the firm's age variable and the firm's revenue variable has a parabolic shape.

Firm size

In Vietnam, the Government uses capital and labor criteria to classify enterprises into large, medium, small or micro enterprises. According to Decree No. 39/2018/ND-CP issued by the Government, the size of enterprises by fields has been detailed, specifically for enterprises in the industrial sector as follows: Micro-enterprises have an average annual number of employees participating in social insurance no more than 10 people per year and a total annual revenue no more than 3 billion VND or total capital no more than 3 billion VND. Small enterprises have an average annual number of employees participating in social insurance no more than 100 people and a total annual revenue no more than 50 billion VND or a total capital no more than 20 billion VND. Medium enterprises have an average annual number of employees participating in social insurance no more than 200 people and total annual revenue no more than 200 billion VND or total capital no more than 100 billion VND. The rest are big enterprises. The thesis selects capital criteria to classify large enterprises, medium enterprises and small enterprises. Since industrial enterprises are mainly medium and large enterprises, the two variables representing firm size are LE and ME.

Information and Communication Technologies index (ICT index)

The ICT Index is a measure of development level in Information and Communication Technology and it is also a measure of the readiness to develop and apply information and communication technology in the many fields of each country. The indicator system of the ICT index consists of three main groups: technical infrastructure, human infrastructure and information technology application. In this thesis, the data of the ICT index is the Index of readiness for the application and development of information and communication technology of the province (including 2 groups of indicators: infrastructure and applications). The variable ICT index (ICT) is expected to have a positive impact on TFP.

Real average monthly salary per employees

The salary factor also has an impact on TFP growth. According to Gehringer et. al (2013), salary (wage unit, salary per worker) is the main factor affecting TFP growth. They assume that the more productive workers the more salary are paid and therefore industries that have higher productive workers also have higher TFP. Therefore, the variable Real average monthly salary per employees (RWA) is expected to have a positive impact on the TFP of firms in this model. The basic statistics of these variables are reported in the Table 1

Table 1: Descriptive Statistic for variables used in TFP estimation,

Variable	Description of variables	Obs	Mean	Std.Dev
y	Logarithm of the company revenue	112.039	8,922175	2,14401
l	Logarithm of the number of employees working in the company	113.464	2,799628	1,559686
k	Logarithm of the firm's real capital	113.464	9,041731	1,816131
EX	Dummy variables for enterprises having import and export activities	47.642	1,436695	0,749291
Age	Firm age (base on the year of establishment)	113.464	365,2283	310,4908
ICT	Information and Communication Technologies index (ICT index)	113.311	0,6148654	0,1070028
RWA	Real average monthly salary per employees	112.984	4,190566	4,060708
LE	Large enterprises	113.464	0,1217919	0,3270468
ME	Medium enterprises	113.464	0,159046	0,3657206

ESTIMATED RESULTS

Table 2 provides the estimated results using the two-step SYS-GMM method for the production function of industrial enterprises in the Red River Delta region. Table 2 also gives the results of the diagnostic tests including: Hansen's test for the appropriateness of the instrument used in the model, and Arellano and Bond (1991) tests for autocorrelation, namely (AR (1) and AR (2). The Hansen test of overidentifying restrictions tests the null hypothesis that the instruments are distributed independently of the production function and are uncorrelated with the residuals. Therefore, a strong rejection of the null hypothesis of the test would strongly counter the estimates' validity. The results of the AR(2) test reject the null hypothesis that the model has autocorrelation at the first-differences. The Hasen test results show that the p=0.852 value is quite large, that is, the set of instrumental variables is exogenous, uncorrelated with the error term The coefficients of labor and capital are both positive and statistically significant at a fairly high 1% level For the EX variable, the estimated

coefficient has a positive sign, which means that import-export activities have a positive impact on the firm's TFP growth. Enterprises with import-export activities will have a 0.23% higher TFP growth rate than those without import-export activities. This variable is statistically significant at a high level of 1%. This result is completely consistent with the concept of learning by exporting. In this view, a company learns how to be more productive and competitive through exporting. The more they exports, the more company is able to increase productivity. This is because by entering foreign markets, a company faces a large number of competitors. To survive in such an environment, the company will need to continuously improve productivity by taking measures to increase TFP. Furthermore, exporters can benefit from the trade interactions that exports bring, as mentioned by Grossman and Helpman (1991). Therefore, the implication drawn from this estimation result encourages enterprises to engage in import and export activities to promote TFP growth. The coefficient of the firm age variable has a negative sign, which means that the older the firm is, the more negative impact on TFP growth it has. Every 1% increase in the age of the firm will reduce the TFP growth of that firm by 0.0003%. However, it can be seen that the impact of firm age on TFP growth is quite small and not statistically significant. The results of this study are consistent with the assumption that when a company has existed for a long time, it may also become slower than other companies to adjust its strategies to suit the markets. in which the company operates and to keep its technology from being obsolete compared to other companies operating in the same industry. This can lead to a lower TFP. The variable Information and Communication Technologies index (ICT index) also has a positive impact on TFP growth of enterprises. With every 1% increase of the Information and Communication Technologies index (ICT index), the TFP of enterprises will grow 3.06% and this variable is statistically significant at quite high level 1%. The coefficient of the real average monthly salary per employees variable has a positive sign, which is completely consistent with the expectation that an increase in the real average monthly salary per employees will help the TFP grow 0.1%. This result is also consistent with the results studied by Gehringer et. al (2013). This study shows that wages are the main factor affecting TFP growth. They assume that productive workers are paid more salary and therefore industries that employ higher productive workers also have higher TFP. The two firm size variables (LE and ME) have a positive impact on the TFP growth because the coeffiecient of both these variables are positive. This is also completely consistent with the expectation of the firm size variable. Specifically, large enterprises will help their TFP grow by 0.34% compared to non-large enterprises. Medium enterprises will help their TFP grow by 0.21% compared to non-medium enterprises.

Table 2: Estimation results of the two-step System-GMM Production Function

VARIABLES	lrevenue
l	0.685***
	(0.242)
k	1.006***
	(0.153)
EX	0.236***
	(0.0797)
age2	-0.000370
	(0.00228)
ICT	3.068***
	(0.809)
RWA	0.101***
	(0.0364)
LE	0.340
	(0.471)
ME	0.212
	(0.319)
Constant	-4.358***
	(1.265)
Observations	134
Number of id	26
AR(1) z-statistic	-1.85
AR(1) z-statistic p-value	0.064
AR(2) z-statistic	0.39
AR(2) z-statistic p-value	0.700
Hansen Test	7.86
Hansen Test p-value	0.852

Standard Errors in Parentheses, *** p<0.01, ** p<0.05, * p<0.1

CONCLUSION

At the macro level, total factor productivity (TFP) plays a key role in raising living standards, promoting economic growth and is the main driver behind differences in economic growth among countries in the long run. At the micro level, TFP reflects the efficiency of enterprises and is a determining factor for the survival of a business. Red River Delta Region is the place where many factories producing modern electronic products are concentrated such as Samsung, LG, Panasonic, Vinfast... so it is convenient to develop high-tech industries, electronics, informatics, software, and supporting industries. Analysing TFP and its determinants enables an understanding of which factors policymakers can target in order to achieve higher TFP.

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