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Analysing Productivity in Vietnamese Seafood Processing Firms: A Control Function Approach

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Abstract

This study aims to estimate the production function and total factor productivity (TFP) of Vietnamese seafood processing firms. At the same time, the study analyses the impact of internal factors of firms and the quality of economic institutions on the TFP of the Vietnamese seafood processing industry. The study uses the Function Control (FC) approach in TFP estimation and the Feasible Generalized Least Squares (FGLS) regression model in the analysis of factors affecting TFP. The study was carried out on the census data of enterprises of the Vietnamese seafood processing industry collected by the Vietnamese General Statistics Office and Provincial Competitiveness Index data of Vietnam Chamber of Commerce and Industry in the period from 2013 to 2018. Estimated results from the models show that: i) Vietnamese seafood processing firms are, currently, mainly labor-intensive, the TFP contribution and output is only about 2.258. ii) Factors such as the firm's age, firm's size, and the firm's ownership affect TFP. In which, firms that have few numbers of years of operation, small and medium firms, and private firms have low TFP. iii) Institutional quality and the provincial business environment have a positive impact on the TFP of Vietnamese seafood processing firms in this period.

Keywords: Total Factor Productivity, Function Control Approach, FGLS Regression, Seafood Processing Industry

JEL Classification Code: C14, C23, D24, O47

1. Introduction

In recent years, the Vietnamese manufacturing industry has seen a marked improvement in productivity and competitiveness. However, the gap in total factor productivity (TFP) compared to middle-income countries in the region such as China, Indonesia, and Malaysia is still large, especially when compared to industrialized countries. The willingness of firms to accelerate in the context of Industry 4.0 remains low (Ngo & Nguyen, 2020).

The Vietnamese seafood processing industry is currently developing into a spearhead economic sector, playing an important role in the manufacturing industry, bringing great production value, leading to international economic integration. Vietnam's seafood exports and processing now offer great value to the economy. According to the Vietnam Association of Seafood Exporters and Producers (VASEP), seafood export turnover reached about 8.6 billion USD in 2019 and Vietnam became the 4th country in the world in seafood export. Promoting exports to markets with high-quality standards such as America, Japan, Europe, etc. requires Vietnamese seafood processing firms to improve their technology, good management, and optimally combined inputs in the production process. This can significantly improve the productivity of firms (Nguyen & Khoa, 2020)

Besides, with the advantages in the business environment in Vietnam, along with the preferential policies of the Government over the past years, there have been many foreign direct investment (FDI) firms that have participated in the seafood processing market of Vietnam. Moreover, the quality of provincial economic institutions in Vietnam has improved in recent years. This helps firms feel secure to invest in production to achieve a higher level of TFP (Nguyen, 2020)

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Despite great achievements in recent years, the seafood processing industry still has many limitations. The proportion of small- and medium-sized seafood processing enterprises is still high. These firms often face many difficulties in terms of capital, labor, and production technology. Moreover, the majority of domestic firms currently have a low level of production technology, mainly raw processing, so their efficiency and productivity are lower than that of FDI firms.

Stemming from the above reasons, this study aims to estimate the total factor productivity (TFP) of Vietnamese seafood processing firms. At the same time, it analyses the impact of internal factors of firms (exports, age, size, and ownership) and institutional quality on the productivity growth of Vietnamese seafood processing firms.

2. Literature Review

2.1. Estimating Total Factor Productivity (TFP)

Estimating the exact TFP is a topic of great interest to many economists. When subjected to positive productivity shocks, firms responded by expanding production to increase output such that demand for inputs also increased. Conversely, when faced with negative productivity shocks, firms will cut output, such that the demand for inputs will decrease. A positive correlation between observed input levels and unobserved productivity shocks leads to bias estimation of TFP when estimated using the ordinary least squares (OLS) method. There are many methods proposed to solve this problem, we can group them into the following basic groups: Group of fixed effects (FE) methods, group of instrumental variables (IV) methods, and group of function control (CF) methods.

In the CF group, Olley and Pakes (1996) (OP) were the first to propose a two-step estimation procedure to correct the indigenousness of the model by choosing the investment levels that represent the productivity shocks. However, the investment levels of firms are often difficult to determine at each time. They are accumulated over many years, so the data will have many observations with zero investment levels at several times. Therefore, this method has great limitations in application. Levinsohn and Petrin (2003) (LP) overcame this by proposing intermediate input levels that represent productivity shocks. They showed how to use the investment to control for the correlation between input levels and the unobserved firm-specific productivity process. However, both OP and LP assume firms are able to adjust input levels immediately without incurring cost losses when exposed to productivity shocks. Bond and Soderbom (2005) criticized this and argued that the coefficient of labor can be consistently estimated in the first step if the free variables are variably independent of the variable representing the productivity shock. On the contrary, the coefficients will be perfectly collinear in the first step estimation and therefore the coefficient of labor cannot be determined. Wooldridge (2009) proposed to solve the problems of OP and LP by replacing the two-step estimation procedure by establishing a generalized method of moments model. Specifically, Wooldridge (2009) narrowed the moment involved in the coefficients of the equations established by OP and LP. He showed that in the common case where polynomial approximations are used for unknown functions, proxy variable approaches to controlling for unobserved productivity, proposed by OP and LP can be implemented by specifying different instruments for different equations and applying a generalized method of moments. Studying the parameters within a two-equation system clarifies some key identification issues (in the first step by Ackerberg et al. (2015)) and joint estimation of the parameters leads to simple inference and more efficient estimators.

2.2. Factors Affecting the Firm's Productivity

The TFP change is mainly due to technological progress. Trade theory proves that import and export activities lead to an increase in technology knowledge over time, thereby increasing TFP (Melitz, 2003; Helpman et al., 2004). The amount of technology knowledge is spread by different channels. The first is through the import of goods, innovative goods that increase reserves of knowledge. The second channel is through the technology spreading of foreign direct investment (FDI) capital. And the third channel is through exports. Two main theories explain the growth of TFP through exports: The theory of self-selection mechanism (Melitz, 2003; Bernard et al., 2003; Yeaple, 2005) and the theory of learning by exporting (Bernard & Jensen, 1999; Wagner, 2007). Therefore, the firm's export activity is an important factor affecting the firm's TFP.

The second factor affecting the firm's TFP has been recognized by many studies around the world as the firm's number of years of operation (firm's age) (Pitt & Lee, 1981; Chu & Kalirajan, 2011). Most studies argued that the firm's age positively affects productivity through work experience. Therefore, older firms have TFP better than young firms. However, Admassie and Matambalya (2002) also pointed out that the marginal effect of this factor tends to decrease over time when firms grow in their manufacturing sector. This can also make the efficiency and productivity of the firm subject to the opposite impact of time.

Another factor influencing productivity that needs to be addressed is the firm's size (Admassie & Matambalya, 2002; Pitt & Lee, 1981; Hallberg, 1999; Rios & Shively, 2004). Most studies show that the firm's size has a positive impact on the firm's productivity. Besides, the theory of production efficiency also shows that other important factors should also be considered such as the regional factor of the firm, the capital structure of the firm, etc.

The factors mentioned above belong to the group of characterize firms. This group of factors assesses the subjective effects on a firm's productivity. Besides, the group of objective factors under the institution of the business environment also has a significant impact on the efficiency and productivity of the firm.

The business environment includes the institutional environment, the macro-policy environment, and the legal environment in which firms operate (Dollar et al, 2003). A good business environment will allocate input resources better, help firms use resources more effectively and have the motivation to expand production scale to increase operational efficiency. And that is the source of productivity growth. A good business environment helps firms reduce transaction costs and variable costs (Aron, 2000). A good business environment contributes to productivity growth through change and progress in technology (Baumol, 1990). It increases productivity by encouraging firms to invest in technology and transfer technology, encourage firms to manufacture at a larger scale, use better technology, and make firms more competitive. On the contrary, with poor institutional quality, enforcement of contracts becomes difficult, and paying a bribe is necessary, which will increase the operating costs of firms. It gives firms an incentive to absorb inefficient technologies for production rather than to absorb modern technologies (Fredriksson & Svensson, 2003). Besides, Bowen and De-Clercq (2008) pointed out that the relationships between factors of the institutional environment related to corruption, financial capital, and human capital of firms are closely related to the activity that creates high productivity.

The important role of economic institutions for development is shown in the previous studies; the results show that economic institutions have a direct impact on economic efficiency in the same period and the distribution of resources of later periods (Acemoglu & Johnson, 2005). Economic institutions contribute to economic growth by creating favorable conditions for firms to do business or direct their operations. When the two economies have a relatively similar infrastructure, market size, and financial system, the economy with a better institution will not have unofficial costs, reliable legal institutions, property rights are firmly enforced. Those will help firms achieve higher productivity and better economic opportunities (Johan, 2015). An overview of studies on the quality of economic institutions in Vietnam shows that there have been many studies using indicators in the provincial competitiveness index (PCI) to measure the quality of institutions between provinces (Nguyen et al, 2013; Neil et al, 2013). The studies all say that the province has no function to issue laws and macro policies but the province is the law enforcement agency and macro policy, so the difference in enforcement is the basis to measure the quality of economic institutions.

3. Methodology

The research selects Cobb-Douglas production technology to estimate TFP for Vietnamese seafood processing firms in the period 2013-2018. The production function of firm *i* at time *t* is written in the logarithmic form as follows:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \varepsilon_{it} \quad (1)$$

For *yit*, *kit* and *lit* are the natural logarithms of total output, capital, and labor, respectively. Where *kit* is a state variable and *lit* is a free variable (Wooldridge 2009)

According to Van Beveren (2012), ε_{it} is decomposed into a specific productivity shock v_{it} that is observed by the owner but not by the economist and the unobserved error η_{it}. Hence (1) can be rewritten as follows:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + v_{it} + \eta_{it} \quad (2)$$

Then $\omega_{it} = \beta_0 + v_{it}$ is defined as the productivity of firm *i* at *t* time. Estimate the coefficients of equation (2), from which the productivity is calculated as follows:

$$\hat{\omega}_{it} = \hat{\beta}_0 + \hat{v}_{it} = y_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_l l_{it} \quad (3)$$

To assess the impact of factors, that is, firm's characteristics and factors of business environment institutions on TFP of Vietnamese seafood processing firms, we build econometric models in which the dependent variable is the TFP level estimated from (3). The independent variables include Export (*Ex*); Firm's age (*Age*); Firm's size (*Size*); Ownership type (*Ownership*) and the variable representing the quality of economic institutions (*Pci*) that is the provincial competitiveness index (PCI). The specific model is as follows:

$$\begin{aligned} \mathrm{TFP}_{it} = {} & \beta_0 + \beta_1 \mathrm{L1.TFP}_{it-1} + \beta_2 \mathrm{Ex}_{it} + \beta_3 \mathrm{Age}_{it} \\ & + \beta_4 \mathrm{Sizel}_{it} + \beta_5 \mathrm{Size2}_{it} + \beta_6 \mathrm{Ownership1}_{it} \\ & + \beta_7 \mathrm{Ownership2}_{it} + \beta_8 \mathrm{Pci}_{it} + \beta_9 \mathrm{year} + \varepsilon_{it} \end{aligned} \quad (4)$$

Estimation of the production function, TFP, and coefficients in the regression model analyzing the factors affecting TFP of Vietnamese seafood processing firms in the period 2013 between 2018 were performed using Stata 14 software.

4. Results

4.1. Data and Variables

The study uses the enterprise census data of the Vietnam General Statistics Office and the Provincial Competitiveness

Index (PCI) data of the Vietnam Chamber of Commerce and Industry from 2013 to 2018. After processing data, the study obtained a panel data set of 170 (1020 observations) seafood processing firms in this period. The variables in the models are presented in Table 1, descriptive statistics of the variables are presented in Table 2.

4.2. Estimated Results of the Total Factor Productivity

Table 3 presents the results of estimating the production function and contribution of TFP to the output of Vietnamese seafood processing firms according to the methods of Levinsohn and Petrin (2003) and Wooldridge (2009). The results show that the estimated coefficients of capital and labor in the methods are appropriate and statistically significant. Both methods have the same tendency: The elasticity of labor to output is much larger than the elasticity of capital, implying that Vietnamese seafood processing firms are still very labor-intensive. However, there are slight differences between methods - estimates according to Levinsohn and Petrin (2003) show that the total elasticity of labor and capital to output is less than 1. It means firms have decreasing returns to scale. Whereas estimation according to Wooldridge (2009) gave opposite results.

Regarding the contribution of TFP, the results of the LP method show that the average contribution of TFP is 2.681 while that of Wooldridge (2009) is 2.258. As analyzed in the literature review, the results of TFP estimation by Wooldridge (2009) method will be selected. This shows that the contribution of factors other than capital and labor (technological progress, quality of labor, quality of capital, and use of efficient resources) make the output of Vietnamese seafood processing firms increased to 2.258 times in the period 2013 between 2018.

Table 1: Description of the Variables in the Models

Variables in TFP estimation model		
Variable		**Meaning and measurement**
Output variable	VA	Is the real added value of the firm, calculated at constant 2010 prices (equal to nominal added value/inflation reduction coefficient)
Input variables	K	Total real assets of the firm at the end of the year, calculated at constant 2010 prices (equal to year-end assets/inflation reduction coefficient).
	L	Is the number of full-time employees of the firm in the year.
	M	Intermediate input variable (Equals total revenue minus value-added / inflation reduction coefficient)
The variables VA, K, L, M are taken natural logarithm before being put into the model.		
Variables in the factors affecting TFP model		
Variable		**Meaning and measurement**
Dependent variable	TFP_{it}	Total factor productivity was estimated using Wooldridge (2009) method.
The independent variables	$L1.TFP_{it}$	The lag variable of the dependent variable TFP_{it} at time t-1
	Age_{it}	Firm's age (measured by the fiscal year subtract the year of establishment)
	Ex_{it}	This is a dummy variable, where Ex = 1 is an export firm, Ex = 0 is the opposite.
	$Size_{it}$	Those are the firm's size and dummy variables in many categories. In which $Size1_{it}$ is micro-firms, $Size2_{it}$ is small and medium firms, the base category is large firms.
	$Ownership_{it}$	Those are the firm's ownership and dummy variables in many categories. In which $Ownership1_{it}$ is state-owned firms, $Ownership2_{it}$ is private firms, the base category is FDI firms.
	Pci_{it}	This is institutional of the provincial business environment in Vietnam
	year	Year of the research (2013-2018)

Table 2: Statistical Values of the Variables

Variable	Obs	Mean	Std. D	Min	Max
VA (million VND)	1020	22097.0	41738.3	44.0	306881.0
K (million VND)	1020	95132.2	166871.8	313.0	1189619.0
L (person)	1020	171.8	279.1	8.0	2100.0
M (million VND)	1020	122169.2	270111.9	11.9	3030304.0
Ex	1020	0.6	0.5	0.0	1.0
Age	1020	11.8	6.4	6.0	54.0
Pci	1020	61.2	3.4	53.9	70.7

Table 3: Estimated Results of Production Function and TFP

	Estimated by Levinsohn & Petrin (2003) method		Estimated by Wooldridge (2009) method	
Variable	**Coef**	**z**	**Coef**	**z**
LnL	0.675***	19.850	0.735***	30.200
LnK	0.287***	6.380	0.305***	12.110
TFP	2.681		2.258	

Note: ***, ** and * indicates significant at 1%, 5% and 10% level of significance based on t-statistics.

Table 4: TFP Distribution of Vietnamese Seafood Processing Firms

Year	Mean	Std. D	Min	Max
2013	2.277	0.643	0.258	4.758
2014	2.250	0.557	−0.174	3.781
2015	2.178	0.574	−0.035	3.965
2016	2.353	0.507	0.566	3.487
2017	2.247	0.598	0.879	4.753
2018	2.245	0.575	0.601	3.577

Table 4 describes the TFP distribution of Vietnamese seafood processing firms in the period from 2013 to 2018. The results showed that TFP had no significant change during this period, the average contribution to output was 2.258. The average standard deviation of TFP over the years has small changes, showing the gap of production technology, improving the quality of labor, effective management, and use of resources that have not been narrowed down among seafood processing firms in this period.

4.3. Estimated Results of The Model of Factors Affecting TFP

Tests on the correlation of the independent variables and the multicollinearity were done before estimating the model (4), the test results showed that the variables in the selected model are appropriate. Estimating model (4) by pooled ordinary least square method does not reflect the specific effects of each seafood processing firm. Research continues to perform the estimation of the model (4) by the fixed effects method (FEM) and the random effects method (REM). Then perform a Hausman test to choose a suitable model. The test result shows that *P*-value = 0.0002, so the FEM model is selected. After that, the study tested defects of the model, the results showed that the model had autocorrelation and heteroscedasticity. Therefore, the study overcomes these problems with the feasible general least square model (FGLS). The estimated FGLS coefficients of the model (4) are presented in Table 5.

The estimation results show that the previous year's TFP has a positive impact on the current year's TFP of firms. This shows that if firms are actively investing in production technology, reducing average long-term costs, and know-how to allocate production resources effectively, then the contribution of TFP to their output will be higher in the next year.

Among the factors belonging to the firm's characteristics impacting TFP, the estimated results show that: There is no evidence of the impact of exports on TFP of seafood processing enterprises in the period 2013–2018. It means the self-selection mechanism and the learning through export mechanism have not had a positive impact on the TFP growth of enterprises. Besides, the firm's age has a positive impact on TFP. It reflects the positive impact of manufacturing experience on TFP growth. Small and medium firms have lower TFP than large firms. However, there is no evidence to show a difference in TFP between micro firms and large firms. There is no evidence of a difference in TFP between state seafood processing enterprises and FDI enterprises, but the FDI sector has better TFP than the private sector.

Table 5: Estimated Results of the Model of Factors Affecting TFP

Variable	Coef.	Std. E	z	P>|z|
L1.TFP	0.872***	0.025	34.590	0.000
Ex	0.011	0.017	0.630	0.532
Age	0.004**	0.002	2.470	0.014
Size1	0.054	0.069	0.780	0.436
Size2	-0.061***	0.014	-4.290	0.000
Ownership1	0.000	0.201	0.000	1.000
Ownership2	-0.055**	0.018	-3.060	0.002
Pci	0.009*	0.005	2.020	0.044
year	0.174***	0.014	12.080	0.000
_cons	-1.265***	0.317	-3.990	0.000
AR(1) coefficient for all panels (-0.6431)				
Wald chi2(9) = 5937.73				
Prob > chi2 = 0.0000				

Note: ***, ** and * indicates significant at 1%, 5% and 10% level of significance based on t-statistics.

The coefficient of institutional quality and business environment variable shows that there is a positive impact on the TFP of seafood processing firms. This reflects the provinces that have advantages in accessing land to invest in production, have time and costs to deal with administrative procedures, and provincial leaders are dynamic and creative in solving problems, which will make the firms increase their TFP. Furthermore, the provinces where firms have easy and transparent access to planning documents, legal documents, and opportune publication of budget documents, etc., will help firms to have appropriate planning in investment production technology as well as effectively combining resources to promote TFP growth. Besides, provinces with good business support services in market information search, trade promotion, legal advice, technology assistance, training, etc. will help businesses achieve higher productivity. The research results also reflect the fact that in recent years, some provinces in Southeast Vietnam such as Ho Chi Minh City, Dong Nai, Binh Duong, among others always have the PCI in the leading group; these are the places where the Vietnamese leading seafood processing enterprise exist.

5. Conclusion and Recommendation

Vietnamese seafood processing firms are mainly labor-intensive. The average contribution of TFP to the output was 2.258 in the period 2013 between 2018. Therefore, firms need to increase technology into production to further improve the contribution of TFP to output. Internal factors of firms have an impact on TFP, in which small and medium firms and private firms have low TFP. Moreover, these firms account for a large proportion of the structure of the Vietnamese seafood processing industry. Therefore, the government should have specific policies for these sectors. There should be policies to support these firms in accessing land, accessing credit for investment in production technology, human resource development, etc., thereby helping firms improve their TFP.

Regarding the institutional quality of the business environment, it is necessary to create favorable conditions for seafood processing firms to develop. Reduce costs and time to deal with administrative procedures for firms, remove barriers related to the enforcement of corporate operating regulations, and transparency of government information for firms. Having appropriate firms support services and labor training policies, flexible authorities at all levels in the legal framework, and creative dynamism in solving problems arising with firms. Doing this well will help improve the TFP of the Vietnamese seafood processing industry.

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