THE ECONOMIES SCALE OF AGRICULTURAL PRODUCT PROCESSING COMPANIES LISTED ON STOCK EXCHANGE IN HOCHIMINH CITY AND HANOI, VIETNAM

Le Thanh Tung, Pham Thi Quynh Nhu, Nguyen Hai An

Abstract

This study applied the Cobb-Douglas production function to identify economic efficiency of 18 agricultural product processing companies listed on the Stock exchange in Ho Chi Minh City (HOSE) and Hanoi (HNX) in such sectors as fisheries, rubber and sugar in the period 2009-2013. The method employed FEM and REM models using panel data. The results showed that performance of all and each sector in this study has increasing returns to scale. In particular, firms in the sectors of fisheries and rubber primarily relied on raising capital to increase their output value, while those in the sugar sector mainly increase labor to improve their output value. Finally, the paper also provides some policy implications to improve the efficiency of capital and labor in the agricultural product processing companies.

Keywords: economics of scale, listed companies, agricultural processing companies

JEL Classification: J43, Q13

1 INTRODUCTION

According to the data from Vietnam General Statistics Office (GSO) in 2013, the agricultural sector contributed 18.4% to Vietnam's GDP. Besides, the agricultural industry provided jobs for 25.16 million employees (accounted for 46.9% of total labor force) and about 60.4 million people are living and working in rural areas (about 46.8% of total population). The role of agricultural industry is essential in the Vietnam economy. Therefore, the industrialization and modernization of agricultural and rural sector attracts a lot of attention. Particularly, the center of cohesion between industrialization and modernization is to connect and transform raw materials and outputs of agricultural sector to inputs of industrial sector. Thenceforth, the production value chain for agricultural product manufacturing and processing firms is formed to enhance the industrialization and modernization of agricultural industry in Vietnam.

Currently, for the case of agricultural product processing companies in Vietnam, the sectors of rubber, sugarcane and fisheries play the most important role. These companies provide goods not only for domestic market, but also for exporting markets such as USA, Japan, South Korea, China, Malaysia, India, etc. Due to their characteristics of production, the agricultural manufacturing need to utilize lots of labor, capital and materials for increasing their outputs. However, their most common mistakes is to select outputs that cause labor shortage or surplus and utilize capital ineffectively that results in capital shortage. Therefore, it is essential and indispensable to conduct deeper study and analysis on effectiveness of input utilization (capital, labor) in production and business activities at companies.

This paper studied the economics scale of agricultural companies listed on HOSE and HNX from 2009 to 2013. The research used panel data regression with quarterly data. The research objective is to answer two questions: (i) What kind of economics of scale for each sector and all sectors (ii) Does capital or labor determine the increase in output of each sector and all sectors? Finally, this paper also suggests some solutions to enhance the efficiency of management to better utilize capital and labor at agricultural product processing enterprises.

2 LITERATURE REVIEW AND MODEL RESEARCH

The studies about economics of scale at levels of firms, regions or whole economy have been implemented in many countries in the world. Many types of production function have been proposed to illustrate the relationship between output and inputs, and the most common is Cobb–Douglas production function. The production function theory was developed by Charles Cobb and Paul Douglas (1928) after verification using the conditions of the US economy. The Cobb – Douglas production function stated that output (Q) depends on labor (L) and capital (K). In addition, the relationship among the variables of production functions is determined by level of science, technology and management that are called Total Factor Productivity (TFP).

In recent decades, many studies have successfully applied Cobb – Douglas production function into economics of scale research in such fields as industry, trading and service. A study of Ingene and Lusch (1999) with the application of Cobb – Douglas function for trading sector in USA showed that for the case of all grocery stores, return to scale remains constant while the small grocery stores have increased returns to scale. Hossain et al. (2004) also studied returns of scale for 21 sectors in Bangladesh. The results showed that only 14 sectors have increasing returns of scale while 7 sectors have diminishing returns of scale. Yuan et al. (2009) used Cobb-Douglas function in research of energy consumption in China, the result showed that improvement in technology declines the energy intensity of industrial sector by 6.3 percent per year. Hossain and Al-Amri (2010) also applied Cobb-Douglas function in Oman for 9 important sectors in industry. The research found that there are 7 sectors with increasing returns of scale and 2 sectors with decreasing returns of scale.

Based on Cobb-Douglas production function, the research model about economics of scale for the case of agricultural product processing company listed on HOSE and HNX will be written as follows:

$$Q_{it} = AK_{it}^{\alpha}L_{it}^{\beta} \quad (1)$$

If $\alpha + \beta > 1$, this production function has increasing returns to scale. 1% increase in inputs (labor, capital) results in more than 1% increase in outputs.

If $\alpha + \beta = 1$, returns to scale of the function remains constant. If inputs (labor, capital) increase by 1%, outputs increase by the same level of 1%.

If $\alpha + \beta < 1$, the function has diminishing returns to scale. If 1% increase in inputs (labor, capital) improves the outputs less than 1%.

After transforming both sides of the equation (1) into logarithm form, we have the following equation (2):

$$\ln Q_{it} = \ln A + \alpha \ln K_{it} + \beta \ln L_{it} + \varepsilon_{it} \quad (2)$$

$$i = 1, 2, 3, \dots, n$$

$$t = 1, 2, 3, \dots, m$$

Where: Q is total output of the sectors, A represents TFP, L is quantity of labor, and K is quantity of capital. α and β denote the output elasticity on labor and capital respectively. When conducting regression model using panel data, i denotes i^{th} firms ($i: 1 \rightarrow n$) and t denote time ($t: 1 \rightarrow m$).

3 METHODOLOGY AND DATA

3.1 Econometrics method

To accomplish the research objectives, this paper applies panel data regression with two methods of FEM and REM, and then uses the Hausman test for selecting appropriate method.

According to Gujarati (2004) and Gujarati and Porter (2009), panel data regression model is written as following:

$$Q_{it} = \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + \dots + \beta_k X_{kit} + u_{it} \quad (3)$$

Assume that the slope coefficients are unchanged across companies but intercepts vary across units. Therefore, model (3) can be rewritten as follows:

$$Q_{it} = \beta_{1i} + \beta_2 X_{2it} + \beta_3 X_{3it} + \dots + \beta_k X_{kit} + u_{it} \quad (4)$$

The difference in intercept may reflect the features of each company in terms of managerial philosophy or managerial style. Model (4) is known as the Fixed Effects Model (FEM). FEM is appropriate for the study using sample with short period.

In the Random Effects Model (REM), instead of treating β_{1i} as fixed, we assume that it is a random variable with a mean value of β_1 (without i denotation). The intercept for a specific company can be represented as follows:

$$\beta_{1i} = \beta_1 + \varepsilon_i; \quad i = 1, 2, \dots, N \quad (5)$$

Where, ε_i is a random error term with a mean value of zero and variance σ^2_{ε} .

It can be understood that the companies in the sample are derived from a larger sample set and have a common mean of intercept (β_1). The individual difference in intercept value of each company is reflected via the error term ε_i .

Substituting equation (5) into equation (4), we obtain:

$$Q_{it} = \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + \dots + \beta_k X_{kit} + \varepsilon_i + u_{it} \quad (6)$$

$$Q_{it} = \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + \dots + \beta_k X_{kit} + w_{it} \quad (7)$$

Where:

$$w_{it} = \varepsilon_i + u_{it} \quad (8)$$

The equation (7) is called Random Effects Model (REM). The composite error term w_{it} is constituted of two components: ε_i denotes the cross-section or individual-specific error term, and u_{it} denotes the combined time series and cross-section error term.

3.2 Data

The study used quarterly data for the period from the first quarter in 2009 to the end of fourth quarter in 2013. Each company has the number of observations of 20 quarters. Data are derived from transparent reports, quarterly and yearly audited financial reports. The samples were surveyed at 9 fishery firms, 5 rubber firms and 4 sugar firms listed on HOSE and HNX. Total observations is 360 (20 periods multiplied by 18 firms). When conducting the research model, all data are transformed to natural logarithm form.

Tab. 1 - List of enterprises use statistical research data. *Source:* Research data from HOSE and HNX

No	Name	Listed	Field	Stock Code
1	Cuu Long An Giang Fisheries Import Export Joint Stock Company	HOSE	Fisheries	ACL
2	An Giang Fisheries Import and Export JSC	HOSE	Fisheries	AGF
3	Nam Viet Joint Stock Company	HOSE	Fisheries	ANV
4	NTACO Joint Stock Company	HOSE	Fisheries	ATA
5	Basa Joint Stock Company	HOSE	Fisheries	BAS
6	Number 4 Fisheries Join Stock Company	HOSE	Fisheries	TS4
7	Vinh Hoan Join Stock Company	HOSE	Fisheries	VHC
8	Bac Lieu Fisheries Join Stock Company	HNX	Fisheries	BLF
9	Number 1 Fisheries Join Stock Company	HNX	Fisheries	SJ1
10	Hoa Binh Join Stock Company	HOSE	Rubber	HRC
11	Dong Phu Rubber JSC	HOSE	Rubber	DPR
12	Phuoc Hoa Rubber JSC	HOSE	Rubber	PHR
13	Thong Nhat Rubber JSC	HOSE	Rubber	TNC
14	Tay Ninh Rubber JSC	HOSE	Rubber	TRC
15	Bien Hoa Sugarcane JSC	HOSE	Sugarcane	BHS
16	Lam Son Sugarcane JSC	HOSE	Sugarcane	LSS
17	Thanh Thanh Cong Tay Ninh Sugarcane JSC	HOSE	Sugarcane	SBT
18	KonTum Sugarcane JSC	HNX	Sugarcane	KTS

4 RESULTS AND DISCUSSION

4.1 Firms' Returns to Scale by sectors

This section estimates firms' returns to scale by sectors for the case of 9 fishery companies (180 observations), 5 rubber companies (100 observations) and 4 sugarcane companies (80 observations). Regression methods with panel data are employed using FEM and REM model. The regression results are presented as follows.

Tab. 2 - Regression Results by Sectors (Fishery - Rubber – Sugarcane)

Variables	Dependent variable: LnQ					
	Fishery Branch		Rubber Branch		Sugarcane Branch	
	FEM	REM	FEM	REM	FEM	REM
C	-1.351*	-1.569*	0.952	0.340	1.112	0.844
LnL	0.524**	0.479**	0.540**	0.432**	0.876**	0.480**
LnK	0.764**	0.806**	0.521**	0.628**	0.408**	0.766**
R ²	0.859	0.850	0.877	0.812	0.822432	0.691
Adjusted R ²	0.840	0.848	0.843	0.808	0.758140	0.683
F-statistics	45.718	501.498	26.385	209.589	1279218.000	85.950
Probability	0.000	0.000	0.000	0.000	0.000	0.000
Hausman test	0.301		0.167		0.005	
Observations	180		100		80	

Note: ** and *: significant at 1% and 5% respectively

After conducting regression analysis for each sector, Hausman test is also applied to determine whether FEM or REM is appropriate. Table 2 shows that P-value of fishery firms equals to 0.301 and that of rubber branch is 0.167; that is, these values are more than 0.05. Therefore, for the case of fishery and rubber sectors, REM is more suitable than FEM. In contrast, the Hausman test for sugarcane sector with P-value = 0.005 < 0.05 indicates that FEM is more appropriate than REM.

Tab. 3 - Results of Production Function by sectors (Fishery - Rubber – Sugarcane)

Industry	Production function using equation (2)	Production function using equation (1)
Fishery	$\ln Q = -1.569 + 0.807 \ln K + 0.479 \ln L$	$Q = 0.208 K^{0.807} L^{0.479}$
Rubber	$\ln Q = 0.34 + 0.629 \ln K + 0.433 \ln L$	$Q = 1.405 K^{0.629} L^{0.433}$
Sugarcane	$\ln Q = 1.112 + 0.408 \ln K + 0.876 \ln L$	$Q = 3.089 K^{0.408} L^{0.876}$

Table 3 shows that all the three sectors have increasing returns to scale with $(\alpha + \beta) > 1$. In particular, the value of fishery industry, rubber industry and sugarcane is 1.286, 1.061 and 1.285 respectively. The rubber enterprises have the lowest increasing returns to scale. The results also show that the production function of fishery and rubber industries has contribution of capital higher than that of labor (due to the coefficient $\alpha > \beta$). On the other hand, the contribution of labor toward output in sugarcane industry is larger than that of capital (due $\alpha < \beta$). Additionally, in terms of Total Factor Productivity (TFP), the sugarcane industry was the highest (3.089), followed by the rubber industry (1.405) and the fishery industry (0.208).

4.2 Returns to scale of all firms in three sectors: Fishery, Rubber and Sugarcane

18 enterprises in all three sectors with 360 observations are used for calculating returns to scale. Results from panel data regression method using FEM and REM are presented in Table 4.

Tab. 4 - Regression results of all firms in three sectors

Dependent variable: LnQ				
Variable	FEM		REM	
	Coefficient	t-statistics	Coefficient	t-statistics
C	-1.759**	-3.181	-1.719**	-3.198
LnL	0.167*	2.566	0.171**	2.655
LnK	0.937**	16.727	0.932**	17.297
R ²	0.670		0.653	
Adjusted R ²	0.650		0.651	
F-statistics	32.699		336.135	
Probability	0.000		0.000	
Hausman test	0.3017			
Observation	360			

Note: ** and * : significant at 1% and 5% respectively

The result of the Hausman test indicates that REM is better than FEM with p-value of 0.3017. From Table 4, the production function for the case of all firms in three sectors is written as follows:

$$\begin{aligned}\ln Q &= -1.719 + 0.171 \ln L + 0.932 \ln K \\ Q &= 0.839 K^{0.932} L^{0.171}\end{aligned}$$

The results indicate that for the case of all firms in three sectors, there exists increasing returns to scale with the value of $(\alpha + \beta)$ higher than 1 ($\alpha + \beta = 1.103$). The coefficient of $\alpha = 0.932$ is higher than $\beta = 0.171$, which indicates that the increase in output is mainly due to capital while the contribution of labor is limited. The value of Total Factor Productivity (TFP) equal to 0.839 reflects the contribution of technology and management to the firms' outputs in all three sectors.

5 CONCLUSION AND POLICY IMPLICATIONS

This research applied panel data regression method using FEM and REM to estimate production function for the enterprises listed on HOSE and HNX in three sectors including fishery, rubber and sugarcane in the period of 2009-2013. Generally, this paper has contributed to the existing theoretical framework literature in two main ways: (1) it provided an experimental evidence about the operation of firms in Vietnam, an emerging economy in Asia; (2) it also supplied some useful policy implications in SMEs area in developing countries.

In particular, the research results indicate that the enterprises in three sectors and each sector have increasing returns to scale. It is also found that the fishery and rubber sectors primarily rely on the increase in capital to improve the quantity of outputs while the sugarcane sector mainly uses more labors to increase output value.

Therefore, the results partly show that the growth pattern of Vietnamese enterprises in the period of 2009 – 2013 is chiefly dependent on capital leverage. Therefore, when the government decided to contractionary monetary policy, raise interest rates, reduce money supply and credit growth in this period immediately, a lot of enterprises have difficulties in their production activities. This is considered as an obvious evidence for the growth model that primarily relies on credit and banking system in Vietnam in the past period.

From the findings, this research proposes some policy implications to improve production and business management in the future:

Firstly: Because Vietnam has abundant labor force, the enterprises need to focus on labor-intensive production to boost up their output. Furthermore, firms should pay special attention to labor productivity factor to increase the contribution of labor to firms' output. Firms should organize training, retraining and advanced training activities to improve qualification and skills, as well as arrange and utilize labors for appropriate jobs.

Secondly: Firms should continuously invest in innovation, technology improvements to increase the contribution of science and technology to outputs. Moreover, the advanced methods of production methods and organization should be actively applied to improve outputs value. Additionally, the connection between enterprises and the agricultural sector should be tightened to diversify processing products in order to construct a strong value chain in processing agricultural products industry for domestic consumption and export.

Thirdly: Capital-intensive production model should be adjusted into model with harmonious combination of labor and capital; henceforth, the effect of diminishing marginal productivity of capital can be inhibited. Moreover, firms need to be less reliant on capital to reduce the dependence on banks' credit growth and the increase in the economy's money supply.

Fourth: The policy makers need to establish medium- and long-term development orientations and plans for firms in each sector and the whole economy. Besides, the management agencies in each sector should also provide consultancy for firms on an appropriate specific model. On that basis, firms will construct their production and business plans to take best advantage of inputs, thereby enhance their competitiveness in the market, create more jobs as well as contribute to economic growth in the future.

On the other hand, this study also had limitations too among them followings can be mentioned: the research sample is quite small because there are only 18 firms in three sectors in agricultural in Vietnam and the study period only is from 2009 to 2013. The future study might develop more by adding more companies in these sectors in Vietnam and take data in longer period to make this topic be more better.

References:

1. Cobb, C. W., & Douglas, P. H. (1928). A Theory of Production, *American Economic Review*, 18(1), 139-165.
2. Gujarati, D. N. (2004) *Basic Econometrics (Fourth Edition)*, McGraw-Hill, USA.
3. Gujarati, D. N., & Porter, D. C. (2009). *Basic Econometrics (Fifth Edition)*, McGraw-Hill, USA.
4. Hajkova, D., & Hurnik. J. (2007). Cobb-Douglas Production Function: The Case of a Converging Economy, *Czech Journal of Economics and Finance*, 57, 465-476.
5. Hossain, M. Z., Bhatti, M., & Ali. Z. (2004). An econometric analysis of some major manufacturing industries: A case study, *Managerial Auditing Journal*, 19(6), 790-795. DOI: <http://dx.doi.org/10.1108/02686900410543895>
6. Hossain, M. Z., & Al-Amri, K. S. (2010). Use of Cobb-Douglas Production Model on Some Selected Manufacturing Industries in Oman, *Education, Business and Society: Contemporary Middle Eastern Issues*, 3(2), 78-80.
7. Hossain, M. Z., Majumder, A., & Basak. T. (2012). An Application of Non-Linear Cobb-Douglas Production Function to Selected Manufacturing Industries in Bangladesh, *Open Journal of Statistics*, 2, 460-468.
8. Ingene, C. A., & Lusch, R. F. (1999). Estimation of a department store production function, *International Journal of Physical Distribution & Logistics Management*, 29 (7), 453 – 465. DOI: <http://dx.doi.org/10.1108/09600039910371138>
9. Moutain, D. C. (1989). A Quadratic quasi Cobb-Douglas extension of the multi-input CES formulation, *European Economic Review*, 33, 143-158. DOI: [http://dx.doi.org/10.1016/0014-2921\(89\)90042-1](http://dx.doi.org/10.1016/0014-2921(89)90042-1)
10. Muro, K. (2013). A note on the three-sector Cobb-Douglas GDP function, *Economic Modelling*, Vol. 31, 18-21. DOI: <http://dx.doi.org/10.1016/j.econmod.2012.11.008>
11. Wei, T. (2007). Impact of energy efficiency gains on output and energy use with Cobb-Douglas production function, *Energy Policy*, 35, 2023-2030.
12. Yuan, C., Liu, S., & Wu, J. (2009). Research on energy-saving effect of technological progress based on Cobb-Douglas production function, *Energy Policy*, 37(8), 2842-2846. DOI: <http://dx.doi.org/10.1016/j.enpol.2009.04.025>

Contact information

Name: Le Thanh Tung

Diploma: Ph.D in Economics

Expertise: Economics, Economics Policy Analysis

Affiliation (University): Ton Duc Thang University (Faculty of Business Administration)

Address: No 19 Nguyen Huu Tho street, Tan Phong ward, district 7, Ho Chi Minh city
Vietnam

Email: lethanhtung@tdt.edu.vn

Tel: 0918796756

Name: Pham Thi Quynh Nhu

Diploma: MBA

Expertise: Business Administration, International Economics

Affiliation (University): Ton Duc Thang University (Faculty of Business Administration)

Address: No 19 Nguyen Huu Tho street, Tan Phong ward, district 7, Ho Chi Minh city
Vietnam

Email: phamthiquynhnhu@tdt.edu.vn

Tel: 0937962211

Name: Nguyen Hai An

Diploma: MBA

Expertise: Business Administration