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Technical efficiency (TE) of small and medium (SME) food enterprise in West Malaysia

(Kecekapan teknikal perusahaan makanan kecil dan sederhana di Malaysia Barat)

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Abstract

The study focused on measuring the technical efficiency of small and medium enterprises (SME) in the food processing industry. A total of 158 companies were involved and data were analysed using Frontier 4.1. The majority of the companies (96.84%) attained a level of technical efficiency of around 80%. Production elasticity of the sample companies was estimated at 0.9957 indicated that the sample companies were operating at slightly decreasing return to scale. At this stage, an introduction of new innovation in technology, usage of machinery or optimum scale of production is required in order to improve productivity.

Introduction

The food and beverage of the small and medium enterprises (SME) accounted for 15% of the total establishment in the food and manufacturing industry (DOS 2005). Output produced by these SME was RM41,346 billion with value added of RM7.6 billion and created a number of 115,626 job opportunities. Since 1980s, the government of Malaysia has launched a number of development programmes to support the SME in the food processing industry. Such programmes include training to upgrade technological and managerial skills, financial support, extension and advisory services on production, process flow, plant and machinery layout. Since 1980s, a substantial amount of budget has been invested for the implementation of these programmes. It is crucial to gauge SMEs' performance to see whether they have incorporated all inputs both tangible and intangible into efficient operation.

Technical efficiency (TE) measurement is one of the methods commonly used to gauge firm performance. The determination of companies' efficiency level will enable the identification of the factors where improvement could be made besides providing useful information for policy formulation. A number of studies on TE measurement have been done. In the food processing industry, Raziah (1999) had conducted TE measurement on the 38 fish-based small and medium enterprises using the Koop and Timmer method. The study indicated that those companies were operating at very low level of efficiency with mean efficiency of 0.3447 and standard deviation of 0.2265.

Jejri and Rahmah (2006) measured the total factor productivity growth in the overall Malaysian manufacturing sector using a time series data from the Industrial Manufacturing survey of 1985 to 2000, compiled by the Malaysian Statistic

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Department. They found out that TFP growth was increasing due to TE especially in food, wood and chemical subsectors.

Zalina and Marziah (2007) assessed industrial level of efficiency among the Malaysia small and medium enterprises using stochastic frontier Cobb-Douglas model and found out that the average TE for all industrial subsectors were 0.7609 which indicated 24% loss or inefficiency in the production process.

In livestock industry, Tapsir (2004) examined the issues of TE in beef cattle production using the translog Cobb-Douglas stochastic frontier production function and found out that the average TE for individual farm was 0.6829 thus the total loss in production due to inefficiency was estimated at 32%.

All the studies regarding the SME mentioned indicated that there is a positive development in terms of TE. This study specifically focused on determining TE level of the Malaysian SME in the food processing industry based on cross sectional data from primary survey.

Theoretical background

Technical efficiency (TE) refers to the maximum attainable level of output for a given level of input within a given range of technology. Aigner et al. (1977) developed the stochastic frontier analysis (SFA) approach to estimate TE of companies using the parametric econometric approach. The method proposed a single-equation cross-sectional stochastic production frontier model which assumes that firm uses the input X_i to produce a single output Y_i based on the following equations:

$$Y_i = f(x_i, \beta) \exp(\sigma_i - \mu_i) \quad (1)$$

$TE_i = Y_i / Y^*$

Y_i = observed output

Y^* = potential output

TE measures how close a firm is to its maximum achievable output. It is measured as the ratio of the observed output to its potential output derived from frontier function. The error term in the model (equation 1) comprises two components, a random noise component (σ_i) and a new one-sided inefficiency component (μ_i). The (σ_i) accounts for measurement error and other random factors. The (μ_i) captures technical inefficiency that constraints a firm from achieving maximum possible output from a given set of inputs.

In TE measurement, equation (1) has to be estimated and the residuals decomposed into noise (σ_i) and inefficiency (μ_i). However, in this study, the focus was only on TE measurement of the sample companies. Even though the Frontier 4.1 software program is able to measure the technical inefficiency, but during the survey, not much data regarding technical inefficiency has been compiled. Therefore, technical inefficiency analysis was omitted in this study.

The Cobb-Douglas production function specification used in this study:

$$LnY_i = \beta_0 + \beta_1 LnCapital + \beta_2 LnLabour + \beta_3 LnRawMat + \beta_4 LnAdmin + \beta_5 LnMt \quad (2)$$

Where:

LnY_i = natural logarithm of output
LnCapital = natural logarithm of capital
LnLabour = natural logarithm of number of labour
LnRawMat = natural logarithm of raw materials
LnAdmin = natural logarithm of administration cost
LnMt = natural logarithm of maintenance cost

Methodology

It was reported that there were 5,925 food and beverages enterprises which was 15% of the total of 39,373 SME enterprises in the overall manufacturing industry (DOS 2005). Data were randomly gathered from 158 SME throughout West Malaysia using a structured questionnaire. The input variables

data were capital, number of labour, raw materials, administration cost and machinery usage. Output data were yearly value of output of the firm. Socio-economic data were type of business registration, number of year in operation and education level of the entrepreneur. Data were analysed using Frontier 4.1 software program (Coelli 1996).

Results and discussion

The descriptive statistics of the sample companies was depicted in *Table 1*. The median output of the sample companies was RM316.5 thousand with maximum output of RM2 million and minimum was RM42.7 thousand. The median for raw material was RM93 thousand with maximum of RM1 million and minimum of RM7.8 thousand. While the median number of labour was 8 people, the maximum number of worker was 41 and minimum was 2.

Table 1. Descriptive statistics for the selected variables

Variable	Maximum	Minimum	Median
Output	2,2042,000	42,720	316,524
Capital	45,850	301	5,643
Raw material	1,074,000	7,823	93,081
Administration	184,800	2,000	24,000
No. of labour	41	2	8
Maintenance	122,656	3,051	21,909

The estimation of the Cobb-Douglas production function was specified in the following equation i.e. equation 3. The Frontier 4.1 software program will produce both the ordinary least square (OLS) and the maximum-likelihood (MLE) estimates of the parameters which were summarized in *Table 2*.

The Cobb-Douglas production frontiers for technical efficiencies with five input variables were specified as:

$$LnY_i = 1.88778 + 0.03217LnCapital + 0.04070LnLabour + 0.67634LnRawMat + 0.09480LnAdmin + 0.15170LnMt \quad (3)$$

The result showed that all independent variables (capital, labour, raw material, administration and maintenance) have positive signs for both the OLS and MLE estimates. As depicted in *Table 2*, MLE

Table 2. Parameter estimate of the stochastic frontier (OLS & MLE) technical efficiency model in the Cobb-Douglas production function

Variables	Parameter	Coefficient			
		OLS	S.E.	MLE	S.E.
Constant	β_0	1.7515*** (7.63)	0.2296	1.88778*** (2.95950)	0.63787
Capital	β_1	0.0277* (1.80)	0.0154	0.03217** (2.13150)	0.01509
No. of labour	β_2	0.0370 (1.40)	0.0265	0.04070* (1.64893)	0.02529
Raw material	β_3	0.6779*** (45.68)	0.0148	0.67634*** (46.62820)	0.01450
Administration	β_4	0.1013*** (5.65)	0.0179	0.09480*** (5.21786)	0.01817
Maintenance	β_5	0.1471*** (8.44)	0.0174	0.15170*** (8.69250)	0.01745
Mean TE				0.86554 (87%)	
Elasticity				0.9957	
Log likelihood function				76.18231	

t ≥1.64 (*10% significant); t ≥1.96 (**5% significant); t ≥2.57 (***1% significant)

yielded a better estimate of the variables as compared to OLS technique (Tapsir 2004; Fesessu 2008). The MLE for raw material, administration and maintenance were statistically significant at $p < 0.01$ whereas labour and capital were statistically significant at $p < 0.05$. The result followed the prior expectations that as these variables increase, the value of output increases.

Technical efficiency (TE)

The mean TE of the sample companies was 87% (*Table 2*). The majority of the companies (96.8%) acquired TE level in the range of 80%. One firm (0.6%) achieved TE level in the range of 70% and four companies (2.5%) were in the range of 90%. This finding is consistent with the study of TE in selected food processing industry by Raziah et al. (2009). High TE performance among sample companies could be achieved because production practices were very systematic and followed standard procedure. Raw materials supply was always consistent and could be acquired on schedule. The extension service on almost every aspect of production, technology and machinery was easily available and efficient.

Elasticity and return to scale

The elasticity of the model was 0.9957 (*Table 2*). This indicates that the companies were operating at slightly decreasing return to scale or almost constant return to scale. *Table 3* depicts the partial elasticity of each parameter i.e. capital, labour, raw material and maintenance. Raw material contributes the most in the elasticity performance (0.67634) although in decreasing mode.

Table 3. Elasticity and return to scale

Variable	Elasticity
Capital	0.03217
Labour	0.04070
Raw material	0.67634
Administration	0.09480
Maintenance	0.15170
Return to scale	0.99571

This indicates that all parameters in sample companies were in the positive decreasing return to scale. Thus, the food SME needs to be restored to an improved situation through the injection of capital, improved production technology or the use of appropriate and efficient machinery.

Conclusion

The SME companies surveyed were generally efficient in the use of inputs for production. These companies attained a relatively higher level of TE, where majority (96.8%) of them were concentrated in 80% category. This was possible because technological skill and knowledge in this area could be easily accessible/acquired regardless of the entrepreneurs' educational background. Government has extended remarkable support in the development of this subsector. The production elasticity has gone into the declining stage indicating that an introduction of radical move in terms of increasing productivity per worker through new innovation in technology, usage of machinery or scale of production is required. A more comprehensive study on all possible factors relating to efficiency and inefficiency is necessary to give an in-depth condition of the food SME.

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Abstrak

Kajian ini memberi fokus kepada pengukuran kecekapan teknikal kilang kecil dan sederhana (SME) dalam industri pemprosesan makanan. Sejumlah 158 kilang terlibat dalam kajian ini. Data dianalisis menggunakan program Frontier 4.1. Didapati kebanyakan kilang (96.8%) mencapai tahap kecekapan sekitar 80%. Keanjalan pengeluaran dianggarkan bernilai 0.9957, menunjukkan kilang yang dikaji beroperasi pada skala menurun. Pada tahap ini, pengenalan kepada inovasi teknologi, penggunaan mesin dan peralatan yang lebih cekap atau pengeluaran pada skala yang optimum diperlukan untuk meningkatkan produktiviti.