International Food Research Journal 19(1): 287-295 (2012)

The empirical evaluation of productivity growth and efficiency of LSEs in the Malaysian food processing industry

[1*]Yodfiatfinda, [1]Mad Nasir, S., [1]Zainalabidin, M., [1]Md Ariff, H., [2]Zulkornain, Y. and [3]Alias, R.

[1]Department of Agribusiness, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia
[2]Department of Economics, 3Department of Management and Marketing, Faculty of Economics and Management, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

Abstract: This study investigates productivity growth and efficiency of Large Scale Enterprises (LSEs) in the Malaysian food processing industry. Malmquist productivity index of Data Envelopment Analysis (DEA) was employed to five-digit panel data for the period of 2000-2006. The findings suggest that average Technical Efficiency (TE) of the LSEs was 0.683 during the period of observation, which indicates that the industries are able to expand their output as much as 31.7 percent by using the same level of inputs. Total Factor Productivity (TFP) growth was positive at 7.3 percent, which is contributed by a Technical Efficiency Change (EFCH) of 4.3 percent and Technological Change (TECH) of 3.0 percent. Sub industries of manufacturing alcohol and wine as well as the processing and preserving of meat and meat products shows the highest productivity growth at 84.8 percent and 47.5 percent respectively. On the other hand, the sub industries of processing and preserving poultry and poultry products together with the manufacturing of chocolate are those which have the lowest TFP growth at -30.5percent and -14.8 percent respectively. The significant determinants of the productivity growth, with a positive relationship are public infrastructure, IT expenditure and foreign ownership, while energy price is the determinant with a negative relationship. The main contributor to the TFP growth of the LSEs in the Malaysian food processing industry is EFCH, however, the LSEs can also improve the TFP growth by moving forward the production frontier as well.

Keywords: LSEs, food processing industry, productivity growth, technical efficiency, DEA, Malaysia

Introduction

Malaysia is one of the emerging economic growth nations in the Southeast Asia. During 2000-2008, her economy grew at an average of 6.7 percent annually. Purchasing power parity increased 4.7 times from USD 87.629 billion in 1990 to USD 412.302 billion in 2010. Among the Association of South East Asian Nation (ASEAN) members, the country stands as the third highest income per capita, with about 61 percent of the populations belong to the middle to upper income groups. Development strategies that bring a significant growth in the manufacturing sector led the Malaysia success to maintain unemployment rate as low as 3.2 percent in 2007 and 3.3 percent in 2008.

Nevertheless, currently Malaysia is a net importer for food products. Value of the imported food increase from RM8.2 billion in 1996 to RM17.9 billion in 2005; and spawn a larger trade deficit of RM7.2 billion, compared with RM4.2 billion in 1996 (MIDA, 2007). Especially from 2005-2008, the deficit has increased sharply. The primary imported foods were cereal and cereal preparations, cocoa, vegetables and fruits, dairy products and animal feed. As an attempt to reduce dependence to the imported food, the government launched a policy to encourage the development of agro-base industry in the Third Industrial Master Plan (2006-2020). The policy was explicitly addressed to the development of food processing industry to be a modern industry and generate a higher value added.

Food processing industry is important for the nation's economy. The industry converts raw agricultural commodities to be an edible product closer to the consumer's desire. Morrison (1997) argued that the food industry contributes significantly to the economic performance of the industries. Adelaja *et al*., (2000) calculates contribution of the industry as much as 8.9 percent of total employment, 11.0 percent of total value added and 13.5 percent of total gross sales in the US manufacturing sector. In Australia, Kidane (2006) noted that the processed food industry accounts for about 68 percent of the total real value of food exports and 20 percent of the total merchandise real export value of the country. Consider the output value of processed food is greater than that of non processed one; all countries tend to develop their food processing industry sector. Exporting the output of processed agricultural products benefits the economy and food security program as well.

*Corresponding author.
Email: *yodfiat@gmail.com*

Performance of agro-food industry in terms of efficiency and productivity growth has been a multitude of studies in the food industry and applied economics field (see: Alpay *et al*., 2002; Hossain *et al*., 2005; Bermstein *et al*., 2008). Athukorala and Sen (1998) investigated the growth of processed food export in developing and developed countries suggested that when resources are available in the country, successful export of the food industrial products, depend on the nature of domestic policy. Compared with the conventional manufactured goods export, the spread effects of the processed food tend to be superior.

In the food processing industry, productivity growth is important due to the market is awfully competitive. Especially among LSEs of food industries worldwide, presently, the competition was fueled by globalization. Henderson (1998) reports the intensity use of intellectual inputs such as patents, brand, products reputation, trademarks, trade secrets, consumer loyalty and advanced technology strongly influence the competitiveness in the food market. Besides this, as the product mostly for human consumption; the dynamic change of consumer's taste and preferences also forms a thigh competition. Meanwhile, in the production process, the food processing industry faces some constraint factors, mainly about supply of raw material, skilled labor and energy crisis.

Large Scale Enterprises in the Malaysian food processing industry

Large Scale Enterprises (LSEs) is defined as an enterprise employs at least 150 workers or an enterprise has annual turnover more than RM25 million. In 2006 there are 136 firms, which are categorized as LSEs in the Malaysia food processing industry. It is only around four percent of the total firms in the Malaysian food industry. However, the share of this group to the whole value added and employment of food processing industry in the country was relatively high, i.e. 44 percent and 35.5 percent respectively. Table 1 shows the annual mean of the gross output, value added, labor, wages, capital and material of the LSEs in the Malaysia food processing industry for the period of 2000-2006. The value of gross output was doubled from RM 19,447 billion in 2000 to RM 43,084 billion in 2006 growing at an annual average growth rate 15.5 percent. From the total 202,616 labor engaged in the food processing industries, 55,217 of them are hired by the LSEs with an averaged growth of 19.6 percent per annum. In terms of labor cost, from total RM 1,961,448 million wages paid in the food industries, as much as 39.3 percent was contributed by the LSEs.

The dominant industries in terms of higher gross output and value added were refined palm oil, crude palm oil, kernel palm oil, industry of milk, sugar refinery, oil from other vegetables and alcohol. The total output of these seven sub industries accounted of 75 percent to the total output in the LSEs. The number of industries however is dominated by: crude palm oil, fish, refined palm oil, milk and the manufacturing of other food products.

Currently, the Malaysian food processing industry is facing some problems, mainly about productivity and efficiency, as reported by Kalirajan and Tse (1989), Mahadevan (2002) and Alias Radam (2007). These studies revealed a similar result that the productivity of this sector was low. About 30 percent of the production capacity is idle due to several constraints in production and management. To increase competitiveness and remain in the domestic and international market, the industry should improve the performance. Two the most important performance characteristics in the industrial sector are efficiency and productivity growth. Besides, the particular sub industry is also facing traditional constraints such as shortage of raw materials and skilled labor. Dairy industry, chocolate and canning of pineapple are industries that show typically dependence raw material on imported sources. However, in the present study, the focus is addressed to productivity growth issue in the LSEs of the Malaysian food processing industry.

Productivity and Efficiency Measurement

The roles of productivity growth and efficiency have been the subject of an increasing focus in the literature to understand the performance of industrial organization. Polopolus (1986), Pritchard *et al*. (1991) and Spithoven (2003) argued that productivity determines the living standard. It means the firm can distribute a better wealth to all stakeholder including worker, board of management, owner, consumer, supplier and government. Other benefits of higher productivity growth are lower inflation and improve competitiveness of the industries. Slow productivity growth limits the rate at which real income improves. Sudit (1995) concluded that productivity was an important clue for industrial enterprises to sustain a long term growth and to attain a stable profitability in a competitive environment. In addition, Morrison (2000) asserted that productivity together with efficiency is important to characterize the production and the economic performance in the food industry. While Boeh-Ocansey (1988) argued that productivity improvement in the food processing industry means an increase in food availability at a given cost, which can improve the living standards indirectly.

In the theory of production economics, there are two methods to increase output: (i) employing more inputs into the production process; or (ii) using current inputs more efficiently (higher productivity). The first method will increase income per unit input, only if an increasing return to scale technology exists. Meanwhile the second method can add revenue in any condition because it utilizes resources more productive. This is also associated with the growth of capital intensity and labor productivity. High productivity growth enables an organization to remain in a competitive market and meet its goal.

Economic theory of production provides a theoretical framework for productivity analysis. Nishimizu and Page (1982) noted that the production function is a relationship between affordable maximum outputs to reasonable minimum inputs in the production process. Using such a function, one can construct a production technology frontier with any possible combination of minimum input and maximum outputs (Seiford and Thrall, 1990). Besides, Morrison Paul (2000) argued that the measurement of productivity and efficiency focuses on the modeling of cost to output ratio (TC/Y) or output to input ratio (Y/I) where TC is the total cost, Y is the output and I proxies the aggregate input, respectively. Productivity, efficiency and its growth were the main variables for an organizational performance analysis. The importance of these variables has been widely studied in many fields of economics. At the national level, productivity is an important ingredient for increased living standard. Alpay *et al*. (2002) noted that the productivity gap between two countries influences the migration, factor payments and international conflicts.

The concept of the modern efficiency measurement was proposed by Farrell (1957). The concept was then extended by many researchers to model the efficiency measurement in various fields of the economy (see: Aigner *et al*., 1977; Charnes *et al*., 1978; Banker and Morey, 1986; Seiford and Thrall, 1990). The concept breaks down the efficiency into two components, namely technical efficiency (TE) and allocative efficiency (AE). TE reflects the ability of a firm to gain maximum output from a given level of inputs (best piece-wise), while AE reflects the ability of a firm to use the inputs in optimal proportions at the lowest combination cost. The combination of these two efficiencies is used for measuring the total economic efficiency. Aigner *et al*. (1977) used Farrell's idea to develop a parametric approach using stochastic frontier analysis (SFA) and Charnes *et al*. (1978) extended it to develop a non parametric approach to measure efficiency using Data Envelopment Analysis (DEA).

In the existing literature, DEA is widely used and known as one of the most popular methods for investigating the efficiency and productivity of economic units. Scheel and Scholtes (2003) and Emrouznejad *et al*. (2008) argued that DEA nowadays is recognized as the useful tool for researchers and practitioners for efficiency measurement, meanwhile (Ray, 2004) noted that a generic approach of DEA appears as valid alternative to regression analysis for efficiency measurement. Seaford (1996) listed a large number of studies (until 1992 at least 472 published literature) used DEA as a tool of productivity and efficiency study.

Methodology

In this study, we used DEA model to calculate technical efficiency and productivity growth of LSEs in the Malaysian food processing industry. Initially, Charnes *et al*. (1978) developed a constant return to scale model of the DEA which defines technical efficiency (TE) based on input and output orientation. Input oriented TE minimizes input at a constant amount of output, while output oriented TE maximizes output at a constant amount of input. The two approaches give the same TE scores in cases, where the production function assumes a constant return to scale (CRS) technology, but give a different TE score when it assumes a variable return to scale (VRS) technology. Banker *et al*. (1984) proposed a variable return to scale DEA, which more appropriate model because of each company has different ability and experience, and not all firms have a constant return to scale. The present study applies output oriented approach since it is more realistic to assume that firms behave to maximize output at a given set of inputs rather than minimizing the input consumption to produce a constant amount of output.

The general DEA model assumes, that there are i = 1, 2…N, Decision Making Units (DMUs), each produces M outputs using K inputs. For each i^{th} firm we have K x N inputs matrix X, and M x N output matrix Y. If u proxies the M x 1 vector of output weight and v proxies the K x 1 vector of input weight, for each DMU we can write the ratio of all outputs to all inputs as u'yi/v'xi. Following Coelli (1998), an optimal weight of this ratio can be obtained by using a linear mathematical programming:

$$\max_{u,v} (u'y_i/v'x_i),$$
$$\text{subject to } u'_i/v'_i \leq 1,\ i=1,2,\ldots,N; \text{ and } u, v \geq 0 \text{.......(1)}$$

For maximum efficiency, the i[th] firm should have a value of u and v, subject to the constraint that all efficiency measures must be in the range of 1 to 0. For a finite solution problem an additional constraint should be imposed on equation (1):

$$\begin{aligned} &\max_{\mu,\nu} (\mu' y_i), \lambda \\ &\text{s.t.} \quad \nu' x_i = 1 \\ &\mu' y_i - \nu' x_i \leq 0, \quad i=1,2,\ldots,N. \\ &\mu,\nu \geq 0 \quad \ldots\ldots\ldots\ldots \text{(2)} \end{aligned}$$

in duality of linear programming, equation (2) can be derived from an equivalent envelopment set, in the form of:

$$\begin{aligned} &\min_{\theta,\lambda} \theta, \\ &\text{s.t.} \quad -y_i + Y\lambda \geq 0 \\ &\theta x_i - X\lambda \geq 0 \\ &\lambda \geq 0, \ldots\ldots\ldots\ldots \text{(3)} \end{aligned}$$

where θ represents a scalar indicating the efficiency level of i[th] DMU with a maximum value of 1 and a minimum of 0, and λ is a N x 1 vector of constant. Equation (3) is subject to a lesser constraint than the form of (K+M<N+1), hence this form is preferred to be solved (Coelli, 1998). Equation (3) is a constant return to scale DEA model assuming the DMU is operating at an optimum scale. In the real world, an organization or a firm faces some constraint factors such as limited input supply, labor productivity etc., and make the DMU operating under its optimum level. Banker *et al*. (1984) proposed a variable return to scale DEA model by adding a convexity constraint N1'λ=1 to equation (3):

$$\begin{aligned} &\min_{\theta,\lambda} \theta, \\ &\text{s.t.} \quad -y_i + Y\lambda \geq 0 \\ &\theta x_i - X\lambda \geq 0 \\ &N1'\lambda = 1 \\ &\lambda \geq 0, \ldots\ldots\ldots\ldots \text{(4)} \end{aligned}$$

where N1 denotes Nx1 vector of unity forming a convex relationship for all data points. Coelli (1998) argued this approach provides a greater TE score than that of CRS approach. Currently the VRS DEA model is commonly used in the existing literature of efficiency and productivity studies.

To investigate productivity growth, in the present study we use Malmquist productivity index based on the geometric means of two distance functions from period "t" to period "t+1". If a DMU produces output y by using input x, at point A with the possibility production frontier F(t), then moves forward to point B with F(t+1), then we can draw four distance functions if the DMUs move from point A in the period F(t) to point B in the period of F(t+1), each: Dt (A) = aA/ab, Dt+1(A) = aA/ac, D^t (B) = dB/de and Dt+1 (B) = dB/df. Following Fare (1994), the Malmquist productivity index (M) can be defined as:

$$M^{t+1}(A,B) = \frac{dB/df}{aA/ab}\left[\frac{aB/de}{dB/df}\frac{aA/ab}{aA/ac}\right]^{1/2} = \frac{dB/df}{aA/ab}\left[\frac{df}{de}\frac{ac}{ab}\right]^{1/2} \quad \ldots\ldots\ldots\ldots \text{(5)}$$

The Malmquist productivity index (M), consist of two components: the efficiency change term and the technological change. The efficiency change is depicted by the change of distance from the frontier function in *t* and *t+1* (outside the parentheses) and the technological change is depicted by the vertical movement of the frontier function from F(t) to F(t+1) as shown within the parentheses. Fare et al. (1994) hypothesizes that $D^{t+1}(X^{t+1}, Y^{t+1})$ and $D^t(X^t, Y^t)$ must be equal to unity to be efficient. Therefore we can express the relative efficiency change as:

$$M\left(y^{t+1},y^t,x^{t+1},x^t\right) = [M^t\left(y^{t+1},y^t,x^{t+1},x^t\right) x M^{t+1}(y^{t+1},y^t,x^{t+1},x^t)]^{1/2} =$$

$$\underbrace{\frac{D_c^{t+1}\left(y^{t+1},x^{t+1}\right)}{D_c^t\left(y^t,x^t\right)}}_{\text{TE}}\underbrace{\left[\frac{D_c^t(y^{t+1},x^{t+1})}{D_c^{t+1}(y^{t+1},x^{t+1})} x \frac{D_c^t(y^t,x^t)}{D_c^{t+1}(y^t,x^t)}\right]^{1/2}}_{\text{TP}} \quad \ldots\ldots\ldots\ldots \text{(6)}$$

The Malmquist productivity index can be greater than one (DMUs exhibits positive TFP growth), equal to one (no growth) or less than one (negative TFP growth).

Data

Panel data of LSEs in the Malaysian FPI was obtained from the Department of Statistics, Malaysia (DoS). The five-digit data refers to the Malaysian Standard Industrial Classification (MSIC). Detail of the sub industries is provided in Appendix 1. From each of the sub industry, we have one output and nine inputs were used as the variables for measuring efficiency and productivity growth (equation 4 and 6) in the DEA. Value added was used as a proxy for the output, while inputs consist of: number of workers, wages, and total working hours, over time working hours, capital (total asset), materials, water, electricity, fuel and gas. All variables are valued in Ringgit Malaysian (RM) except for the number of workers and working hours. Descriptive statistics of the data is presented in Table 2.

Results and Discussion

Technical Efficiency in the LSEs

Most sub industries in the LSEs of Malaysian food processing industry have higher Technical Efficiency (TE) under variable return to scale technology. Table 3 presents TE under VRS and CRS, from 2000 to 2006. Average technical efficiency score of VRS

Table 1. Annual mean of gross output, value added and input in the LSEs of Malaysian food processing industry, 2000-2006

Year	Output (000)	Value Added (000)	Labor	Wage (000)	Capital (000)	Material (000)
2000	19,447,269	2,436,784	39,698	769,115	4,955,879	14,080,046
2001	20,967,129	3,578,876	42,007	842,925	5,114,606	14,289,487
2002	23,951,285	3,777,638	42,703	892,015	5,582,777	16,948,133
2003	29,930,452	3,540,907	45,783	910,282	5,472,226	22,871,565
2004	35,296,475	3,776,315	49,753	994,354	6,379,654	27,310,200
2005	40,332,975	4,631,958	56,688	1,203,258	7,452,066	30,514,997
2006	43,084,623	4,820,726	55,217	1,249,326	7,269,948	32,393,570
Growth*)	15.5	21.3	19.6	14.4	13.7	16.5

Source: The Department of Statistics Malaysia. *) : annual average growth 2000-2006.

Table 2. Descriptive statistics of output and inputs of LSEs Malaysian food processing industry

	Variables	N	Minimum	Maximum	Mean	Standard Deviation
Output	Value Added	189	4439	1083044.0	163678.2	2163130
Input	Labor	189	199	8687.0	1781.7	1447.31
	Wage	189	3336	262397.2	37743.7	33396.09
	Capital	189	5256	1297737.5	235838.0	216774
	Material	189	10711	15157738.0	841106.6	1974540
	MHW	189	248770	15934736.0	2736990.0	2568620
	OVT	189	0	4964638.0	447803.6	623271
	Water	189	17.76	65869.1	1651.8	4927.59
	Electric	189	257	73943.4	9932.5	11872.72
	Fuel	189	0	124060.0	11338.4	19429.35
	Valid N (listwise)	189				

Source: Author's calculation

0.952; meanwhile average for CRS is 0.683. In the DEA concept, the production frontier function is a virtual function formed by judging the best practice against all of DMUs in the sample data. Since ability of each DMU to catch up his frontier is vary from one DMU to others, it is realistic to assume a VRS technology in the efficiency measurement. Our finding support this assumption found a large portion of sub industry with high TE under VRS.

If a DMU experiences a negative technological change, it does not necessarily mean the firm has low technical efficiency, because a fully efficient firm would be unable to increase output at given inputs , but they can move forward the frontier through employing new technology. Positive technological change can be achieved by improving the technology management in the production process, for instance: using machinery, skilled labor, automation systems, and new product development and innovation.

Appendix 1. Sub Industries in the LSEs of food processing industry in Malaysia

No	Code	Sub Industries	ABBR
1	15111	Processing, preserving poultry & poultry products	POULT
2	15119	Processing, preserving meat & other meat products	MEAT
3	15120	Processing and preserving fish and fish products	FISH
4	15131	Canning of pineapples	PINAP
5	15139	Canning and preserving fruits and other vegetables	FRVGT
6	15142	Manufacturing of crude palms oil	PALMO
7	15143	Manufacturing of refined palm oil	RFPLM
8	15144	Manufacturing of palm kernel oil	KERNO
9	15149	Manufacturing of oil and fat from other vegetables	OOTVG
10	15201	Manufacturing of ice cream	ICECR
11	15202	Manufacturing of condensed, flour, other milk	MILK
12	15312	Manufacturing of flour (excluding sago & tapioca)	FLOUR
13	15330	Manufacturing of animal feed	FEEDS
14	15411	Manufacturing of biscuit and cakes	BISCU
15	15412	Manufacturing of bread, cake & other bakery	BREAD
16	15420	Sugar refinery	SUGAR
17	15431	Manufacturing of coco products	COCO
18	15432	Manufacturing of chocolate and sugar confectionary	CHOCO
19	15440	Manufacturing of macaroni, noodle and others	NOODL
20	15492	Manufacturing of coffee	COFFE
21	15494	Manufacturing of spice and curry powder	SPICE
22	15496	Manufacturing of sauce and flavor include MSG	SAUCE
23	15497	Manufacturing of Snack	SNACK
24	15499	Manufacturing of food other category	OTHER
25	15510	Alcohol from fermentation, drugs and wine	ALCHO
26	15541	Manufacturing of soft drink	SOFTD
27	15542	Processing of mineral water	MWTR

Adapted from the Department of Statistics Malaysia 2008

Table 3. Technical efficiency of LSEs in the Malaysian food processing industry, 2000-2006

Year	CRTS		VRTS	
	TE	Growth	TE	Growth
2000	0.636	-	0.931	-
2001	0.650	2.201	0.945	1.504
2002	0.700	7.692	0.973	2.963
2003	0.686	-2.000	0.943	-3.083
2004	0.576	-16.035	0.945	0.212
2005	0.754	30.903	0.949	0.423
2006	0.785	4.111	0.979	3.161
MEAN	**0.683**	**4.479**	**0.952**	**0.863**

Source: Authors's calculation by using DEA

Overall technical efficiency of the LSE in the Malaysian food processing industry shows an increasing trend from 0.636 in 2000 to 0.785 in 2006 (CRS) averaging 0.683 per annum. Based on VRS calculation, the TE score also increased from 0.931 to 0.979 for the same period with an average of 0.863. This finding is greater than TE score of food industry in Spain (0.44) reported by Marcos and Galvez (2000) and in China (0.63) as reported by Sun *et al*. (1999).

Total Factor Productivity Growth

During the period 2000-2006, LSEs of Malaysian food processing industries have an average total factor productivity growth of 7.3 percent. The sources of the TFP growth come from technical efficiency change of 4.3 percent and the technological change of 3.0 percent. DEA decomposes the technical efficiency change to pure efficiency change (PECH) and scale efficiency change (SECH) each contributing 1.2 percent and 3 percent respectively. Table 4 shows a summary of annual means of the Malmquist index for LSEs in the Malaysian FPI, 2001-2006.

Table 4. Summary of annual means of Malmquist Index for LSEs Malaysian food processing industry, 2001-2006

YEAR	EFFCH	TECH	PECH	SECH	TFPCH
2001	0.876	0.863	0.981	0.893	0.756
2002	1.196	1.196	1.080	1.107	1.430
2003	1.001	1.173	0.938	1.067	1.174
2004	0.802	1.590	0.997	0.804	1.274
2005	1.314	0.590	1.030	1.275	0.775
2006	1.151	1.056	1.043	1.103	1.215
MEAN	**1.042**	**1.031**	**1.012**	**1.030**	**1.073**

Source: Author's calculation by using DEA

Figure 1 shows the trend of productivity growth and its components. The number of sub industries that had positive growth were 18 (EFCH), 13 (TECH), 4 (PECH), 18 (SECH) and 17 (TFPCH), particularly for the PECH, there are 29 sub industries with zero growth. It is interesting to note that while productivity grew for each sub industry in the LSEs Malaysian FPI, the increment demand for processed food was much supplied by the imported sources. Cereals, Fish products, dairy and meat are the major commodities imported by Malaysia and these industries show a positive TFP growth. Table 5 presents the performance of LSEs Malaysian FPI for each sub industry. Some industries have a remarkable growth while others have negative growth. Seventeen sub industries experience with positive TFP growth, while the rest ten sub industries experience with negative TFP growth.

Table 5. Malmquist index summary by sub industry means in the LSEs

INDUSTRY	EFFCH	TECH	PECH	SECH	TFPCH
POULT	0.986	0.705	1.000	0.986	0.695
MEAT	1.475	1.000	1.000	1.475	1.475
FISH	1.036	0.967	1.000	1.036	1.002
PINAP	0.679	1.401	1.000	0.679	0.951
FRVGT	1.024	1.162	1.000	1.024	1.189
PALMO	1.000	0.914	1.000	1.000	0.914
RFPLM	1.000	0.956	1.000	1.000	0.956
KERNO	1.047	1.335	1.042	1.005	1.397
OOTVG	1.238	1.273	1.158	1.069	1.576
ICECR	1.058	1.028	1.000	1.058	1.087
MILK	1.000	1.101	1.000	1.000	1.101
FLOUR	1.076	1.158	1.059	1.017	1.246
FEEDS	0.892	1.164	1.064	0.839	1.038
BISCU	1.059	1.012	0.990	1.070	1.072
BREAD	1.113	0.944	0.887	1.255	1.051
SUGAR	1.000	1.031	1.000	1.000	1.031
COCO	1.118	1.061	1.109	1.008	1.187
CHOCO	1.008	0.846	1.000	1.008	0.852
NOODL	1.215	0.985	1.000	1.215	1.197
COFFE	1.087	0.888	1.000	1.087	0.966
SPICE	1.029	0.919	1.000	1.029	0.946
SAUCE	1.033	0.999	1.000	1.033	1.032
SNACK	1.115	0.794	1.000	1.115	0.885
OTHER	1.103	0.797	1.000	1.103	0.879
ALCHO	1.000	1.848	1.000	1.000	1.848
SOFTD	1.103	0.846	1.000	1.103	0.933
MIWATR	0.838	1.288	1.000	0.838	1.079
MEAN	**1.043**	**1.030**	**1.01**	**1.03**	**1.073**

Source: calculation from data using DEA method

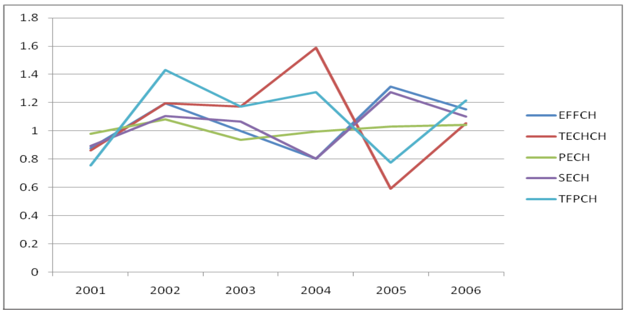

Figure 1. Trend of TFPG and its component in the LSEs

Sub industries that have the high potential for growth were the manufacturing of alcohol, manufacturers of oil (from other vegetables), meat, palm kernel oil and flour. In contrast, sub industries of poultry and poultry products as well as manufacturing of chocolate need special attention because of the lowest TFP growth. Although Malaysia is self sufficiency for poultry products, in fact the TFP growth is negative as much as -30.5 percent per annum during the period of 2000-2006. Also, for the manufacturing of chocolate, Malaysia is ranked the fourth largest producer in the world and exports the chocolate and cocoa products to more than 80 countries worldwide. Unfortunately, for this performance, the industry imports up to 85 percent of cocoa beans. During the period of observation this industry has a negative TFP growth -14.8 percent per annum. Data from the Malaysian Cocoa Board (MCB, 2010) reveals that the export values shows negative growth of -0.62 percent per annum, while import registered a positively growth of 20.07 percent per annum during 1999-2006.

The above findings disclose the general picture of the performance of LSEs in the Malaysia food industry in terms of TFP growth, technical efficiency and technological change. It gives an idea to which particular sub industries need strengthening and draw more attention for improvement. Some of the industries stand as primary export commodities such as palm oil and chocolate manufacturing, while others may stand as import substitution to food stuffs like dairy, meat and sugar.

Determinants

Hausman test gives a result that the random effect is the fit model to analyze the determinants of productivity growth in the LSEs of the Malaysian food processing industry. Summary of the determinants of productivity growth and its components are presented in Table 6. This study revealed that the positive determinants for technical efficiency change are R&D, training cost, IT expenditure, openness and foreign ownership. R&D and foreign ownership were significant at one percent level of significance, while training cost and IT expenditure were significant at ten percent level and openness was significant at five percent level. From these determinants the only uncontrollable factor is openness, while the other three determinants can be controlled by the decision maker in the firm. Output of R&D activities and training are intellectual resources such as patents, trademarks, the loyal consumer and suppliers, advanced technological and uncommon strategies on how to produce and sell a less expensive or superior products. All of these resources can be converted into intellectual property or firm-specific assets that contribute positively to the productivity growth.

For technological change, this research result suggested that the main determinants are training cost and foreign ownership. Foreign ownership is a source of technology spillover, primarily in the manufacturing sector is well documented in the literature. It usually enters a country through a direct investment to establish a fully foreign owned or joint venture firms. The foreign ownership will color the management vision of the firm as well as production behavior and it can encourage the firm to use the advanced technologies. Benfratello and Sembenelli (2006) founds that firms with foreign subsidiaries have larger TFP than domestically owned firms in the case of cross national productivity studies. In LSEs of the Malaysian food processing industry, we found that all sub industries allocate a budget for training varying from RM 18 thousand (canning pineapple) to RM 2,397 thousand (manufacturers of condensed, flour and other milk products).

Table 6. Summary determinants of productivity growth in the LSEs

	Determinants	Coef.	Std. Err.	z	P>|z|	
EFFCH	RND	0.089	0.025	3.560	0.000	***
	TRAIN	0.045	0.025	1.810	0.071	*
	ITEXP	0.034	0.020	1.670	0.094	*
	OPEN	3.307	1.411	2.340	0.019	**
	FOWE	0.844	0.125	6.760	0.000	***
TECH	TRAIN	0.235	0.016	4.780	0.000	***
	FOWE	0.291	0.080	3.630	0.000	***
SECH	RND	0.060	0.030	1.980	0.048	**
	TRAIN	0.126	0.038	3.310	0.001	***
	GINF	0.970	0.570	1.700	0.089	*
	FDI	0.664	0.156	4.250	0.000	***
	OPEN	1.590	1.491	3.750	0.000	***
	FOWE	0.817	0.157	5.210	0.000	***
PECH	FOWE	0.720	0.386	1.870	0.062	
TFPCH	ITEXP	0.058	0.027	2.140	0.033	**
	GINF	8.834	5.094	1.730	0.083	*
	WOILP	-3.853	2.123	1.810	0.070	*
	FOWE	1.550	0.165	9.370	0.000	***

All regressed using random effects model (tobit regression method)

Meanwhile the determinants of scale efficiency change (SECH) are R&D, training cost, public infrastructure, FDI, and foreign ownership. The theory behind SECH is that the larger companies tend to have higher scale efficiency (Tsai and Wang, 2005). In our case, however, the larger sub industries (proxy of total asset), do not show the SECH index vary according to the size of sub industry. This condition presumably is due to the ability of the firms to maximize output or minimize input between CRS and VRS, so that it is not congruent to sub industry size. The coefficient of each determinant as per shown in Table 6 is relatively small, except for openness (1.590). Hypothetically, this indicated that a one percent increase in trade openness index will impact as much as 1.59 percent on the change of productivity growth in LSEs of Malaysian food processing industry.

There are 20 out of 27 sub industries which experience zero growth of PECH, while only five sub industries have positive growth and the remaining two industries have negative growth. Regression results show that foreign ownership stands as a significant factor affecting PECH with a coefficient of 0.72 and confidence level of 10 percent. Total factor productivity growth of LSEs in the Malaysian food processing industry grew at average rate of 7.3 percent during 2000-2006, contributed by the technical efficiency change of 4.3 percent and technological change of 3.0 percent. As shown in Table 7, the determinants of TFP growth were IT expenditure, public infrastructure and foreign ownership (positive determinants); and energy price (negative determinant). This finding is consistent to the existing literature, for example, Isik (2007) reported foreign ownership in Turkish industrial sector exhibit robust fast the productivity growth originating from increasing technical efficiency changes. Since last four decades the Malaysian government was able to attract foreign investment bringing several benefits, including job generation, technology spillover and income. Food processing industry is one of the fastest growing sectors in the country that benefits substantially from foreign investment. Therefore foreign ownership is an important factor to enhance the performance of LSEs food industry in Malaysia.

World oil price is also a significant determinant of TFP in a negative direction with a coefficient of 0.0853, meaning that an increasing one percent of world oil price would worsen the TFP growth of 0.0853 percent. World oil price which is a proxy for energy price in the model, is just one of the exogenous variables and has an impact to input and output price as well. Hence, more detail analysis about relationship between the dependent variable and the explanatory variables may be needed by focusing to a particular sub industry using a firm level data refer to the initial clue of this finding.

Conclusion

The goal of the present study is to evaluate the efficiency and productivity growth of large scale enterprises (LSEs) of the Malaysian food processing industry (FPI) empirically. There are 27 sub industries on the LSEs in the Malaysian food processing industry. The results suggest average technical efficiency of the LSEs in the Malaysian FPI was estimated at 0.683, indicating that the industry can expand its output as much as 31.7 percent by using the same level of inputs. The manufacturing of soft drink, alcohol, animal feed, kernel palm oil and refined palm oil are industries with a high technical efficiency. On the other hand, the manufacturing of palm oil, pineapple, sugar, glucose and flour (from other beans) are sub industries with a low technical efficiency. During the period of 2000 to 2006 the LSEs of Malaysian food processing industry experienced a positive total factor productivity growth of 7.3 percent which was contributed by technical efficiency change and technological change at 4.3 percent and 3.0 percent respectively.

Considering the productivity growth and efficiency level is different across the industry, the Malaysian government should establish policies encourage the improvements of industries, especially to the sub industries that have low efficiency and productivity growth. Such improvements will make the industry more competitive in domestic and international markets. The policies should be directed at moving forward technological change by promoting new investments for machinery and automation. To achieve economies of scale, the government can introduce a merger strategy among firms within the same sub industries. This strategy has been successful in many developed countries to increase the performance of the food processing industry. Determinants of productivity growth in the present study are in line with evidence in the existing literature of productivity; public infrastructure, IT expenditure and foreign ownership positively influence TFP growth, while energy price influence it negatively.

Acknowledgment

We deliver great appreciation and special thank to Universiti Putra Malaysia (UPM) for their financial support through graduate research fellowship scheme for undertaking this work.

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