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EFFECTS OF EXTENDED VALUE CHAIN ACTIVITIES ON PROFIT EFFICIENCY IN MALAYSIAN PLANTATION COMPANIES

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ABSTRACT

The palm oil industry in Malaysia is the main driver of Malaysia's agricultural sector due to its significant contribution. High demand and attractive earnings of palm oil have attracted high participation from plantation companies in this industry. Therefore, this study aimed to assess the level of profit efficiency of plantation companies involved in different value chain activities, as well as the factors that influence the profit efficiency of these plantation companies. A total of 40 Malaysian plantation companies listed in Bursa Malaysia from 2000 to 2018 with different value chain activities were examined using panel data. The evaluation of profit efficiency was based on data analysis, which included working capital costs, labour costs, and property, plant, and equipment (PP&E) costs that affect the plantation companies' profit function. The parametric approach, also known as Stochastic Frontier Analysis (SFA), was used to assess the profit efficiency of these plantation companies empirically. The results revealed that the average profit efficiency of 40 plantation companies was 60.3 percent, implying that an estimated 39.7 percent of profit was lost due to a combination of technical inefficiencies and allocative inefficiencies in plantation companies. Other findings were based on value chain activity categories (pure upstream plantation companies and downstream integrated plantation companies), whereby downstream integrated plantation companies had the highest profit efficiency (76.6%) when compared to the pure upstream plantation companies (54.2%). As a result, the study showed that plantation companies engaged in extended value chain activities were more profit efficient than plantation companies that did not extend their value chain activities (referring to pure upstream plantation companies).

Keywords: Extended value chain, stochastic frontier analysis approach, profit efficiency, pure upstream plantation companies, and downstream integrated plantation companies.

INTRODUCTION

The palm oil industry has been the backbone of Malaysia's agricultural economy since the 1960s (Basiron, 2007). Today, it contributes to almost 40 percent of the agricultural gross domestic product (GDP) (Department of Statistics Malaysia, 2020). However, the growth of the palm oil industry in this country is reaching its limits. The yield from oil palm harvest has been stagnant at 20 tonnes per hectare since the 1980s (Malaysian Palm Oil Board, 2018). There is also no improvement in the oil extraction rate, which seems to have reached its peak at 20 percent (Malaysian Palm Oil Board, 2019). Nonetheless, above-normal profits are occasionally derived, but only from forex gains and increases in commodity prices. The industry's rapid growth in the previous decades was mainly fuelled by massive land expansion, and to this date, oil palm occupies almost 90 percent of the agricultural land in this country. Unlike other palm oil-producing countries, Malaysia can no longer rely on land expansion for the growth of its oil palm industry since the land allocated for the crop is capped at 6 million hectares.

Given the land limitation, the palm oil industry has to only rely on efficiency improvements for its growth. Farm efficiency and profitability could be achieved through technological advancements such as genetic improvements and mechanisation (Abdulla et al., 2018). From a broader industry perspective, revenue growth and profitability in a competitive sector like agriculture could be better achieved through value chain integration. Recent developments, such as the acquisition of Batu Kawan over Chemical Company of Malaysia (CCM) Berhad on 16th March 2021, and Kuala Lumpur Kepong (KLK) Berhad over IJM Plantations Berhad on 21st February 2022, are evidence of vertical integration corroborating this claim (Batu Kawan Berhad; Kuala Lumpur Kepong (KLK) Berhad Website (2022). Room for vertical integration is ample in the oil palm industry due to its extensively developed value chain, which spans from upstream activities, such as the production of high-quality seedling and crude palm oil (CPO) production to various downstream activities, e.g., the production of oleochemicals and palm oil biodiesel (Malaysian Productivity Corporation, 2015).

The value chain approach helps palm oil producers to identify and improve each part of their production process to deliver the most value for the least possible cost. Operating in a highly competitive market, the producers compete to sustain themselves and to ensure a top market position. Furthermore, in such a market, supernormal profits are nearly impossible, and companies have to contend with small margins that are getting thinner. There are various exogenous factors beyond the control of the companies, such as commodity price and exchange rate fluctuations, which would impact their profit. Thus, these producers are left with no option but to focus on internal efficiencies by engaging in an extended palm oil value chain to gain a competitive advantage. Even though this argument is one of the main strategies adopted by large palm oil producers in Malaysia, not much work has been done to assess its effectiveness. This study aims to address this gap by examining palm oil companies with different value chain activities to understand whether extending the value chain from pure upstream to the more downstream integrated activities will increase profitability.

LITERATURE REVIEW

In recent years, the measurement and analysis of efficiency have attracted attention in the operational research literature. Studies on efficiency have been a concern of researchers in various fields, especially in the agriculture sector. This has fuelled a large body of literature and is also important from the microeconomic and macroeconomic perspectives. Efficiency, as defined by the pioneering work of Farrell (1957), is known as the ability to produce a given level of output at the lowest cost. With the limitations faced by the producers in the palm oil industry, combined with their interest to maximise profit or minimise cost, measuring profit efficiency is the best approach since it can be used to define a firm's ability to reach the highest profit level at a specific price and fixed input usage (Ali & Flinn, 1989; Kumbhakar & Lovell, 2000).

Profit efficiency has been widely studied across many fields. Various researchers (Berger & Mester, 1997; Akhigbe & McNulty, 2005; Sabir & Qayyum, 2018) have found that profit efficiency is the best measurement to measure the actual profitability compared to the best-practice frontier. Thus, many researchers and economists have urged for more studies to be done on profit efficiency (Perez-Gomez et al., 2018; Fitzpatrick & McQuinn, 2008). Profit efficiency is defined as a firm's ability to reach the highest profit level at a certain price and fixed input usage (Ali & Flinn, 1989; Kumbhakar & Lovell, 2000). There are two main methods to measure the level of profit efficiency, namely parametric and non-parametric approaches. Both approaches are often used to assess profit efficiency levels by either using panel data or cross-section data. Based on previous studies, profit efficiency measurements are mainly used in the agriculture sector.

By applying the Cobb-Douglas Stochastic Frontier profit function to determine the profit efficiency of rice farmers in Malaysia, Kaka et al. (2016) found that the profit efficiency of producers was 73.2 percent, with an estimated 26.8 percent of the profit being lost due to a combination of technical and allocative inefficiencies in paddy production. This profit efficiency was contributed by factors such as education, farming experience, extension service, seed variety, and broadcast planting method, machine broadcasting method, and herbicides, where all of these factors were significant in influencing profit inefficiency. In a similar study, Dang (2017) revealed that the profit efficiency of rice farmers in Vietnam ranged between 29.8 percent and 97.6 percent, with an average of 77.46 percent, while the inefficiency factors that significantly affected the farmers' profit were size, education, farmers association, and households. Another study by Galawat and Yabe (2012) estimated the profit efficiency of rice farmers in Brunei. The results revealed that the average profit efficiency of the farmers was 80.7 percent. The results showed that farmers could increase profit by 23 percent through improvement in their technical and allocative efficiency. In terms of factors that affect profit efficiency, the inefficiency model proved that factors, such as being in a cooperative, irrigation, training, and seed variety, were essential to increase profit efficiency. By adopting the trans-log profit function, Rachmina et al. (2014) studied the impact of infrastructure on the profit efficiency of vegetable farmers in Indonesia. The results indicated that, on average, the farmers' profit efficiency was 52.6 percent and not yet efficient, where 70 percent of farming activities had an efficiency level below 0.7. Factors, such as crop diversification, land conservation, seed technology, education, and market access, could effectively increase vegetable farming profit efficiency.

From the discussion above, although there are various studies on agriculture profit efficiency, they are mostly limited to farm-level studies (Kaka et al., 2016; Galawat & Yabe, 2012; Dang, 2017; Rachmina et al., 2014) while firm-level investigations are still relatively scant. This study on the profit efficiency of palm oil plantation companies using the value chain approach provides an interesting perspective to this growing corpus of literature. The current study examined the value chain activities of 40 large plantation companies listed in the Malaysian stock exchange (i.e., Bursa Malaysia) from 2000 to 2018 and evaluated their profit efficiency using the Stochastic Frontier Analysis (SFA) method. The results confirmed the existing expectation that firms with extended value chain activities have better profit performance than their less vertically integrated competitors.

METHODOLOGY

Data and Sample

The data for this study were collected from 40 palm oil plantation companies (refer to Appendix A) that were engaged in various value chain activities. Financial and non-financial characteristics of the firms were obtained from the companies' annual reports and the Thomson Reuters DataStream (2018). Macroeconomic variables, such as exchange rate and commodity prices, were acquired from Bank Negara Malaysia (2018) and Malaysian Palm Oil Board's websites.

This study began by examining four major value chain activities of the plantation companies, namely plantations, mills, refineries, and oleochemical/biodiesel. The 40 plantation companies in this study were divided into two broad groups based on their value chain activities, which were pure upstream and downstream. Companies engaged in plantation and mill activities were classified as pure upstream plantation companies. Downstream integrated plantation companies were those involved in almost or all value chain activities, such as plantation, mill, refinery, and oleochemical/biodiesel[1.] The sample consisted of 28 pure upstream and 12 downstream integrated plantation companies.

Out of the 28 upstream companies, 11 were involved in plantation activities, such as Astral Asia Berhad, Dutaland Berhad, Gopeng Berhad, Hap Seng Plantations Holdings Berhad, Innoprise Plantations Berhad, and others, and another 17 were involved in plantation and mill activities, such as Boustead Plantations Berhad, Far East Holdings Berhad, IJM Plantations Berhad, Sarawak Plantation Berhad, and others. In 2020, the market capitalisation of pure upstream plantation companies ranged from RM71.16 million to RM2.69 billion, with gross margins ranging from -19.65 percent to 10.37 percent.

From 2000 to 2018, seven fully integrated plantation companies, namely Batu Kawan Berhad, FGV Holdings Berhad, Genting Plantations Holding Berhad, IOI Corporation Berhad, KLK Berhad, Sarawak Oil Palms Berhad, and Sime Darby Plantation Berhad, were involved in the entire value chain activities, namely plantation, mill, refinery, and oleochemicals/ biodiesel. The five remaining companies (BLD Plantation Berhad, Kretam Holdings Berhad, Kwantas Corporation Berhad, TSH Resources Berhad, and United Plantations Berhad) were involved in plantation, mill, and refinery activities. In 2020, the market capitalisation and gross margins of downstream integrated plantation companies ranged from RM874.23 million to RM28.56 billion and 0.3 percent to 31.7 percent, respectively.

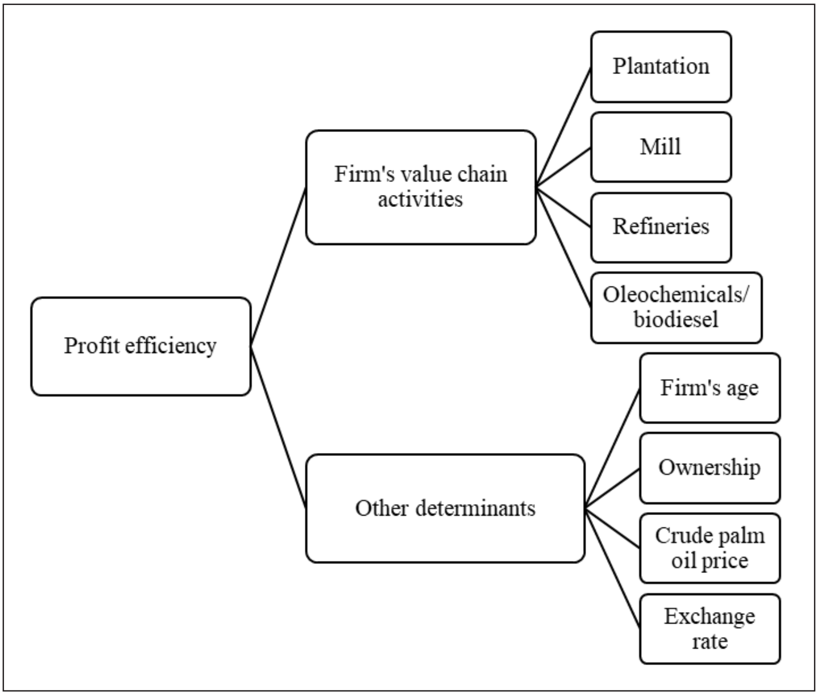
Conceptual Framework

The goal of this study was to determine whether extended value chain activities in palm oil-based plantation companies would improve their performance in terms of profit efficiency by employing the Stochastic

Frontier Analysis (SFA) approach. The conceptual framework of this study is illustrated in Figure 1. Nevertheless, some changes have been made in accordance with the argument presented in the last paragraph of the previous section.

Figure 1

Conceptual Framework of the Study



Theoretical Framework

The ability of a company to generate the highest level of profit at a given price and fixed input usage is known as profit efficiency (Kumbhakar & Lovell, 2000). In the context of the Stochastic Frontier profit function, the profit efficiency of a firm is computed as a ratio of its predicted or actual profit (P_{it}) to the corresponding predicted maximum profit (P_{max}) given the price of variable inputs and the level of fixed factors. Mathematically, it is expressed as follows:

$$PE_{it} = {P_{it}}/{P_{max}} = \frac{\exp[f(y_{it},\ p_{it})]\exp(lnv_{it})\ \exp(-lnu_{it})}{\exp[f(y_{it},\ p_{it})]\exp(lnv_{it})} = \exp(-lnu_{it}) \quad (1)$$

This study specified the correct profit function for the industry. A standard profit efficiency (SPE) function is used for a perfect competition industry and an alternative profit efficiency (APE) function is employed for imperfect markets. In this study, SPE was selected since the palm oil industry is highly competitive and the plantation companies are price takers. The firms maximise their profits by adjusting input usage since they have no power to dictate prices (Astral Asia Berhad, 2018). SPE measures how close a company earns maximum profits based on given output prices and is expressed as follows:

$$\ln(\pi_{it} + \theta) = \int (\mathrm{w}, \mathrm{p}, \mathrm{z}, \mathrm{v}) + \ln\mu_{\pi \mathrm{it}} + \ln\varepsilon_{\pi \mathrm{it}} \tag{2}$$

where π_{it} is the variable profits of the *i*-th firm that includes all the interest and fee incomes earned on the variable outputs minus variable costs (cost here is used in the cost function), θ is a constant added to the profit of each firm to attain positive values to allow for logarithmic transformation, is the input price, p is the output price, z is the fixed input, v is the set of environmental or market variables that may affect performance, $ln\mu_{\pi it}$ represents inefficiency factors that reduce the firm's profits, $ln\varepsilon_{\pi it}$ and is a random error term.

The Stochastic Profit Function Model Specification

In the frontier-efficiency literature, there are two primary frontier approaches that have been extensively used for measuring efficiency: (i) parametric approaches; and (ii) non-parametric approaches. In parametric studies, Stochastic Frontier Analysis (SFA) is the most preferred approach since it is a statistical technique that eliminates the effects of dissimilarity in input and output prices as well as other external factors that affect a firm's performance (Kumbhakar & Lovell, 2000).

Based on Farrell's (1957) seminar paper, SFA was developed by Aigner et al. (1977) and Meeusen and van den Broeck (1977). Berger and Humphrey (1997) asserted that SFA specified a functional form and allowed for random error for the cost, profit, or production relationship among inputs, outputs, and environmental factors. It is assumed that the random error has an asymmetric distribution with a zero mean and a constant variance. On the other hand, the inefficiency term has an asymmetric distribution that can be represented by a two-parameter gamma distribution or a half-normal, truncated normal, exponential distribution. SFA, according to Radam (2007), differs from simple regression analysis in many ways. Simple regression, for example, uses "maximum likelihood" estimation techniques to estimate the frontier. Furthermore, SFA distinguishes between error and inefficiency components, requiring separate assumptions about the distributions of the "inefficiency" and "error" components, potentially leading to more accurate measures of relative efficiency.

A multiple regression model based on the Stochastic Frontier profit function with Cobb-Douglas functional form was employed to assess the profit efficiency of plantation companies. The frontier model based on Battese and Coelli (1995) is specified as follows:

$$\ln\pi^{*}{}_{it} = \beta_0 + +\beta_1 \ln p_{1it} + \beta_2 \ln p_{2it} + \beta_3 \ln Z_{1it} + (v_{it} - u_{it}) \quad (3)$$

where *ln* denotes natural log, πrepresents the normalised profit for i-th plantation company for *i*=1, 2, 3…., p_i is the price of variable inputs normalised by output price: p_1 represents working capital normalised by output price, $p_2$represents the labour cost of normalised by output price, and Z_i represents the fixed input: where $Z_1$is property, plant, and equipment, whereas β_0 and β_j are the constant parameters and coefficients of the *i*-th variables for *j*=1, 2, 3, respectively.

Likelihood Ratio Test

The likelihood ratio test was used to determine whether firm-specific characteristics had an impact on profit efficiency in plantation companies. Two null hypotheses were tested using the estimation of Stochastic Frontier profit: (i) Cobb-Douglas or trans-log model; (ii) the absence of the effect of profit inefficiency. The likelihood ratio tests statistics are as follows:

$$\lambda = -2\{\ln[L(H_0)/-L(H_1)]\} = -2\{\ln[L(H_0)] - \ln[L(H_1)]\} \quad (4)$$

where $L(H_0)$and $L(H_1)$are the likelihood values computed from the restricted ordinary least squares (OLS) model and the unrestricted Stochastic Frontier model with eight degrees of freedom representing the imposed restriction. Critical values for the mixed distribution are obtained from Kodde and Palm (1986).

Profit Inefficiency Specification

The determinants of profit inefficiency of plantation companies were modelled following firm-specific characteristics in the study area and macroeconomic variables.

$$u_{it} = \delta_0 + \delta_1 F_{1it} + \delta_2 F_{2it} + \delta_3 F_{3it} + \delta_4 F_{4it} + \delta_5 F_{5it} + \delta_6 F_{6it} + \delta_7 F_{7t} + \delta_7 F_{8t} + \vartheta \quad (5)$$

Where is the inefficiency effect, F_1=pure upstream (plantation), F_2=first processing stage (mill), F_3 =second processing stage (refinery), F_4= third processing stage (oleochemical/ biodiesel), F_5=ownership, F_6=age, F_7= exchange rate, F_8= crude palm oil price, ϑ is a truncated random variable, δ_0 is a constant term, and $\delta_1, \delta_2, \delta_3, \ldots. \delta_8$ is a coefficient for *f*-th firm characteristics and control variables.

Table 1

The Definition of Variables

Profit efficiency variables		
Variable	Notation	Description (RM Million)
π	Gross margin	Total revenue minus cost of goods sold
w_1	Costs of labour	Total personnel expenses
w_2	Costs of working capital	Current assets minus current liabilities
z_1	Cost of property, plant, and equipment (PP&E)	Net property, plant, and equipment (PP&E)
Determinants of profit inefficiency and their expected sign		
PU	Pure upstream activity	Plantation
S1	First processing stage	Mill
S2	Second processing stage	Refinery
S3	Third processing stage	Oleochemicals/ Biodiesel
Own	Ownership	0 = Government/ State-owned 1 = Private owned
Age	Age of firms	From the year since the firm was incorporated until 2018
ER	Exchange rate	Yearly average Ringgit Malaysia (RM) per unit of US$
CPOP	Crude palm oil price	Log of the yearly average price of CPO per tonne (in RM)

The stochastic profit function in Equation (3) and the inefficiency models in Equation (5) were jointly estimated by combining the two-stage procedure into one stage. The maximum likelihood method was used to estimate the profit function parameters and those of the inefficiency model. The variables of the study are provided in Table 1.

RESULTS

The study conducted generalised log-likelihood tests to examine the model fit and rule out profit inefficiency of the proposed stochastic profit model of plantation companies. The results are presented in Table 2. The first null hypothesis was to identify the appropriate functional form and whether restrictive Cobb-Douglas is the best fit for this study. The results showed that it failed to reject the first null hypothesis because the lambda (λ) value (-14.76) was less than the critical value (13.36) at a 1 percent level of significance. This finding indicated that Cobb-Douglas form was the best functional form for the data.

Table 2

Generalised Log-Likelihood Tests for Stochastic Profit Model

Null hypothesis	H_0:	H_0:
Log-likelihood of H_0	-611.20	362.15
Log-likelihood of H_1	-677.23	-611.20
Statistical value (λ)	-14.76	19.47
Critical value	13.36	13.36
Degree of freedom	8	8
Decision	Fail to reject H_0 (Cobb-Douglas is the best fit)	Reject H_0 (No profit inefficiency)

*Note**** Taken from Kodde and Palm (1986), using 1% level of significance.

After selecting the Cobb-Douglas profit function form as the best fit for the data, the second hypothesis test was carried out to confirm that profit inefficiency had no effect on the plantation companies. This test was particularly important to ascertain whether the impact of profit inefficiency existed in plantation companies. The results in Table 2 revealed that the statistical values (19.47) were greater than the critical value (13.36) at a significance level of 1 percent, indicating that profit inefficiency was absent. The results showed no profit inefficiency from plantation companies' profit function, and uncontrollable factors caused the actual profit, which was higher than the estimated profit.

Table 3

Descriptive Statistics of the Variables

Variables	Mean	Standard deviation	Min	Max
Gross margin (RM million)	403.92	1944.16	-49,986,578	4,162,085,248
Working capital (RM million)	284.16	889.86	-1237.09	6983.12
Labour costs (RM million)	104.85	273.03	0.11	2599.13
Property, plant, and equipment (RM million)	1138.76	2267.80	0.42	19243.29
Pure upstream (PU): Plantation	0.98	0.151	0	1
First stage processing (S1): Mill	0.65	0.478	0	1
Second stage processing (S2): Refinery	0.25	0.432	0	1
Third stage processing (S3): Oleochemical/ biodiesel	0.14	0.346	0	1
Ownership (Government or private ownership)	0.80	0.404	0	1
Age of firm (Years)	35.02	23.928	1	113 years
Exchange rate (RM per unit of USD)	3.67	0.41	3.06	4.49
Crude palm oil price (RM thousand/ tonnes)	2433.24	691.31	1085.53	3441.44

Table 3 presents the descriptive statistics of the variables in the profit frontier model. The profit function represented the relationship between profit, input prices, and fixed input prices. The average annual profit for all 40 plantation companies was RM403.92 million. Negative profits were also quite prevalent since the minimum gross margin that plantation companies attained showed a negative sign. The study's input prices were labour costs, working capital costs, and the fixed input price representing property, plant, and equipment. Working capital is a significant expense for plantation companies, with an average spending of RM284.16 million, between -RM1,237 million to RM6,983 million. The working capital in this study represented current assets minus current liabilities. Therefore, the negative sign for working capital in this study meant that the plantation companies' current liabilities were more than the current assets, and vice versa. The average labour cost was RM104.85 million, with a minimum cost between RM0.11 million to RM2,599 million. For fixed input price, the property, plant, and equipment (PP&E) was the costliest spending for the plantation companies, with an average expenditure of RM1,139 million between RM0.42 million to RM19.24 billion.

Table 4

Generalised Log-Likelihood Tests for Stochastic Profit Model

Variables	Parameter	Coefficient	Standard error
Frontier Function			
Ln WC	β_1	0.23*** (4.5)	0.05
Ln LC	β_2	0.35*** (12.72)	0.03
Ln PP&E	β_3	0.09*** (3.7)	0.03
Constant	β_0	5.43*** (6.45)	0.84
Parameter Variance Statistics			
Sigma squared	δ^2	0.19** (1.17)	0.16
Gamma	γ	0.54*** (9.15)	0.06
Log-likelihood function	-611.20		

Notes: WC= Working capital; LC= Labour costs; PP&E= Property, Plant, and Equipment; ***, **, indicates significance at 1%, and 5% levels, respectively, and the value in parentheses is a t –value.

Table 4 shows the maximum likelihood estimates (MLE) of the normalised frontier profit function. The estimated value of gamma (γ) was close to 1 at a 1 percent level of significance and was significantly different from zero (0.54). It was revealed that 54 percent of the variation in the actual profit from the maximum profit (frontier profit) in the plantation companies mainly arose due to efficiency differences in the firm's practices. The rest was caused by external factors that were not included in the model. The coefficients of the estimated parameters of the normalised profit function were all positive and statistically significant at a 1 percent significance level. This positive coefficient indicated that a unit increase in the inputs and fixed input prices would increase plantation companies' profit efficiency and vice versa. From the results, the input variables, working capital, and labour cost were statistically significant at a 1 percent level of significance.

Working capital is a necessary amount of capital required for a firm to operate the business smoothly. For the plantation industry, working capital is significant to ensure that the company has enough cash to cover its expenses and debt. Similar to other sectors, the plantation industry needs a vast working capital to help them continue with the activities, such as replanting and others. According to Samson et al. (2012) and Ahmed et al. (2017), working capital is vital to support organisations' day-to-day financial operations, such as purchasing stock, paying salaries, and other business expenses. Working capital costs are one of the most critical variables that significantly impact plantation companies' profit efficiency since it is essential in managing a company's financial aspects. Thus, in this study, the positive coefficient of working capital meant that an increase in one unit of working capital would increase 0.23 of the plantation companies' profit efficiency.

The positive coefficient of labour cost is contrary to previous studies (Kaka et al., 2016; Bahta & Baker, 2015) that obtained the negative coefficient. However, this result is not impossible since the palm oil industry is labour-intensive. The larger number of workers in this industry needs a vast expense to pay the employee. The bigger the land area, the more workers are required. This result is consistent with the findings of Galawat and Yabe (2012) and Dang (2017), who obtained the positive sign of labour. Furthermore, the positive coefficient of property, plant, and equipment (PP&E), i.e., 0.09, indicated that plantation companies need to increase their expenditure on fixed inputs, such as machinery, vehicles (tractors, or lorry), buildings, etc., to generate a long-term economic profit. The results are parallel with previous literature that found that fixed input (land area) was essential to increase farmers' profit efficiency by expanding the land area for plantation (Kaka et al., 2016; Sadiq et al., 2015; Rachmina et al., 2014).

Table 5

Maximum Likelihood Estimates of Cobb-Douglas Profit Inefficiency Function

Variables	Parameter	Coefficient (t-value)	Standard error
		Profit inefficiency function	
PU	δ_1	-0.57*** (-3.33)	0.17
S1	δ_2	-0.08 (-1.31)	0.06
S2	δ_3	-0.27*** (-3.08)	0.09
S3	δ_4	-0.57*** (-3.08)	0.19
Own	δ_5	0.29*** (4.30)	0.07
Age of firm	δ_6	-0.17*** (-5.57)	0.03
ER	δ_7	1.02*** (4.23)	0.24
CPOP	δ_8	-1.14** (-2.65)	0.43
Constant	δ_8	-4.22*** (-4.07)	1.04

Notes: PU, S1, S2, and S3 denote the processing stage of value chain activities, where PU = plantation activity, S1 = 1st processing activity (Mill), S2 = 2nd processing activity (Refinery), S3 = 3rd processing activity (Oleochemical/ Biodiesel), Age of firm = Age since companies were incorporated; Own = Ownership (0 = Gov. / State-owned, 1 = Private-owned); ER = Exchange rate; and CPOP = crude palm oil price. ***, ** significant at 1% and 5% level, respectively. The value in parentheses is a z-value.

Table 5 estimates the inefficiency factors that explain profit efficiency in plantation companies. The model analysis showed that the sign and significance of the estimated coefficient had important implications for plantation companies' profit efficiency. It should be noted that a negative coefficient of the variables indicated that as these variables increased, the profit inefficiency of plantation companies decreased, and vice versa. As expected, the value chain activities, PU (plantation), S2 (refinery), and S3 (oleochemicals/ biofuels), were statistically significant and showed a negative coefficient, except for S1 (mill). The result signified that the increases in PU, S2, and S3 activities would reduce profit inefficiency by 5.7 percent, 2.7 percent, and 5.7 percent. Although mill activity was not statistically significant, it does not necessarily mean that it is not crucial in increasing plantation companies' profit because the negative coefficient of S1 revealed that an increase of S1 would decrease the companies' profit inefficiency.

This finding is consistent with Porter's Generic Value Chain that the companies could increase their profit if the companies were integrated with all activities in their value chain. Other than that, ownership and firm age were statistically significant at a 1 percent level of significance. The positive coefficient of ownership was estimated to be positive in this study parallels (Ramasamy et al., 2005; Suhaimi et al., 2010). The negative relationship between firm age and profit efficiency indicated that when plantation companies' age increased, plantation companies' profit efficiency was reduced (Lundvall & Battese, 2000; Perez-Gomez et al., 2018). The results showed that an increase of 1 percent in firm age would decrease the 1.7 percent profit inefficiency of plantation companies. This finding is consistent with Lundvall and Battese (2000) and Perez-Gomez et al. (2018), who believed that younger firms could not perform as well as older firms. The estimated result for the exchange rate is consistent with Khalid et al. (2018) and Mutwiri (2013). Crude palm oil price was estimated to be negative in this study, similar to the reports by Zaky et al. (2019), Ramasamy et al. (2005), and Khalid et al. (2018).

Table 6

Frequency Distribution of Plantation Companies Profit Efficiency Scores from 2000 to 2018

Efficiency scores	Downstream integrated frequency	Percentage (%)	Pure upstream frequency	Percentage (%)	Overall companies	Percentage (%)
1.00	0	0.00	0	0.00	0	0.00
> 0.90 < 1.00	5	41.67	0	0.00	5	12.50
> 0.80 ≤ 0.90	1	8.33	0	0.00	1	2.50
> 0.70 ≤ 0.80	1	8.33	0	0.00	1	2.50
> 0.60 ≤ 0.70	2	16.67	8	28.57	10	25.00
> 0.50 ≤ 0.60	3	25.00	9	32.14	12	30.00
> 0.40 ≤ 0.50	0	0.00	6	21.43	6	15.00
> 0.30 ≤ 0.40	0	0.00	5	17.86	5	12.50
> 0.20 ≤ 0.30	0	0.00	0	0.00	0	0.00
Total	12	100.00	28	100.00	40	100.00
Mean	0.77		0.54		0.60	
Minimum	0.51		0.35		0.35	
Maximum	0.96		0.70		0.96	
Standard Deviation	0.17		0.11		0.18	

Table 6 shows the frequency distribution of plantation companies' efficiency scores. Using the efficiency index criterion of 70 percent, only downstream integrated plantation companies were at a high level of 77, which was more than 70 percent, while pure upstream plantation companies were at a low level of 54. From Table 6, five plantation companies under the downstream integrated group achieved the highest profit efficiency scores, ranging from 90 percent to 100 percent. Meanwhile, the pure upstream companies' highest profit efficiency was 60 percent to 70 percent, represented by eight plantation companies. These results indicated that downstream integrated plantation companies were more profit efficient than pure upstream plantation companies[2]. Overall, the average profit efficiency was 60 percent, ranging from 35 percent to 96 percent, which similarly meant that the plantation companies were operating about 40 percent below the maximum potential output on average. The result implied that the mean plantation companies in this study could increase profit by 40 percent by improving their technical and allocative efficiency (Rachmina et al., 2014; Kaka et al., 2016).

Table 7

The Average Profit Efficiency Scores of 40 Plantation Companies in Malaysia based on Categories, 2000 to 2018

Downstream Integrated Plantation Companies	Average PE
Sime Darby Plantation Berhad	0.96
IOI Corporation Berhad	0.94
Batu Kawan Berhad	0.93
Kuala Lumpur Kepong Berhad	0.92
FGV Holdings Berhad	0.90
Kwantas Corporation Berhad	0.81
Genting Plantations Berhad	0.74
Sarawak Oil Palms Berhad	0.70
United Plantations Berhad	0.68
TSH Resources Berhad	0.58
BLD Plantation Bhd	0.51
Kretam Holdings Berhad	0.50
Pure Upstream Plantation Companies	Average PE
TDM Berhad	0.70
Boustead Plantations Berhad (2013)	0.69

(continued)

Downstream Integrated Plantation Companies	Average PE
Astral Asia Berhad	0.68
Fareast Holdings Berhad	0.67
Sungei Bagan Rubber Company (Malaya) Berhad	0.66
IJM Plantations Berhad	0.64
Negri Sembilan Oil Palm Berhad	0.63
Riverview Rubber Estates Berhad	0.62
Kluang Rubber Company (Malaya) Berhad	0.60
Pinehill Pacific Berhad	0.59
TH Plantations Berhad (2005)	0.58
Dutaland Berhad	0.57
Chin Teck Plantations Berhad	0.54
MHC Plantations Bhd	0.53
Innoprise Plantations Berhad	0.53
Inch Kenneth Kajang Rubber Public Ltd Co	0.52
Gopeng Berhad	0.51
Sarawak Plantation Berhad	0.50
Kim Loong Resources Berhad	0.49
United Malacca Berhad	0.47
Sin Heng Chan (Malaya) Berhad	0.46
Golden Land Berhad	0.43
PLS Plantation Berhad	0.41
NPC Resources Berhad	0.39
Harn Len Corporation Bhd	0.38
Cepatwawasan Group Berhad	0.37
Rimbunan Sawit Berhad	0.36
Hap Seng Plantations Holdings Berhad	0.35

Notes: The profit efficiency earned by these plantation companies is obtained by averaging the value of plantation companies' profit efficiency from the years 2000 to 2018.

Table 7 presents the average profit efficiency of plantation companies. The average scores of profit efficiency ranged between 0 and 1, where the highest profit efficiency scores were 1, and close to 0 or equal to 0 represented the lowest profit efficiency scores. The plantation companies that had the highest profit efficiency scores signified that they were profit efficient, whereas the plantation companies with the lowest scores showed that they were inefficient in terms of profit. From the table, plantation companies, like Sime Darby Plantation Berhad, IOI Corporation Berhad, Batu Kawan Berhad, Kuala Lumpur Kepong Berhad, FGV Holdings Berhad, Kwantas Corporation Berhad, and Genting, which engaged with entire value chain activities from plantation, mills, refineries, and oleochemicals/ biodiesel attained the highest profit efficiency of 0.959, 0.941, 0.939, 0.937, and 0.901, respectively.

CONCLUSIONS

There are numerous studies on profit efficiency in the agricultural sector, but none on plantation companies' participation. This study investigated the impact of various value chain activities on Malaysian plantation companies. The maximum likelihood estimates (MLE) of the specified Cobb-Douglas stochastic profit function model showed a wide range of profit efficiency scores ranging from 35.1 percent to 95.9 percent with a mean efficiency of 60.3 percent that had not reached the frontier level. According to the findings, plantation companies' profit efficiency could be increased by 39.7 percent by improving technical, allocative, and scale efficiency. The results uncovered that, on average, downstream integrated plantation companies were more profit efficient (76.6%) than pure upstream plantation companies (54.2%). The findings revealed that as companies extend their palm oil value chain, they will become more profitable. As a result, by extending the palm oil value chain from pure upstream activities to more downstream integrated activities, inefficiency in plantation companies can be significantly reduced.

In terms of average profit efficiency scores, downstream integrated plantation companies ranged from 51.2 percent to 95.9 percent, while pure upstream plantation companies ranged from 69.8 percent to 35.1 percent. Sime Darby Plantation Berhad (95.9%), IOI Corporation Berhad (94.1%), Batu Kawan Berhad (93.9%), Kuala Lumpur Kepong Berhad (93.5%), and FGV Holdings Berhad (90.1%) were the top five plantation companies in terms of profit efficiency. Hap Seng Plantations Holdings Berhad had the lowest average profit efficiency at 35.1 percent, followed by Rimbunan Sawit Berhad (36.0%), Cepatwawasan Group Berhad (37.2%), Harn Len Corporation Bhd (38.5%), and NPC Resources Berhad (39.2%).

Plantation companies' profit efficiency is influenced by various value chain activities as expected. The findings also showed that the profit efficiency of plantation companies was affected by other factors, such as firm ownership and firm age, exchange rate, and crude palm oil price. In particular, value chain activities in the third stage of processing, which was oleochemical/biodiesel (downstream segment), played a significant role in increasing the profit efficiency of plantation companies at 57.3 percent, which was higher than the 57.1 percent of plantation activity (upstream segment). It is also worth noting that, while the percentage of these two activities was not particularly significant, when the number of companies involved in these two types of activities was considered, it was discovered that plantation companies involved in oleochemicals/biodiesel activities were fewer (seven companies) than companies involved in activities (40 companies). These findings revealed that, even though only a small number of companies were involved in oleochemicals/biodiesel activities, they had the greatest impact on the profitability efficiency of plantation companies. Furthermore, other factors, such as plantation activity, refinery, firm ownership, firm age, exchange rate, and crude palm oil price, had a significant impact on the profit efficiency of plantation companies.

After outlining the importance of downstream activities to the plantation companies' profit efficiency, it is suggested for the plantation companies that are yet engaged in downstream integrated value chain activities to extend to the more downstream integrated value chain activities. The companies can choose whichever profitable activities that can maximise their profit. As an example, if the plantation company is currently involved with plantation and mills activities, it can just be involved in oleochemicals/ biodiesel activities without going through the refinery activities. In addition, government agencies like Malaysian Palm Oil Board (MPOB) need to support the PU plantation companies to shift into downstream activities by their engagement with the plantation industry and better align its research and development (R&D) activities with the market and the plantation industry demands.

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ENDNOTES

1 This study classifies refinery activities as downstream.
2 Downstream integrated companies refer to the companies engaged in upstream to downstream activities (i.e., plantation, mills, refineries, oleochemicals/ biofuels, and end products). Meanwhile, pure upstream companies refer to those engaged in upstream activities (i.e., plantation and mills only).

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APPENDIX

Appendix A

List of Malaysian Plantation Companies in Bursa Malaysia as of 2018 based on the Value Chain Activity

No.	Company	Segment			
		PU	1st S.P	2nd S.P	3rd S.P
1	Astral Asia Berhad	√			
2	Batu Kawan Berhad	√	√	√	√
3	BLD Plantation Bhd.	√	√	√	
4	Boustead Plantations Berhad	√	√		
5	Cepatwawasan Group Berhad	√	√		
6	Chin Teck Plantations Berhad	√	√		
7	Dutaland Berhad	√			
8	Far East Holdings Berhad	√	√		
9	FGV Holdings Berhad	√	√	√	√
10	Genting Plantations Berhad	√	√	√	√
11	Golden Land Berhad	√	√		
12	Gopeng Berhad	√			
13	Hap Seng Plantations Holdings Berhad	√			
14	Harn Len Corporation Bhd	√	√		
15	IJM Plantations Berhad	√	√		
16	Inch Kenneth Kajang Rubber Public Ltd Co	√			
17	Innoprise Plantations Berhad	√			
18	IOI Corporation Berhad	√	√	√	√
19	Kim Loong Resources Berhad	√	√		
20	Kluang Rubber Company (Malaya) Berhad	√			
21	Kretam Holdings Berhad	√	√	√	
22	Kuala Lumpur Kepong Berhad	√	√	√	√
23	Kwantas Corporation Berhad	√	√	√	
24	MHC Plantations Bhd	√	√		
25	Negri Sembilan Oil Palms Berhad	√	√		
26	NPC Resources Berhad	√	√		
27	Pinehilll Pacific Berhad	√	√		
28	PLS Plantations Berhad	√			
29	Rimbunan Sawit Berhad	√	√		

continued

No.	Company	Segment			
		PU	1st S.P	2nd S.P	3rd S.P
30	Riverview Rubber Estates Berhad	√			
31	Sarawak Oil Palms Berhad	√	√	√	√
32	Sarawak Plantation Berhad	√	√		
33	Sime Darby Plantation Berhad	√	√	√	√
34	Sin Heng Chan (Malaya) Berhad	√			
35	Sungei Bagan Rubber Company (Malaya) Berhad	√			
36	TDM Berhad	√	√		
37	TH Plantations Berhad	√	√		
38	TSH Resources Berhad	√	√	√	
39	United Malacca Berhad	√	√		
40	United Plantations Berhad	√	√	√	

Note:

1. PU = Pure Upstream (Plantation)
2. 1st S. P = 1st stage processing (Mill)
3. 2nd S. P = 2nd stage processing (Refinery)
4. 3rd S. P = 3rd stage processing (Oleochemical/ Biodiesel)