American Journal of Information Science and Computer Engineering
Vol. 3, No. 3, 2017, pp. 32-38
http://www.aiscience.org/journal/ajisce
ISSN: 2381-7488 (Print); ISSN: 2381-7496 (Online)

An Empirical Investigation on the Efficiency of the Financial Companies in Malaysia with DEA Model

Lam Weng Siew[1, 2, 3, *], Liew Kah Fai[1, 2], Lam Weng Hoe[1, 2, 3]

[1]Department of Physical and Mathematical Science, Faculty of Science, Universiti Tunku Abdul Rahman, Kampar Campus, Kampar, Perak, Malaysia
[2]Centre for Mathematical Sciences, Universiti Tunku Abdul Rahman, Kampar Campus, Kampar, Perak, Malaysia
[3]Centre for Business and Management, Universiti Tunku Abdul Rahman, Kampar Campus, Kampar, Perak, Malaysia

Abstract

Efficiency is one of the most important criteria in today's globalised and competitive world. Efficiency describes how well the companies can generate their outputs from the resources available. The objective of this paper is to evaluate and compare the efficiency of the companies from the financial sector in Malaysia with Data Envelopment Analysis (DEA) model. In DEA model, the efficiency of the companies is measured as the ratio of sum-weighted outputs to sum-weighted inputs. In this study, the data consists of the companies from the financial sector in Malaysia from year 2010 until 2015. The results of this study show that AEONCR, ALLIANZ, APEX, BURSA, LPI, MANULFE, OSK, PBBANK and TA are classified as efficient companies. This implies that these companies are in optimal control of their inputs or resources to generate maximum outputs. This study is significant because it helps to identify the efficient companies from the financial sector in Malaysia based on multiple inputs and outputs by using DEA model.

Keywords

Efficiency, Linear Programming Model, Optimal Control, LINGO

Received: March 16, 2017 / Accepted: April 7, 2017 / Published online: June 14, 2017

1. Introduction

In today's globalised and competitive world, efficiency becomes the most important criterion in every field. Efficiency describes how well the companies can generate their outputs from the resources available. Efficiency is important to determine the performance of the companies [1]. This study focuses on the evaluation of the financial companies' efficiency in Malaysia by using Data Envelopment Analysis (DEA) model. DEA is a mathematical linear programming model which aims to measure the efficiency of the companies [2].

DEA model was originally introduced by Charnes *et al*. [3], known as CCR model. DEA is a linear programming model which can handle multiple outputs and inputs simultaneously. The unit that achieves an efficiency score of 100% will be classified as efficient unit, otherwise, the unit will be treated as inefficient unit [3, 4]. The objective of this paper is to evaluate and compare the efficiency of the financial companies in Malaysia stock market with DEA model. The rest of the paper is organized as follows. The next section describes the literature review of DEA model in the evaluation on the efficiency of the company. Section 3 discusses about the data and methodology of the study. Section 4 presents the empirical results of this study. Section 5 concludes the paper.

2. Literature Review

Repkova [5] has assessed the efficiency of the Czech banking sector by using DEA model. The source of the data was

* Corresponding author
E-mail address: lamws@utar.edu.my (L. W. Siew), liewkf@utar.edu.my (L. K. Fai), whlam@utar.edu.my (L. W. Hoe)

collected from the database Bank Scope and annual reports of commercial banks. The commercial banks were CS, CSOB, GEM, JTB, KB, LBBW, POPO, PPF, RB, UNIC and Volksbank. The result showed that the overall efficiency of 11 commercial banks managed to achieve approximately 70-78% by DEA model. GEM bank was identified as the most efficient bank as it achieved the highest efficiency score. In addition, the result also revealed that the group of large banks such as CSOB, CS and KB banks achieved lower efficiency score due to the inappropriate size of operation and the excess deposits in the balance sheet.

Zimkova [6] has evaluated the efficiency of the banking sector in Slovakia. Sixteen commercial banking institutions in Slovakia namely Citi Europe plc., CSOB, ING Bank N.V., J&T Banka, Komercnibanka, Oberbank AG, OTP banka, Prima banka, Privatbanka, Postovabanka, SLSP, Tatrabanka, Uni Credit Bank, Volksbank, VUB and Zuno Bank AG were evaluated in terms of the efficiency. Based on the result, there were total of nine commercial banks identified as efficient banks.

Repkova [7] has measured the efficiency of the Czech banking sector by using DEA model. There were total of 15 Czech commercial banks evaluated in this study. The overall efficiency score achieved by the commercial banks was 61 to 90%. Sahin *et al*. [8] have applied the DEA model to examine the effects of global crisis on public, private and foreign-capital deposit banks in the Turkish banking sector's performance. There were total of 19 units assessed in this study. Based on the result, the overall efficiency score of 100% that reached by public-capital deposit banks only can be observed in year 2004. On the other hand, the foreign-capital deposit banks that obtained the overall efficiency score of 100% in the consecutive five years, from year 2007 until 2011. The private-capital deposit banks did not achieve 100% efficiency in his study.

In addition, DEA model has been applied in various fields such as health care [9-11], transportation [12], plantation [13] and so forth. Based on the past research, DEA model is able to evaluate and compare the efficiency of the companies based on multiple inputs and outputs in various countries. However, this model has not been studied actively in Malaysia. Therefore, this paper aims to fill the research gap by evaluating and comparing the efficiency of the financial companies in Malaysia by using DEA model.

3. Data and Methodology

3.1. Data

In this study, the data consists of the companies from the financial sector listed in Malaysia stock market as shown in Table 1.

Table 1. Companies from the Financial Sector in Malaysia Stock Market.

CompanyName	Abbreviations	Code
AEON Credit Service (M) Berhad	AEONCR	5139
Affin Holdings Berhad	AFFIN	5185
Alliance Financial Group Berhad	AFG	2488
Allianz Malaysia Berhad	ALLIANZ	1163
AMMB Holdings Berhad	AMBANK	1015
APEX Equity Holdings Berhad	APEX	5088
BIMB Holdings Berhad [S]	BIMB	5258
Bursa Malaysia Berhad	BURSA	1818
CIMB Group Holdings Berhad	CIMB	1023
ECM Libra Financial Group Berhad	ECM	2143
Hong Leong Bank Berhad	HLBANK	5819
Hong Leong Capital Berhad	HLCAP	5274
Hong Leong Financial Group Berhad	HLFG	1082
Hwang Capital (Malaysia) Berhad	HWANG	6688
InsasBerhad	INSAS	3379
Kaf-Seagroatt& Campbell Berhad	KAF	5096
LPI Capital Bhd	LPI	8621
MAA Group Berhad	MAA	1198
Manulife Holdings Berhad	MANULFE	1058
Malayan Banking Berhad	MAYBANK	1155
Malaysia Building Society Berhad	MBSB	1171
MNRB Holdings Berhad	MNRB	6459
OSK Holdings Berhad	OSK	5053
Pacific & Orient Berhad	P&O	6009
Public Bank Berhad	PBBANK	1295
RCE Capital Berhad	RCECAP	9296
RHB Capital Berhad	RHBCAP	1066
TA Enterprise Berhad	TA	4898
Syarikat Takaful Malaysia Berhad [S]	TAKAFUL	6139

Source: (Bursa Malaysia [14])

There are total of six financial ratios identified in this study, which are current ratio, debt to assets ratio, debt toequity ratio, earnings per share (EPS), return on asset (ROA)and return on equity (ROE). The data are collected from their respective companies' financial annual report on Bursa Malaysia from year 2010 until 2015 [14]. The financial ratio is defined as a relationship between two individual quantitative financial information connected with each other in some logical manner [15]. The financial ratio analysis has been adopted by different researchers in the past studies [16-19].

In this study, current ratio, debt to assets ratio and debt to equity ratio are the inputs to determine the efficiency of the companies. Output that considered in this study are earnings per share (EPS), return on asset (ROA) and return on equity (ROE). Current ratio measures a company's ability to counter balance current assets with the current liabilities [20]. Debt to assets ratio is a measure of financial leverage defined as debt divided by total assets, whereas debt to equity ratio is the relative proportion of shareholders' equity and debt used tofinance a company's assets [21]. Earnings per share (EPS) is the monetary value of earnings per outstanding share of common stock for a company [21]. Return on asset (ROA) describes how productively a company uses its assets to yield profits [22]. Return on equity (ROE) measures acompany's

efficiency at generating profits from every unit ofshareholders' equity [23].

Equation (1) to (6) present the formula for the financial ratios used in the evaluation of the company's efficiency [24].

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liability}} \quad (1)$$

$$\text{Debt to assets ratio} = \frac{\text{Total liability}}{\text{Total assets}} \quad (2)$$

$$\text{Debt to equity ratio} = \frac{\text{Total liability}}{\text{Total shareholders' equity}} \quad (3)$$

$$\text{Earnings per share} = \frac{\text{Net profit}}{\text{Number of shares}} \quad (4)$$

$$\text{Return on asset} = \frac{\text{Net profit}}{\text{Total assets}} \times 100\% \quad (5)$$

$$\text{Return on equity} = \frac{\text{Net profit}}{\text{Total shareholders' equity}} \times 100\% \quad (6)$$

3.2. Data Envelopment Analysis

Data envelopment analysis (DEA) is a mathematical linear programming model which is utilized to evaluate the relative efficiency of the decision making units. DEA model is used to describe how efficient the decision making units are able to transform the inputs into outputs or outcomes. In DEA model, the efficiency of the unit is expressed as the ratio of the sum-weighted outputs to sum-weighted inputs. DEA model is able to handle multiple outputs and inputs simultaneously. The organization unit is identified as an efficient unit if they obtain an efficiency score of 100%. For those companies that fail to achieve 100% efficiency, they will be classified as inefficient unit. The DEA model is formulated as follows:

$$\text{Maximize } h_k = \frac{\sum_{r=1}^{s} t_r y_{rk}}{\sum_{i=1}^{m} w_i x_{ik}} \quad (7)$$

Subject to

$$\frac{\sum_{r=1}^{s} t_r y_{rj}}{\sum_{i=1}^{m} w_i x_{ij}} \le 1, \; j = 1,2,3,\ldots,n \quad (8)$$

$$t_r \ge \varepsilon, \; r = 1,2,3,\ldots,s \quad (9)$$

$$w_i \ge \varepsilon, \; i = 1,2,3,\ldots,m \quad (10)$$

where

h_k is the relative efficiency of DMU_k

s is the number of outputs

t_r is the weights to be determined for output r

y_{rj} is the observed magnitude of r-type output for entity j

m is the number of inputs

w_i is the weights to be determined for input i

x_{ij} is the observed magnitude of i-type input for entity j

ε is the positive value

n is the number of entities

Equation (7) is an objective function which maximizes the efficiency for k-decision-making unit (DMU). Constraint (8) ensures that the efficiency is $0 < h_k \le 1$ for each DMU. The weights w_i and t_r show the importance of each input and output in maximizing the efficiency which is determined by the model. The model above is a nonlinear with a linear and fractional objective function as well as the constraints. The model above can convert to linear programming form by maximizing the numerator and setting the denominator to 1 (Charnes *et al*. [3]; Martic *et al*. [25]).

$$\text{Maximize } h_k = \sum_{r=1}^{s} t_r y_{rk} \quad (11)$$

Subject to

$$\sum_{i=1}^{m} w_i x_{ij} - \sum_{r=1}^{s} t_r y_{rj} \ge 0, \; j = 1,2,3,\ldots,n \quad (12)$$

$$\sum_{r=1}^{m} w_i x_{ik} = 1 \quad (13)$$

$$t_r \ge \varepsilon, \; r = 1,2,3,\ldots,s \quad (14)$$

$$w_i \ge \varepsilon, \; i = 1,2,3,\ldots,m \quad (15)$$

The DEA model is solved by using LINGO software.

4. Empirical Results

The empirical results for the performance efficiency of the financial companies are presented in Table 2.

Table 2. Performance Efficiency of the Financial Companies in Malaysia.

Company	Efficiency (%)	Rank
AEONCR	100.00	1
AFFIN	28.17	21
AFG	39.87	19
ALLIANZ	100.00	1
AMBANK	71.06	13
APEX	100.00	1

Company	Efficiency (%)	Rank
BIMB	20.44	23
BURSA	100.00	1
CIMB	12.40	25
ECM	23.49	22
HLBANK	76.22	12
HLCAP	20.22	24
HLFG	49.05	16
HWANG	39.28	20
INSAS	4.13	28
KAF	98.86	10
LPI	100.00	1
MAA	7.14	27
MANULFE	100.00	1
MAYBANK	62.57	15
MBSB	82.13	11
MNRB	1.58	29
OSK	100.00	1
P&O	43.72	18
PBBANK	100.00	1
RCECAP	63.76	14
RHBCAP	11.87	26
TA	100.00	1
TAKAFUL	44.93	17

As shown in Table 2, there are total of nine companies manage to achieve 100% efficiency score. These companies are AEONCR, ALLIANZ, APEX, BURSA, LPI, MANULFE, OSK, PBBANK and TA. These companies are ranked as efficient companies since they manage to achieve 100% efficiency score. This implies that these efficient companies are in optimal control of their inputs or resources to generate maximum outputs or outcomes.

For those companies that fail to achieve 100% efficiency score, they are classified as inefficient companies. Therefore, the companies such as AFFIN, AFG, AMBANK, BIMB, CIMB, ECM, HLBANK, HLCAP, HLFG, HWANG, INSAS, KAF, MAA, MAYBANK, MBSB, MNRB, P&O, RCECAP, RHBCAP and TAKAFUL are ranked as inefficient companies since these companies are not able to achieve 100% efficiency. As shown in Table 2, KAF and MBSB achieve maximum 98.86% and 82.13% efficiency respectively. Thus, KAF and MBSB obtain the tenth and eleventh ranking respectively in this study. On the other hand, MAA, INSAS and MNRB achieve the last three ranking based on their efficiency score obtained. Based on the results, they obtain the efficiency scores of 7.14%, 4.13% and 1.58%, respectively. This implies that MAA, INSAS and MNRB do not perform well in terms of efficiency as compared to other companies.

As a recommendation, these inefficient companies need to take immediate action in order to improve their level of efficiency. In summary, the efficient companies from the financial sector in Malaysia can be identified in this study by using DEA model. The efficient companies are AEONCR, ALLIANZ, APEX, BURSA, LPI, MANULFE, OSK, PBBANK and TA. Other inefficient companies can enhance their efficiency by taking these efficient companies as a benchmark in order to achieve optimal efficiency. Figure 1 to Figure 9 present the input and output weights for the efficient companies.

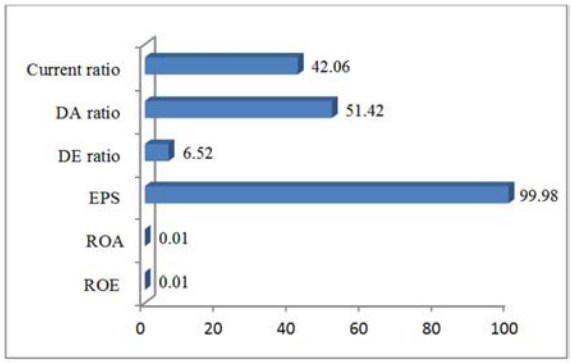

Figure 1. Input and Output Weights for AEONCR.

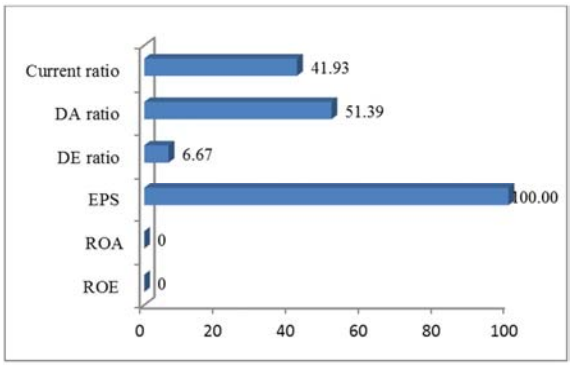

Figure 2. Input and Output Weights for ALLIANZ.

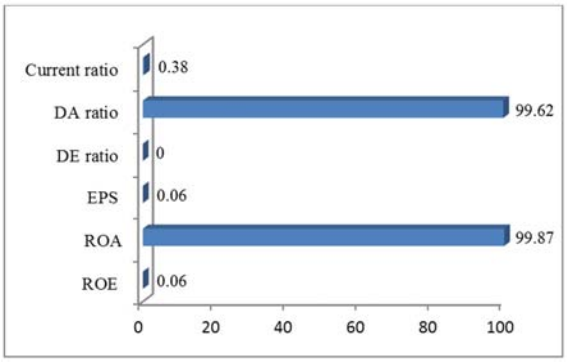

Figure 3. Input and Output Weights for APEX.

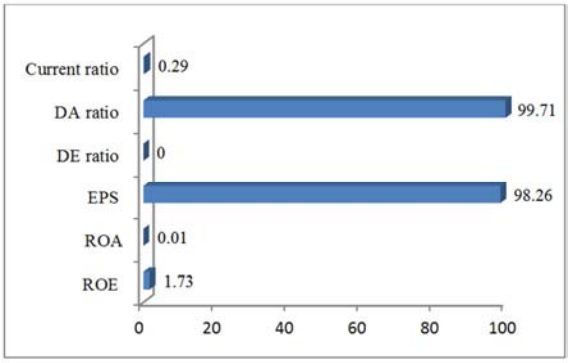

Figure 4. Input and Output Weights for BURSA.

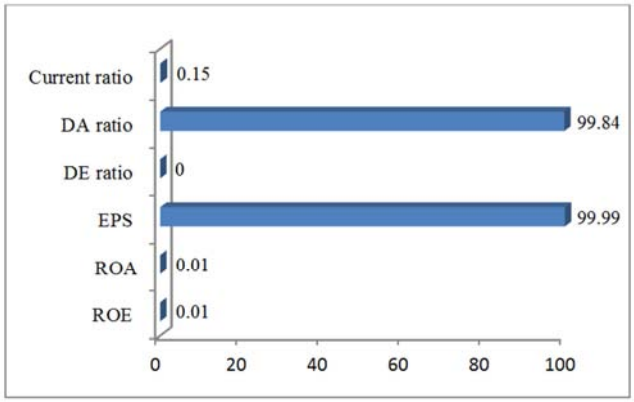

Figure 5. Input and Output Weights for LPI.

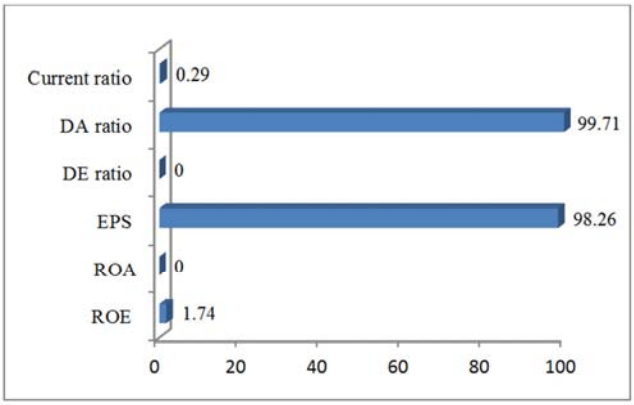

Figure 7. Input and Output Weights for OSK.

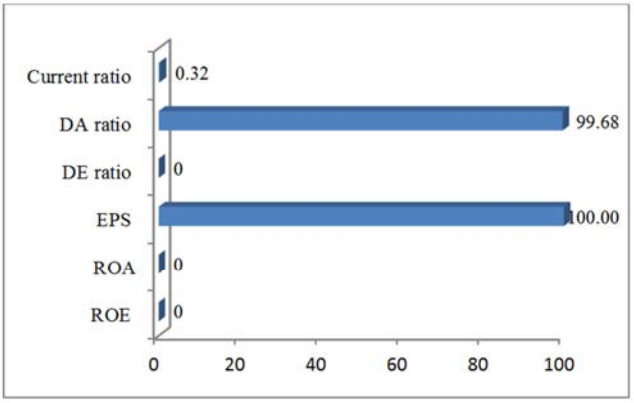

Figure 6. Input and Output Weights for MANULFE.

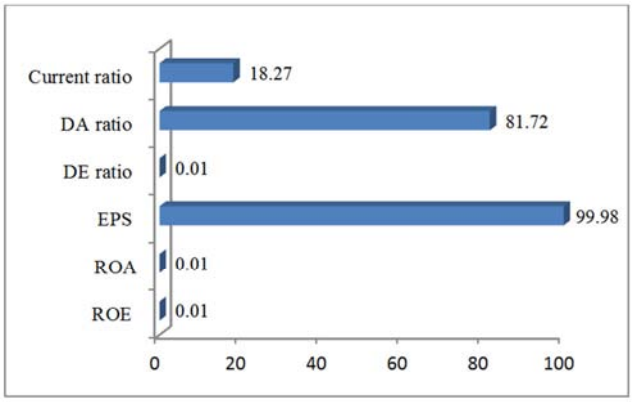

Figure 8. Input and Output Weights for PBBANK.

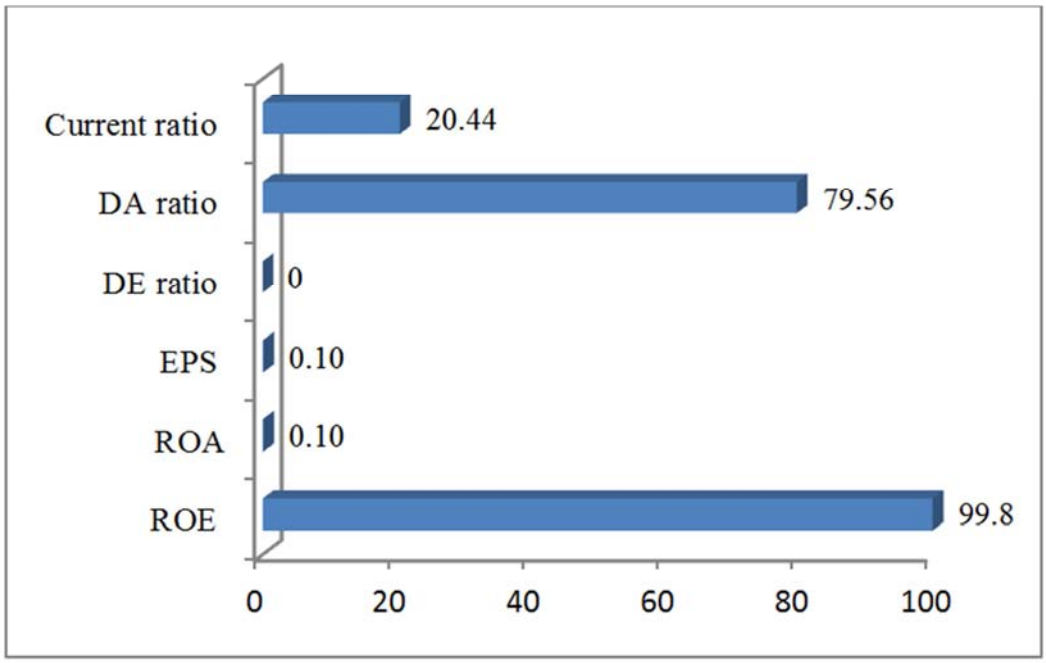

Figure 9. Input and Output Weights for TA.

Based on Figure 1 to Figure 9, the optimal input and output weights for the efficient companies are different. Table 3 presents the optimal control of input and output weights (%) in maximizing the efficiency by using DEA model.

Table 3. Optimal Control of Input and Output Weights (%) in Maximizing the Efficiency.

Company	Current ratio (Input 1)	Debt to assets ratio (Input 2)	Debt to equity ratio (Input 3)	EPS (Output 1)	ROA (Output 2)	ROE (Output 3)	Efficiency (%)
AEONCR	42.06	51.42	6.52	99.98	0.01	0.01	100.00
AFFIN	42.07	51.31	6.62	99.99	0.01	0.01	28.17
AFG	0.02	99.98	0.00	0.30	0.30	99.40	39.87
ALLIANZ	41.93	51.39	6.67	100.00	0.00	0.00	100.00
AMBANK	0.45	0.00	99.55	99.99	0.00	0.00	71.06
APEX	0.38	99.62	0.00	0.06	99.87	0.06	100.00
BIMB	0.28	99.72	0.00	97.99	0.01	2.00	20.44
BURSA	0.29	99.71	0.00	98.26	0.01	1.73	100.00
CIMB	0.09	99.91	0.00	97.13	0.04	2.83	12.40
ECM	2.03	0.00	97.97	0.13	99.74	0.13	23.49
HLBANK	18.27	81.72	0.01	99.98	0.01	0.01	76.22
HLCAP	0.02	99.98	0.00	0.32	0.32	99.36	20.22
HLFG	0.32	99.68	0.00	99.98	0.01	0.01	49.05
HWANG	0.09	99.91	0.00	97.13	0.03	2.83	39.28
INSAS	0.38	99.62	0.00	0.19	99.62	0.19	4.13
KAF	0.02	99.98	0.00	0.11	99.79	0.11	98.86
LPI	0.15	99.84	0.00	99.99	0.01	0.01	100.00
MAA	0.02	99.98	0.00	0.29	99.41	0.29	7.14
MANULFE	0.32	99.68	0.00	100.00	0.00	0.00	100.00
MAYBANK	51.49	41.84	6.67	99.24	0.01	0.75	62.57
MBSB	99.98	0.01	0.01	0.29	0.29	99.42	82.13
MNRB	18.23	81.76	0.01	99.98	0.01	0.01	1.58
OSK	0.29	99.71	0.00	98.26	0.00	1.74	100.00
P&O	0.28	99.72	0.00	97.99	0.01	1.99	43.72
PBBANK	18.27	81.72	0.01	99.98	0.01	0.01	100.00
RCECAP	0.00	100.00	0.00	0.18	0.18	99.65	63.76
RHBCAP	0.32	99.68	0.00	99.98	0.01	0.01	11.87
TA	20.44	79.56	0.00	0.10	0.10	99.80	100.00
TAKAFUL	18.39	81.60	0.01	99.97	0.02	0.02	44.93
Average	13.00	79.28	7.73	65.10	17.24	17.67	58.65

As shown in Table 3, DEA model provides the optimal control of input and output weights in maximizing the efficiency for each financial company. The efficient companies such as AEONCR, ALLIANZ, APEX, BURSA, LPI, MANULFE, OSK, PBBANK and TA have fully utilized their inputs in generating maximum outputs.

The average efficiency for the companies from the financial sector is 58.65%. Figure 10 presents the overall input and output weights in the maximization of the efficiency.

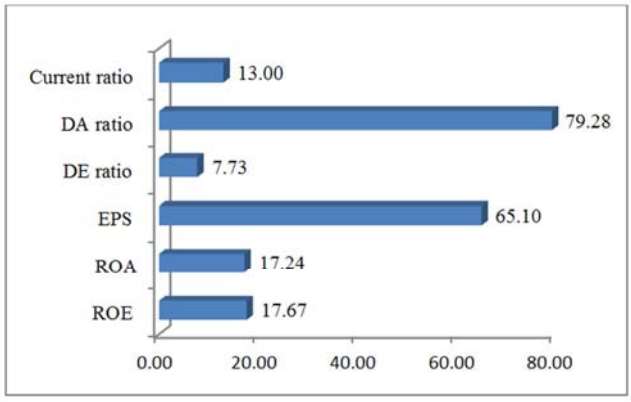

Figure 10. Overall Input and Output Weights in the Maximization of the Efficiency.

As shown in Figure 10, the overall output weights in the maximization of efficiency is mostly contributed by EPS (65.10%), followed by ROE (17.67%) and finally ROA (17.24%). On the other hand, the overall input weights in the maximization of efficiency is mostly contributed by debt to assets ratio (79.28%), followed by current ratio (13.00%), and lastly debt to equity ratio (7.73%).

5. Conclusion

DEA model is utilized to evaluate the efficiency of the organizational units since the DEA model can deal with multiple inputs and outputs simultaneously. This study aims to evaluate and compare the efficiency of the companies from the financial sector in Malaysia by using DEA model. The results of this study show that AEONCR, ALLIANZ, APEX, BURSA, LPI, MANULFE, OSK, PBBANK and TA have fully utilized their inputs in generating maximum outputs. Therefore, they are classified as efficient companies with 100% efficiency score. This study is significant because it helps to identify the efficient companies from the financial sector in Malaysia. Besides that, this study also provides the optimal control of input and output weights in maximizing the efficiency for each financial company by using DEA model.

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