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Performance Measurement of Islamic and Conventional Banking in Malaysia Using Two-stage Analysis of DEA Model

Noor Asiah Ramli, Siti Shaliza Mohd Khairi and Nor Azizah Razlan

Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Shah Alam, 40450 Selangor, MALAYSIA

Abstract

Efficiency and effectiveness are two factors that have been considered in measuring the overall performance of any institution. The objective of this study is to measure the technical efficiency scores as well as the effectiveness of the Malaysian banking sector, and thus, determine their overall performance. The study analyzes the performance of the Malaysian banking sector, which comprises two types of bank, namely commercial banks and Islamic banks. The study covers the period of 2011 to 2015. A two-stage analysis of Data Envelopment Analysis (DEA) has been used in this study. The results of the analysis show that the average efficiency scores are greater than the average effectiveness scores for both types of bank for the years 2011 until 2015, while conventional banks perform better than Islamic banks. An efficient bank does not always equate to it being more effective. Together, these two factors reflect the overall performance of a bank. An analysis on the correlation between efficiency, effectiveness, and overall performance scores indicates that a positive and strong correlation exists between effectiveness and performance, whereas there is a negative correlation between efficiency and effectiveness scores.

Keywords: Performance Measure, Efficiency, Effectiveness, Islamic Banks, Conventional Banks

Introduction

The overall performance of organizations can be defined as an appropriate combination of efficiency and effectiveness measurement. Drucker (1977) defined and compared efficiency and effectiveness by associating efficiency to “doing things right” and effectiveness to “doing the right things”. These terminologies indicate that the efficiency of a firm reflects its ability to attain output with minimum level of inputs. More precisely, Achabal et al. (1984) claimed that efficiency is primarily concerned with minimizing the costs and dealing with the allocation of resources across alternative uses. On the other hand, Keh et al. (2006) observed that the measure of effectiveness assesses the ability of an organization to attain its predetermined goals and objectives, while Asmild et al. (2007) claimed that an organization is effective to the degree to

which it achieves its goals. In addition, Keh et al. (2006) stated that effectiveness can be extended to the point that the policy objectives of an organization are achieved.

It can be noted that efficiency and effectiveness are two mutually exclusive components of the overall performance measure, yet they may influence each other. More specifically, effectiveness can be affected by efficiency or can influence efficiency as well as have an impact on the overall performance (Ozcan, 2008). Similarly, the studies conducted by Rapheal (2013) and Kumar and Gulati (2009) discovered that performance is a function of both efficiency and effectiveness. Moreover, they also defined overall performance as the product of efficiency and effectiveness.

Efficiency and effectiveness are two main indicators of performance evaluation for a company as well as the industry. Based on the previous researches on performance evaluation, the primary focus was on efficiency, while the effectiveness aspect has been compromised. Regardless of a bank's underlying philosophy, its long-run sustainability depends on economic efficiency. It is a well-known fact that an effective and efficient banking system is important for long-term growth and crucial for economy development. Thus, each bank tries to be unique to achieve higher market shares. Therefore, both efficiency and effectiveness aspects should be taken into consideration to gauge whether the goals and objectives of the banks are achieved. Ultimately, this paper attempts to measure both efficiency and effectiveness of the Malaysian banking sector and determine the behaviour of their performance. The study analyzes the performance of the Malaysian banking sector involving two types of bank, which are commercial banks and Islamic banks.

Literature Review

Bank industry plays a vital role in a country's economic development. Numerous studies have been conducted in the past in relation to efficiency or/and effectiveness in measuring the performance of the banking system. Recently Hamid et al. (2017) acknowledged nonperforming loans as being undesirable outputs while measuring efficiency. The Directional Distance Function (DDF) approach which extended from the Data Envelopment Analysis (DEA) framework is one of the enhancement efficiency approaches to handle a situation when there is a joint production of the desirable and undesirable outputs. The comparison of both results between the domestic and foreign banks shows that the DEA technical efficiency score for domestic banks is marginally higher than the Malaysian foreign banks. However, when incorporating the undesirable output, the DDF technical efficiency for foreign banks is slightly higher than domestic banks.

Yudistira (2003) examined the efficiency of the Islamic banking industry using DEA as an empirical analysis of eighteen banks in 12 countries. The sample includes four Gulf Cooperation Council (GCC) countries, which are Bahrain, Kuwait, Qatar, and the United Arab Emirates; two East Asian countries: Indonesia and Malaysia; three African countries: Algeria, Gambia, and Sudan; and three other Middle Eastern countries: Egypt, Jordan and Yemen. He then grouped the sample banks according to the size and the region where each bank originates from. Technical, pure technical, and scale efficiency measures were calculated by utilizing the non-parametric technique, DEA model. He found that inefficiency across 18 Islamic banks is small at just over 10%, which is quite low as compared to many conventional counter parts. He also provided new evidence on the performance of 18 Islamic banks during the period 1997–2000, and found that

efficiency differences across the sample appear to be mainly determined by country specific factors.

Kaveh (2011) studied the performance of Iranian bank branches using the method of a two-stage DEA model to measure and evaluate the overall performance of the Iranian banks. In the study, he calculated the efficiency and effectiveness as well as the productivity of 20 branches of Iranian banks. He defined productivity by taking the products of efficiency and effectiveness. The result found that the bank branches appeared to be operating with higher effectiveness as compared to efficiency. Another study on efficiency and effectiveness is from Kumar and Gulati (2009), whereby they observed and studied 27 public sector banks (PSBs) operating in India by using the DEA technique. In their study, they found that high efficiency does not translate to high effectiveness in the Indian PSB industry. The result of this study portrayed a positive and strong correlation between effectiveness and performance measures.

Figure 1 refers to Mouzas's (2006) illustration on the level of efficiency and effectiveness. He mentioned that various levels of efficiency and effectiveness would influence the performance level of an individual organization. From Figure 1, it is clear that banks that mainly focus on efficiency, but neglect effectiveness would have ephemeral profitability. In contrast, banks that neglect efficiency and only focus on effectiveness may result in an unprofitability growth. Thus, to achieve sustainable profitability, there is a need for an equal emphasis on both high efficiency and high effectiveness.

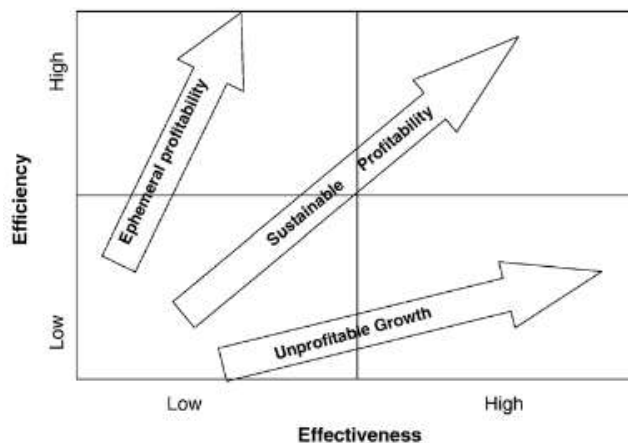


Figure 1. The effect of various levels of efficiency and effectiveness

In Malaysia, separate Islamic banking regulations exist side-by-side with those of the conventional banking regulations. The legal basis for the establishment of Islamic banks was the Islamic Banking Act (IBA), which came into effect on 7 April 1983. The IBA provides Bank Negara Malaysia (BNM) with the power to supervise and regulate Islamic banks. The banking activities of Islamic banks are based on the Syariah (or also known as Islamic) principles. Since Islamic banking is based on Syariah foundation, all dealing, transaction, business approach, product feature, investment focus, and responsibility are derived from the Syariah law, which lead to the significant difference in many parts of an Islamic bank's operations as compared to the operation of conventional banking. The foundation of Islamic banks is based on the Islamic faith and must stay within the limits of the Islamic Law or Syariah Law in all of its actions and deeds. On the other

hand, conventional banking is essentially based on the debtor-creditor relationship between the depositors and the bank on and between the borrowers and the bank. Interest is considered to be the price of credit, reflecting the opportunity cost of money.

Many studies can be found in the literature that analyzed the efficiency of Islamic and conventional banks in Malaysia. For instance, Samad (1999) determined the productive and managerial efficiency in the sources and the uses of banks' funds of both types of banks during 1992–1996. The analysis of managerial test exhibited that the managerial efficiency of conventional banks is better than that of Islamic banks. In another study, Abdul-Majid et al. (2010) also concluded that conventional banks obtained a slightly higher efficiency score as compared to Islamic banks.

To provide a different point of view on Islamic banks in Malaysia, Kamarudin et al. (2014) had conducted a study to assess the efficiency and effectiveness of Malaysian Islamic banks by using the two-stage DEA approach. They measured the performance of ten selected Islamic banks in Malaysia for the financial year period ended in 2011. They found that the average efficiency score is more than the average effectiveness score, thus, asserted that Malaysian Islamic banks exhibited a higher level of efficiency than effectiveness. Moreover, they also found that none of the banks exhibit the best practice in both aspects, hence, concluded that a bank with better efficiency does not always equate to having better effectiveness at the same time. Following the study conducted by Kamarudin et al. (2014), which focused on Islamic banks, this paper attempts to extend the analysis to compare the level of efficiency and effectiveness between Islamic and conventional banks in Malaysia. In addition, this study includes an analysis on the correlation between efficiency, effectiveness as well as the overall performance of the banking sector.

Methodology

This study employed the DEA approach which occasionally called the frontier analysis and was first put forward by Charnes, Cooper, and Rhodes in 1978. It is a linear programming-based technique for evaluating the performance of the banking sector. This method can successfully be applied to profit and non-profit making organizations. DEA also can handle multiple inputs and outputs as opposed to other techniques such as regression and ratio analysis. The performance of a unit is evaluated by comparing its performance with the best performing units of the sample. The best performing units form the efficiency frontier. If the unit is not on the efficiency frontier, it is considered to be inefficient. The aim of DEA is to quantify the distance to the efficient frontier for every decision-making unit (DMU). The measure of performance is expressed in the form of efficiency score. After the evaluation of the relative efficiency of the present set of units, the analysis shows how inputs and outputs have to be changed in order to maximize the efficiency of the target DMU. In this study, the overall technical efficiency measurement will be employed rather than the scale and pure efficiency measurement. The production process of the banking sector is assumed to exhibit a constant return to scale (CRS), whereby it estimates the gross efficiency of a DMU without taking into account the variation of efficiency on the scale of operation. Therefore, the CRS model through output orientation will be implemented for the entire analysis in this study. The DEA efficiency model proposed by Charnes et al. (1978) is as follows:

$$\begin{aligned}
 & \text{Max } \theta_m \\
 & \text{Subject to} \\
 & \sum_{n=1}^N z_n x_{in} \leq x_{im}; \quad i = 1, 2, \dots, I \\
 & \sum_{n=1}^N z_n y_{jn} \geq \theta_m y_{jm}; \quad j = 1, 2, \dots, J \\
 & z_n \geq 0; \quad n = 1, 2, \dots, N
 \end{aligned}
 \tag{1}$$

where θ_m is the inefficiency score of the m^{th} DMU, z_n is the intensity variable for the n^{th} observation, x_{in} is the i^{th} input of the n^{th} DMU, y_{jn} is the j^{th} desirable output of the n^{th} DMU, x_{im} is the i^{th} input of the m^{th} DMU, y_{jm} is the j^{th} desirable output of the m^{th} DMU.

To determine the efficiency, effectiveness, and performance scores of the Malaysian banking industry, we utilize an innovative two-stage performance evaluation model proposed by Ho and Zhu (2004). Previous studies are referred before determining the variables. Raphael (2013) and Kumar and Gulati (2009) employed physical capital, labor, deposit and loanable funds as the input variables while loan and investment as the output variables to examine their efficiency score. As for the effectiveness, the input variables used were loan and investment while the output were net interest income and non-interest income. For the first stage of DEA, in evaluating the efficiency of the banks, the selected output variables are loan and asset, while the input variables are physical capital and deposits. The efficiency scores in the first stage will determine the ability of the banks to generate loan and asset using the inputs of physical capital and deposits. For the second stage of DEA, in determining the effectiveness score of Malaysian banks, the analysis is computed using the input variables of loan and asset, while the output variables are net-interest income and non-interest income. The effectiveness scores obtained in the second stage indicates how effectively Malaysian banks are transforming the outcomes of the first stage to achieve their banks' objectives. Figure 2 represents a two-stage performance evaluation model for Malaysian banks.

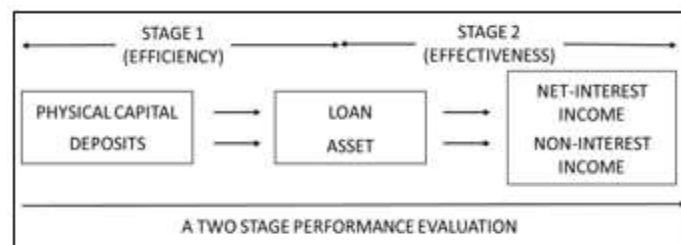


Figure 2. A two-stage performance evaluation model

Later, the overall performance score is computed by multiplying their respective efficiency and effectiveness scores from Stage 1 and Stage 2 of DEA. In addition, the Spearman's rank correlation coefficient analysis will be used to observe the relationship between efficiency, effectiveness and overall performance for Malaysian banks. The formula of Spearman's rank correlation that has usually been applied in numerous studies is as follows:

$$r_s = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n(n^2-1)} \quad (2)$$

where n = number of observations and d_i is the difference between the two ranking.

There are three types of correlation, which are differentiated by the effect of the direction of movement of one variable on another variable:

- Positive correlation – increase in one variable also increases the other variable or vice versa.
 - Negative correlation – increase in one variable decreases the other variable or vice versa.
 - No correlation – movement of one variable does not affect the movement of the other variable.
- This analysis will reveal whether the correlations among efficiency, effectiveness, and performance are positive, negative or non-existent (no correlation).

Results and Discussions

The result shown in the table is divided into two groups, which are conventional banks (DMU1-DMU7) and Islamic banks (DMU8-DMU16). The analysis was conducted using the DEAOS online software. The geometric mean is calculated for both conventional and Islamic banks to observe the performance. Meanwhile, the geometric mean for all banks is also calculated to analyze the yearly bank performance. Any bank that has an efficiency score equal to 100% is defined as fully efficient, while a score of less than 100% is regarded as inefficient. Table 1 shows the efficiency score using the DEA model throughout the banks in Malaysia. The efficiency scores using the DEA approach specify the extension of output expansion. For example, in the year 2011, Affin Bank Berhad (DMU1) was 93.8% efficient. This result suggests that the bank might expand its loan and assets by 6.2% to become fully efficient.

It can be seen from Table 1 that there are two banks that are continuously having the highest score of efficiency between the years 2011 and 2015, which are CIMB Islamic Bank Berhad (DMU10) and Malayan Banking Berhad (DMU5). On the other hand, the bank with the lowest or weakest efficiency is Al-Rajhi Bank and Investment Corporation (Malaysia) Berhad (DMU14). The inefficiency of this bank may be contributed by the managerial inefficiency that has led to it being the most inefficient in 2011. This finding is supported by Ahmad et al. (2012) that asserted that managerial inefficiency mainly contributes to the bank having the lowest technical efficiency score or becomes the most inefficient. Nevertheless, throughout the years, it seems that Al-Rajhi Bank has improved their bank's efficiency, which may be due to the positive improvement in their efficiency management.

Table 1. Efficiency Scores for Malaysian Banks between 2011 and 2015

Year Bank	2011		2012		2013		2014		2015	
	Score %	Rank	Score %	Rank	Score %	Rank	Score %	Rank	Score %	Rank
Conventional Banks										
1. Affin BankBerhad	93.8	13	91.8	14	90.3	14	90.7	16	84.6	14
2. Alliance Bank Malaysia Berhad	95.3	9	94.4	10	94.0	6	97.8	6	90.1	9
3. CIMB Bank Berhad	95.0	11	96.2	5	100.0	1	99.6	5	93.3	7
4. HSBC Bank Malaysia Berhad	98.4	6	94.3	11	93.4	9	93.8	10	91.1	8
5. Malayan Banking Berhad	100.0	1	100.0	1	100.0	1	100.0	1	100.0	1
6. RHB Bank Berhad	95.7	8	94.2	12	93.0	10	93.9	9	87.9	11
7. Public Bank Berhad	99.2	5	94.6	9	91.3	12	91.3	15	87.2	12
Geomean (conventional banks)	96.7		95.0		94.5		95.2		90.4	
Islamic Banks										
8. Affin Islamic Bank Berhad	100.0	1	99.5	4	100.0	1	100.0	1	95.8	6
9. Bank Islam Malaysia Berhad	92.5	14	92.8	13	90.6	13	92.2	13	83.2	16
10. CIMB Islamic Bank Berhad	100.0	1	100.0	1	100.0	1	100.0	1	100.0	1
11. Hong Leong Islamic Bank Berhad	95.2	10	95.5	7	92.9	11	93.5	12	84.5	15
12. Public Islamic Bank Berhad	94.3	12	95.4	8	94.0	6	93.6	11	89.8	10
13. RHB Islamic Bank Berhad	96.9	7	100.0	1	97.7	5	97.7	7	100.0	1
14. Al Rajhi Bank & Investmnt Corp (M) Bhd	89.9	16	91.3	15	89.9	15	91.4	14	84.8	13
15. HSBC Amanah Malaysia Berhad	100.0	1	96.2	5	93.6	8	95.6	8	100.0	1
16. Bank Muamalat Malaysia Berhad	91.7	15	91.2	16	89.5	15	100.0	1	100.0	1
Geomean (Islamic banks)	95.5		95.7		94.2		95.9		92.8	
Geomean (All)	96.1		95.4		94.3		95.6		91.8	

Table 2 indicates the effectiveness scores for Malaysian banks between 2011 and 2015. The results of this table portrayed that two banks continuously show the highest effectiveness score of 100% between the years 2011 and 2015, which are Bank Islam Malaysia Berhad (DMU9) and HSBC Bank Malaysia Berhad (DMU4). The most ineffective bank is RHB Islamic Bank Berhad (DMU13), which is ranked the lowest every year. This is possibly due to the bank's management that does not focus on the effectiveness aspect. Instead, it focuses on the efficiency of their bank as supported by findings in Table 1, whereby RHB Islamic Bank poses a good efficiency score throughout the years. In addition, based on Table 2, most of the banks that are efficient in Stage 1 (refer to Table 1) and have high ranking, such as Malayan Baking Berhad (DMU5) and CIMB Islamic Bank Berhad (DMU10), have low effectiveness scores or are ineffective. This situation is supported by Kamarudin et al. (2014) in which an efficient bank is not usually effective.

Table 2. Effectiveness Scores for Malaysian Banks between 2011 and 2015

Year Bank	2011		2012		2013		2014		2015	
	Score %	Rank	Score %	Rank	Score %	Rank	Score %	Rank	Score %	Rank
Conventional Banks										
1. Affin Bank Berhad	64.6	11	61.9	12	65.5	14	61.9	14	65.3	12
2. Alliance Bank Malaysia Berhad	78.6	10	73.0	9	84.4	7	81.0	6	79.7	7
3. CIMB Bank Berhad	86.7	7	79.7	6	83.8	8	81.3	5	88.5	4
4. HSBC Bank Malaysia Berhad	100.0	1	100.0	1	100.0	1	100.0	1	100.0	1
5. Malayan Banking Berhad	48.1	16	78.0	7	86.2	5	88.9	4	81.0	5
6. RHB Bank Berhad	79.4	9	65.9	11	80.6	10	69.9	12	72.0	10
7. Public Bank Berhad	80.0	8	73.1	8	77.7	11	72.4	10	80.5	6
Geomean (conventional banks)	75.1		75.1		82.0		78.5		80.4	
Islamic Banks										
8. Affin Islamic Bank Berhad	53.2	13	57.2	13	58.8	15	61.1	15	57.9	15
9. Bank Islam Malaysia Berhad	100.0	1	100.0	1	100.0	1	100.0	1	100.0	1
10. CIMB Islamic Bank Berhad	58.7	12	56.6	14	72.1	12	71.2	11	68.8	11
11. Hong Leong Islamic Bank Berhad	52.9	14	52.2	15	67.4	13	66.1	13	64.7	14
12. Public Islamic Bank Berhad	94.6	4	90.5	4	85.0	6	74.5	8	65.2	13
13. RHB Islamic Bank Berhad	50.4	15	47.9	16	50.3	16	46.0	16	46.2	16
14. Al Rajhi Bank & Investment Corp (M) Bhd	92.9	5	69.7	10	81.6	9	73.1	9	77.8	8
15. HSBC Amanah Malaysia Berhad	100.0	1	100.0	1	96.7	3	90.4	3	89.7	3
16. Bank Muamalat Malaysia Berhad	92.8	6	83.9	5	90.5	4	77.0	7	73.3	9
Geomean (Islamic banks)	74.2		70.5		76.3		71.7		69.9	
Geomean (All)	74.5		72.5		78.7		74.6		74.3	

The results presented in Table 3 are the overall performance scores for Malaysian banks between 2011 until 2015. The most performed banks will have a score of 100%, while other banks in the sample gain a score less than 100%. The bank that has a score of 100 will be ranked as number one, which means the bank is regarded as the best performing bank and will be treated as a benchmark to other banks. The bank that has the lowest score will be ranked 16 (last) indicating that the bank has the worst performance in the banking industry.

Table 3 clearly shows that only one bank exhibits the best practice in both stages, thus, securing the score of 1 in the overall performance score, which is HSBC Amanah Malaysia Berhad (DMU15) in 2011. Thus, it has become a benchmark for other banks. HSBC Amanah Malaysia Berhad has been ranked first for two consecutive years. Later, HSBC Bank Malaysia Berhad (DMU4) was ranked first on the overall performance for three consecutive years from 2012 until 2015. One possible explanation for this is that both HSBC Malaysia and HSBC Amanah Malaysia Berhad have a small number of branches in the country. Moreover, they are more efficient and effective in their management of their operation as compared to the rest of the industry players. Based on the approach used for the analysis and the variables used, it can be concluded that they are not only focusing on generating income, but also successfully achieving the bank's objectives.

Table 3. Overall Performance Scores for Malaysian Banks between 2011 and 2015

Bank	2011		2012		2013		2014		2015	
	Score %	Rank	Score %	Rank	Score %	Rank	Score %	Rank	Score %	Rank
Conventional Banks										
1. Affin Bank Berhad	60.6	11	56.8	13	59.1	14	56.1	15	55.2	14
2. Alliance Bank Malaysia Berhad	74.9	10	68.9	9	79.3	8	79.2	6	71.8	7
3. CIMB Bank Berhad	82.4	7	76.7	6	83.8	5	81.0	5	82.6	4
4. HSBC Bank Malaysia Berhad	98.4	2	94.3	2	93.4	1	93.8	1	91.1	1
5. Malayan Banking Berhad	48.1	16	78.0	5	86.2	4	88.9	3	81.0	5
6. RHB Bank Berhad	76.0	9	62.1	11	75.0	9	65.6	12	63.3	11
7. Public Bank Berhad	79.4	8	69.2	8	70.9	12	66.1	11	70.2	8
Geomean (conventional banks)	72.6		71.4		77.5		74.7		72.7	
Islamic Banks										
8. Affin Islamic Bank Berhad	53.2	13	56.9	12	58.8	15	61.1	14	55.5	13
9. Bank Islam Malaysia Berhad	92.5	3	92.8	3	90.6	2	92.2	2	83.2	3
10. CIMB Islamic Bank Berhad	58.7	12	56.6	14	72.1	11	71.2	8	68.8	9
11. Hong Leong Islamic Bank Berhad	50.4	14	49.9	15	62.6	13	61.8	13	54.7	15
12. Public Islamic Bank Berhad	89.2	4	86.3	4	79.9	7	69.7	9	58.5	12
13. RHB Islamic Bank Berhad	48.8	15	47.9	16	49.1	16	44.9	16	46.2	16
14. Al Rajhi Bank & Investment Corp (M) Bhd	83.5	6	63.6	10	73.4	10	66.8	10	66.0	10
15. HSBC Amanah Malaysia Berhad	100.0	1	96.2	1	90.5	3	86.4	4	89.7	2
16. Bank Muamalat Malaysia Berhad	85.1	5	76.5	7	81.0	6	77.0	7	73.3	6
Geomean (Islamic banks)	70.8		67.4		71.8		68.8		64.9	
Geomean (All)	71.6		69.2		74.2		71.3		68.2	

The results from Tables 1 and 2 are then used to plot the graph to observe the overview between efficiency and effectiveness for all the banks. From the graph on Fig. 3, it can be seen that most of the banks are focusing more on efficiency as compared to effectiveness. Nevertheless, generally all banks achieve sustainable profitability as they focus on improving both efficiency and effectiveness levels to achieve better performance and become the best practice for other banks in the industry.

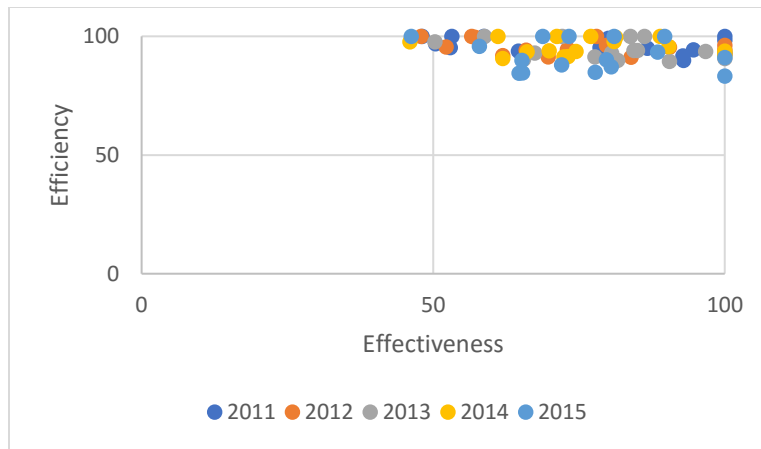


Figure 3. Efficiency versus Effectiveness plot between 2011 and 2015

To observe the relationship between efficiency, effectiveness, and overall performance for Malaysian banks, the Spearman's rank correlation coefficient was computed and presented in Table 4. The correlation analysis exhibited that there is a negative correlation between efficiency and effectiveness. This implies that high efficiency does not always result in high effectiveness in the Malaysian banking industry. Besides, it can be considered no correlation has been noted between efficiency and overall performance scores. On the other hand, there is a positive and strong correlation between effectiveness and overall performance. From these findings, it can be suggested that Malaysian banks can improve their performance by improving their effectiveness in terms of income generation.

Table 4. Spearman's rank correlation coefficient of efficiency, effectiveness and overall performance scores

	Efficiency	Effectiveness	Performance
Efficiency	1.0		
Effectiveness	-0.1634	1.0	
Overall Performance	0.0044	0.9713*	1.0

Conclusion and Recommendations

By referring to the results of conventional and Islamic banks in terms of their levels of efficiency, effectiveness, and overall performance, conventional banks have experienced a remarkable growth as compared to Islamic banks as the average of performance score for conventional banks is higher than that of Islamic banks for the years 2011 until 2015. In addition, for conventional banks, CIMB Bank Berhad is the highest performing conventional bank, thus, will act as a benchmark for other banks. The analysis on the correlation between efficiency, effectiveness, and overall performance scores indicates that there is a positive and strong correlation between effectiveness and overall performance. Hence, it suggests that Malaysian banks could improve their performance by focusing more on their income generating capabilities. A future study could extend the research in various areas that are not considered in this study. Firstly, the efficiency, effectiveness, and performance of Malaysian banks can be analyzed using

a different approach such as production approach or value-added approach. Secondly, undesirable outputs such as non-performing loan can be included in the next study to examine the performance of Malaysian banks. Thirdly, a comparison between the DEA approach and other methods such as DuPont, Artificial Neural Network (ANN) or Linear Discriminant Analysis can be performed to better assess the performance of Malaysian banks.

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Corresponding Author

Noor Asiah Ramli, Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Shah Alam, 40450 Selangor, Malaysia, asiahramli@tmsk.uitm.edu.my.

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