Investigation on the Efficiency of Financial Companies in Malaysia with Data Envelopment Analysis Model

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Abstract. Financial ratio and risk are important financial indicators to evaluate the financial performance or efficiency of the companies. Therefore, financial ratio and risk factor are needed to be taken into consideration to evaluate the efficiency of the companies with Data Envelopment Analysis (DEA) model. In DEA model, the efficiency of the company is measured as the ratio of sum-weighted outputs to sum-weighted inputs. The objective of this paper is to propose a DEA model by incorporating the financial ratio and risk factor in evaluating and comparing the efficiency of the financial companies in Malaysia. In this study, the listed financial companies in Malaysia from year 2004 until 2015 are investigated. The results of this study show that AFFIN, ALLIANZ, APEX, BURSA, HLCAP, HLFG, INSAS, LPI, MNRR, OSK, PBBANK, RCECAP and TA are ranked as efficient companies. This implies that these efficient companies have utilized their resources or inputs optimally to generate the maximum outputs. This study is significant because it helps to identify the efficient financial companies as well as determine the optimal input and output weights in maximizing the efficiency of financial companies in Malaysia.

1. Introduction

Financial ratio and risk are important financial indicators to evaluate the financial performance of the companies [1, 2]. This is because the companies wish to achieve high return with low risk [3-5]. Risk is
interpreted as a chance or probability of loss of the company [6]. Risk has been studied by the past researchers for the evaluation of financial performance [7-10]. However, risk factor is not taken into consideration by the existing Data Envelopment Analysis (DEA) model. DEA is a mathematical linear programming model which evaluates the relative efficiency of a set of companies [11-13]. Linear programming model aims to find values of the decision variables that optimize an objective function among the set of all values for the decision variables that satisfy the given constraints [14, 15].

In DEA model, the performance of the companies is measured by efficiency that expressed as the ratio of sum-weighted outputs to sum-weighted inputs [16-18]. Each company is evaluated in terms of efficiency score ranging from 0% until 100% [15]. For those companies that achieve 100% efficiency score, they will be classified as efficient company. On the other hand, the companies with less than 100% efficiency score will be identified as inefficient companies. DEA model has been studied by the past researchers in the field of banking [19-21], healthcare [22, 23], hospital [24], manufacturing firms [25], plantation company [26] and so forth.

The objective of this paper is to propose a DEA model by integrating the financial ratio and risk factor in evaluating and comparing the efficiency of the financial companies in Malaysia. The rest of the paper is organized as follows. The next section discusses about the data and methodology of the study. Section 3 presents the empirical results of this study. Section 4 concludes the paper.

2. Data and Methodology

In this study, the efficiency of financial companies listed in Malaysia stock market is analyzed. The data of this study are obtained from the financial annual report of the companies from year 2004 until 2015. Table 1 displays the financial companies listed in Bursa Malaysia [27].

| Company Name                  | Abbreviations | Code  |
|-------------------------------|---------------|-------|
| 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        | HL_BANK       | 5819  |
The inputs that need to be minimized in this study are current ratio, debt to assets ratio, debt to equity ratio as well as risk. On the other hand, return on asset, return on equity and earnings per share are the outputs that need to be maximized [28-33]. Risk is measured by the standard deviation of the stock return as follows [10].

\[
\sigma_k = \sqrt{\frac{\sum_{t=1}^{T} (R_{k,t} - \bar{R}_k)^2}{T}} \tag{1}
\]

where

- \(\sigma_k\) is the risk of stock \(k\),
- \(R_{k,t}\) is the return of stock \(k\) at time \(t\),
- \(\bar{R}_k\) is the mean return of stock \(k\),
- \(T\) is the number of observations.
Banker et al. [34] introduced DEA model with variable return to scale to evaluate and compare the efficiency of the companies. DEA model can handle multiple inputs and outputs simultaneously [35]. DEA model aims to find the optimal solution which is the maximum efficiency of a company as compared among other companies. DEA model is able to identify the efficient and inefficient companies. In financial management, efficiency is the measure of financial performance of the companies [36]. According to Zhao and Kang [37], the efficiency score is used to describe how well a company is performing in utilizing resources or inputs to generate outputs or outcomes.

The formulation of the DEA model is presented as follows:

Maximize 
$$h_k = \frac{\sum_{r=1}^{s} t_r y_{rk} - \mu_k}{\sum_{j=1}^{m} w_j x_{jk}}$$  \hspace{1cm} (2)$$

Subject to 
$$\sum_{r=1}^{s} t_r y_{rj} - \mu_k \leq 1, j = 1,2,3,...,n$$  \hspace{1cm} (3)$$
$$w_R \sigma_k \leq I$$  \hspace{1cm} (4)$$
$$t_r \geq \varepsilon, r = 1,2,3,...,s$$  \hspace{1cm} (5)$$
$$w_i \geq \varepsilon, i = 1,2,3,...,R,...,m$$  \hspace{1cm} (6)$$

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 $j$
- $\varepsilon$ is a small positive value
- $n$ is the number of entities
- $\mu_k$ is the free variable of DMU$_k$
- $\sigma_k$ is the risk of stock $k$
- $I$ is the risk of financial index

3. Empirical Results

Table 2 presents the empirical results of the efficiency score and ranking of the financial companies in Malaysia.
Table 2. Efficiency Score and Ranking of the Financial Companies.

| Company  | Efficiency (%) | Rank |
|----------|----------------|------|
| AFFIN    | 100.00         | 1    |
| AFG      | 99.05          | 15   |
| ALLIANZ  | 100.00         | 1    |
| AMBANK   | 97.54          | 19   |
| APEX     | 100.00         | 1    |
| BIMB     | 94.92          | 22   |
| BURSA    | 100.00         | 1    |
| CIMB     | 98.61          | 17   |
| ECM      | 62.64          | 27   |
| HLBANK   | 99.22          | 14   |
| HLCAP    | 100.00         | 1    |
| HLFG     | 100.00         | 1    |
| HWANG    | 71.08          | 25   |
| INSAS    | 100.00         | 1    |
| KAF      | 85.56          | 24   |
| KENANGA  | 96.90          | 20   |
| LPI      | 100.00         | 1    |
| MANULFE  | 53.09          | 28   |
| MAYBANK  | 98.91          | 16   |
| MBSB     | 95.07          | 21   |
| MNRB     | 100.00         | 1    |
| OSK      | 100.00         | 1    |
| P&O      | 90.38          | 23   |
| PBBANK   | 100.00         | 1    |
| RCECAP   | 100.00         | 1    |
| RHBCAP   | 98.39          | 18   |
| TA       | 100.00         | 1    |
| TAKAFUL  | 67.99          | 26   |

As shown in Table 2, total of 13 financial companies are found to be efficient since these companies manage to achieve 100.00% efficiency score. Therefore, these 13 companies are classified as efficient companies with first ranking over the study period. The efficient companies are AFFIN, ALLIANZ, APEX, BURSA, HLCAP, HLFG, INSAS, LPI, MNRB, OSK, PBBANK, RCECAP and TA. This implies that these efficient companies have fully utilized their resources or inputs in generating the maximum outputs. Moreover, these efficient companies can serve as benchmark to other inefficient companies for further improvement. On the other hand, AFG, AMBANK, BIMB, CIMB, ECM, HLBANK, HWANG, KAF, KENANGA, MANULFE, MAYBANK, MBSB, P&O, RHBCAP and TAKAFUL are identified as inefficient companies in this study. This indicates that these inefficient companies have not fully utilized their inputs in maximizing their outputs optimally over the study period. Furthermore, the position of ranking achieved by them is corresponding to their efficiency score obtained. The efficiency scores for HLBANK and AFG are 99.22% and 99.05% respectively. This implies that HLBANK and AFG almost close to optimal efficiency level. MANULFE is residing at the bottom with 53.09% efficiency score which is the lowest among the financial companies.
Table 3 displays the optimal input weights in maximizing the efficiency for each company by the DEA model.

**Table 3. Optimal Input Weights in Maximizing the Efficiency for Financial Companies.**

| Company  | Current ratio (%) | Debt to assets ratio (%) | Debt to equity ratio (%) | Risk (%) |
|----------|-------------------|--------------------------|--------------------------|---------|
| AFFIN    | 34.17             | 33.10                    | 0.03                     | 32.70   |
| AFG      | 53.68             | 46.30                    | 0.01                     | 0.01    |
| ALLIANZ  | 6.58              | 77.98                    | 0.01                     | 15.43   |
| AMBANK   | 39.92             | 38.94                    | 0.01                     | 21.14   |
| APEX     | 0.00              | 0.00                     | 99.99                    | 0.00    |
| BIMB     | 50.73             | 49.25                    | 0.01                     | 0.01    |
| BURSA    | 14.59             | 59.54                    | 0.01                     | 25.87   |
| CIMB     | 94.64             | 0.02                     | 5.33                     | 0.02    |
| ECM      | 0.00              | 89.92                    | 0.00                     | 10.07   |
| HLBANK   | 50.72             | 49.26                    | 0.01                     | 0.01    |
| HLCAP    | 47.24             | 22.17                    | 2.05                     | 28.55   |
| HLFG     | 75.45             | 17.42                    | 7.11                     | 0.02    |
| HWANG    | 0.00              | 81.68                    | 0.00                     | 18.31   |
| INSAS    | 9.10              | 76.08                    | 0.00                     | 14.82   |
| KAF      | 8.94              | 74.78                    | 0.01                     | 16.28   |
| KENANGA  | 94.21             | 0.02                     | 5.75                     | 0.02    |
| LPI      | 8.07              | 43.06                    | 0.01                     | 48.86   |
| MANULFE  | 8.04              | 53.79                    | 0.01                     | 38.16   |
| MAYBANK  | 35.20             | 17.94                    | 1.07                     | 45.79   |
| MBSB     | 50.80             | 49.18                    | 0.01                     | 0.01    |
| MNRB     | 29.04             | 24.58                    | 3.02                     | 43.36   |
| OSK      | 20.00             | 79.98                    | 0.01                     | 0.01    |
| P&O      | 40.06             | 0.01                     | 13.84                    | 46.09   |
| PBBANK   | 4.25              | 49.64                    | 0.01                     | 46.11   |
| RCECAP   | 42.42             | 56.67                    | 0.90                     | 0.01    |
| RHBCAP   | 53.68             | 46.30                    | 0.01                     | 0.01    |
| TA       | 16.32             | 0.01                     | 58.73                    | 24.94   |
| TAKAFUL  | 13.93             | 56.93                    | 0.01                     | 29.13   |
| Average  | 32.21             | 42.66                    | 7.07                     | 18.06   |

As shown in Table 3, the optimal input weights in maximizing the efficiency for AFFIN Company is mostly contributed by current ratio (34.17%), followed by debt to assets ratio (33.10%), risk (32.70%) and lastly, debt to equity ratio (0.03%). This implies that current ratio, debt to assets ratio and risk are the important inputs that contribute in maximizing the efficiency of AFFIN company. The overall contribution of each input in maximizing the efficiency for all financial companies is computed in average weights. In this study, the overall input weights in maximizing the efficiency of financial companies is mostly contributed by debt to assets ratio (42.66%), followed by current ratio (32.21%), risk (18.06%) and finally debt to equity ratio (7.07%).
Table 4 displays the optimal output weights in maximizing the efficiency for each company by the DEA model.

**Table 4. Optimal Output Weights in Maximizing the Efficiency for Financial Companies.**

| Company   | Return on assets (%) | Return on equity (%) | Earnings per share (%) |
|-----------|----------------------|----------------------|------------------------|
| AFFIN     | 33.33                | 33.33                | 33.33                  |
| AFG       | 33.33                | 33.33                | 33.33                  |
| ALLIANZ   | 0.01                 | 2.92                 | 97.07                  |
| AMBANK    | 33.33                | 33.33                | 33.33                  |
| APEX      | 99.69                | 0.15                 | 0.15                   |
| BIMB      | 33.33                | 33.33                | 33.33                  |
| BURSA     | 0.02                 | 1.59                 | 98.39                  |
| CIMB      | 0.06                 | 4.00                 | 95.94                  |
| ECM       | 33.33                | 33.33                | 33.33                  |
| HLBANK    | 2.46                 | 2.46                 | 95.09                  |
| HLCAP     | 0.58                 | 98.84                | 0.58                   |
| HLFG      | 0.02                 | 0.02                 | 99.95                  |
| HWANG     | 46.32                | 0.06                 | 53.62                  |
| INSAS     | 0.02                 | 0.76                 | 99.22                  |
| KAF       | 0.02                 | 0.76                 | 99.22                  |
| KENANGA   | 33.33                | 33.33                | 33.33                  |
| LPI       | 4.55                 | 0.81                 | 94.64                  |
| MANULFE   | 0.04                 | 0.51                 | 99.45                  |
| MAYBANK   | 0.08                 | 0.08                 | 99.85                  |
| MBSB      | 21.44                | 57.12                | 21.44                  |
| MNRB      | 0.02                 | 2.30                 | 97.69                  |
| OSK       | 0.02                 | 1.70                 | 98.28                  |
| P&O       | 33.33                | 33.33                | 33.33                  |
| PBBANK    | 0.02                 | 2.73                 | 97.25                  |
| RCECAP    | 0.57                 | 98.87                | 0.57                   |
| RHBCAP    | 33.33                | 33.33                | 33.33                  |
| TA        | 33.33                | 33.33                | 33.33                  |
| TAKAFUL   | 0.03                 | 1.57                 | 98.40                  |
| Average   | 17.00                | 20.62                | 62.38                  |

Based on Table 4, the overall output weights in maximizing the efficiency of financial companies are mostly contributed by earnings per share (62.38%), followed by return on equity (20.62%) and finally return on assets (17.00%). This implies that earnings per share give the highest contribution of optimal weights in the maximization of the efficiency of financial companies.
4. Conclusion

DEA is a linear programming model which measures the relative efficiency of a set of companies. In this study, DEA model has been proposed by integrating the risk factor and financial ratio in evaluating the efficiency of the financial companies in Malaysia. The results of this study show that AFFIN, ALLIANZ, APEX, BURSA, HLCAP, HLFG, INSAS, LPI, MNRB, OSK, PBBANK, RCECAP and TA are ranked as efficient companies because these companies manage to achieve 100.00% efficiency score. This implies that these efficient companies are able to utilize the inputs optimally in generating the maximum outputs. Moreover, these efficient companies can serve as benchmark to other inefficient companies for further improvement. This study is significant because it helps to identify the efficient companies as well as determine the optimal inputs and outputs weight in maximizing the efficiency of financial companies in Malaysia.

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