Evaluating Company Efficiency in Malaysian Stock Markets: Insights from DEA and Super Efficiency Models

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ABSTRACT

This study evaluates the financial efficiency of thirty Malaysian companies listed on Bursa Malaysia from 2016 to 2018, using Data Envelopment Analysis (DEA) with the Charnes, Cooper, and Rhodes (CCR) model under constant returns to scale. Efficiency is measured through financial ratios, with return on equity as the output and asset turnover, market capitalization, and debt to equity ratio as inputs. A score of 1 indicates full efficiency, while scores below 1 reflect inefficiency. In 2018, results showed that eight companies (7%) achieved a perfect efficiency score of 1. These companies included DMU2 (Westports Holdings Berhad), DMU3 (AWC Berhad), DMU5 (Cypark Resources Berhad), DMU10 (George Kent (Malaysia) Berhad), DMU11 (AirAsia Group Berhad), DMU15 (UOA Development Berhad), DMU16 (Yinson Holdings Berhad), and DMU17 (RGB International Berhad), making it challenging to identify the top performer. To distinguish the top performers, the Super Efficiency method was applied, revealing DMU15 (UOA Development Berhad) as the most efficient, followed by DMU10 (George Kent (Malaysia) Berhad) and DMU16 (Yinson Holdings Berhad). Similar patterns were observed in 2017 and 2016, with DMU3 (AWC Berhad) consistently emerging as a top performer. The study highlights that using DEA and Super Efficiency methods provides a comprehensive and detailed ranking of company efficiency, offering valuable insights for informed policymaking and investment strategies. The findings underscore the importance of efficiency in driving investor confidence and supporting economic growth.

Keywords: Efficiency, DEA, Super Efficiency, Ranking, Performance

INTRODUCTION

Performance and team-ranked of the decision-making units (DMUs) are increasingly important. Ranking is a competitive strategy measure which is an indication of the unit's reputation compared to its competitors. Recently, there are many methods for efficient performance assessment involving multiple variables. This includes the analysis of the financial statements (Sultan, 2014, Waniak-Michalak & Zarzycka, 2012), Dupont Analysis (Arsad et al., 2017, Sheela & Karthikeyan, 2012), Balance Score Card (Fooladvand et al., 2015), Process of Analytic Hierarchy (Aragonés-Beltrán et al., 2014), Fuzzy Set Theory (Tiwari & Banerjee, 2001), Grey Relation Analysis (Wang, 2009), Stochastic Frontier Analysis (SFA) (Hasan et al., 2012) and Data Envelopment Analysis (DEA) (Chen, 2008). Among these methods, the assessments are focused on single input to single output financial ratios, such as return on equity and return on investment, are used as indices for characterizing financial performance. Multi-criteria results are essential to regulators because it provides information about how much a company can be projected to increase their multiple output and decrease their multiple input level by simply improving their efficiency without consuming or wasting extra resources (Khodabakhshi, 2011). The most used approach for measuring efficiency-based performance is DEA. DMUs which has not any assumption about functional form for the frontier and it evaluates the performance considering various inputs and outputs simultaneously. It also does not require priori assumptions of the relationship between inputs and outputs, and they can have very different units. There are different versions of DEA model based on its features. Two well-known features of DEA model are structure of its returns to scale and orientations in efficiency analysis. Based on the structure of returns to scale, there are two versions namely constant returns to scale (CRS) or CCR (Charnes et al., 1978) and variable returns to scale (VRS) or BCC (Banker et al., 1984).

In the CRS version, it is assumed that an increase in the number of inputs would lead to a proportional increase in the number of outputs. In the VRS version, the number of outputs is deemed to increase more or less proportionally than the increase in the inputs. The CRS version is more restrictive than the VRS and usually produces fewer numbers of efficient units and also lower efficiency scores among all DMUs. This is because the CRS is a special case of the VRS model. Based on the orientations in efficiency analysis, there are two well-known orientations in efficiency analysis. Input-oriented models are models where DMUs are supposed to produce a given number of outputs with the smallest possible number of inputs. Output oriented models are models where DMUs are supposed to be produced with given amounts of inputs and the highest possible outputs. The purpose of these models is to determine the overall efficiencies of DMUs, which are responsible for translating a collection of inputs into outputs (Cooper et al., 2007). DEA models' results divide the DMUs into two sets, the efficient and inefficient DMUs. When DMU either operates on the output boundary, it is considered technically effective, it is not technically efficient if it operates below the boundary.

In DEA, no functional relationship between production outputs and inputs is presumed, nor any unique statistical distribution of the term of error. Its ability to manage multi-input and output development cycle makes it an attractive alternative and outweighs its statistical shortcomings (Murillo-Zamorano, 2004). It offers numerical results on the comparative analysis of each DMU in the form of an efficiency score (one for effective DMUs and less than one for inefficient DMUs) that is perceived as a business performance indicator. DEA defines its peers from a group of efficient units with which it is compared for inefficient DMU, as well as changes in output and input rates needed by the device to be on the effective frontier (Mohamad & Said, 2012). DEA does not have statistical details about the goodness and reliability of the tests (Asmare & Begashaw, 2018). DEA has been widely employed in a variety of disciplines as an efficiency or performance measurement tool for comparing a set of entities such as firms, banks, hospitals, nations, and organizations which are generally termed as decision making units (DMUs).

DEA has been applied in banking (Kumar et al., 2016), education and higher learning (de França et al., 2010), hospitals and health centers (Kohl et al., 2019), manufacturing and industry (Pérez et al., 2017,Tran, 2018), agriculture (Mao & Koo, 1997), port management (Kuo et al., 2020, Mokhtar et al., 2020), and transports (Agarwal et al., 2010). This paper only focuses on investigating the performance of stock company using the DEA model. Generally, the performance of an investment company is based on the performance of the securities and other assets that the investment company owns. Assessing the performance of investment companies is most important for investors and financial managers. Hence, performance evaluation of investment companies has been widely studied in the literature. Gardijan and Kojić (2012) apply DEA model for investment purpose with constructing of a stock portfolio in the Croatian stock market. The efficiency of the DMUs, which are in this case the selected stocks from Zagreb Stock Exchange, is obtained from the output oriented CCR and BCC models. Ismail et al., (2012) investigate the effectiveness of DEA model on portfolio selection for investors over long horizon in the Malaysian stock market. They employ the technical efficiency DEA model to evaluate the firm's efficiency. Then, efficient firms are selected for the portfolio formation. Zohdi et al., (2012) evaluate Iranian investment companies using financial statement analysis for ranking of twelve companies using CCR and BCC models.

However, the limitation of the DEA models is that they cannot further discriminate efficient DMUs, all of which have an efficiency score of unity. Andersen and Petersen (1993) develop a Super Efficiency DEA model in 1993, which can rank efficient DMUs. The input-oriented (output-oriented) Super Efficiency model excludes the DMU under evaluation from the reference set, so that efficient DMUs may have efficiency scores larger (smaller) than or equal to one. The original Super Efficiency model is introduced under the condition of Constant Returns to Scale (CRS) and is feasible if all inputs and outputs of DMUs are positive. However, the infeasibility issue might occur in VRS Super Efficiency models.

Several modified versions of Super Efficiency models have been proposed. Andersen and Petersen (1993) developed one such model, which was later extended to assess socio-economic growth in regions of Serbia.

Furthermore, a measure of Super Efficiency based on the slack-based measure has been developed and widely cited in DEA literature. Research on Super Efficiency models, including ranking papers up to 2002, has been extensively reviewed. Additionally, a measure of Super Efficiency based on improved outputs and input relaxation models was developed, and a model to rank efficient units from the CCR model was proposed by Khodabakhshi (2011). This paper evaluates the performance of selected DMUs (stock companies) using DEA-CCR and Super Efficiency models. The structure is as follows: Section 2 explains the DEA and Super Efficiency models; Section 3 summarizes the data and methods used; Section 4 presents and discusses the results; and the final section offers conclusions and recommendations for future research.

DATA ENVELOPMENT ANALYSIS

DEA is a mathematical linear programming model which is utilized to evaluate the relative efficiency of the decision-making units. The DEA model is used to describe how efficient the decision-making units in transforming the inputs into outputs or outcomes. In the DEA model, the efficiency of the unit is expressed as the ratio of the sum-weighted outputs to sum-weighted inputs. The DEA model is also able to handle multiple outputs and inputs simultaneously. In the DEA approach, efficiency is the objective function value of a multi-criteria linear programming model. The objective of the DEA is to determine relative performance indicators amongst productive units, considering specific groups of inputs and outputs. It is a multi-factor productivity analysis model for measuring the relative efficiencies of a homogenous set of DMUs. The efficiency score in the presence of multiple input and output factors is defined as:

$$\text{Efficiency}=\frac{\text{Weightedsumoutputs}}{\text{Weighted suminputs}} \qquad (1)$$

In this study, the organization unit is identified as an efficient unit if they obtain an efficiency score of 100%. For companies that fail to achieve a 100% efficiency, they will be classified as inefficient unit. The DEA-CCR model is formulated as follows:

$$Maximize\, h_k = \frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \quad for\ DMU_k \qquad (2)$$

$$\text{Subject to:} \quad \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1;\ j = 1,2,\ldots\ldots\ldots\ldots, n \qquad (3)$$

$$u_r \ge 0;\ r = 1,2,\ldots\ldots\ldots\ldots, s \qquad (4)$$

$$v_i \ge 0; \qquad i = 1,2,\ldots\ldots\ldots\ldots, m \qquad (5)$$

Where:

h_k: the relative efficiency (objective function) of DMU_k

s: the number of outputs

u_r: the weight to be determined for output r

y_{rj}: observed magnitude of r type output for DMU_j

m: the no. of inputs

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u_i: the weight to be determine for input i

xij: observed magnitude of i type input for $DMU\ j$

n: no. of DMU

Equation (2) is an objective function which maximizes the efficiency for k - DMU. The model above is a non-linear 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. The model of primal DEA in linear form can be written as follows:

$$Maximize h_k = \sum_{r=1}^{s} u_r y_{rk} \quad for\ DMU_k \tag{6}$$

Subject to: $\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0; j = 1,2,\ldots\ldots\ldots\ldots, n$ (7)

$$\sum_{i=1}^{m} v_i x_{ik} = 1 \tag{8}$$

$$u_r \geq 0; r = 1,2,\ldots\ldots\ldots\ldots, s \tag{9}$$

$$v_i \geq 0; i = 1, 2, \ldots\ldots\ldots\ldots, m \tag{10}$$

This primal model of DEA can solve based on input-oriented or output oriented. The model of input-oriented is used for minimizing the input at particular level output, however, for output-oriented is used for maximizing output at a certain input. In this study, the focus is only on the output-oriented by determining how DMU maximizes their outputs with a certain input. Therefore, a dual model for output-oriented based on the DEA model under the constant return to scale is employed to evaluate the DMU which is defined as follows:

$$Maximize \phi_k \tag{11}$$

Subject to: $-x_{ki} + \sum_{j=1}^{n} \lambda_j x_{ij} = 0; i = 1,2,\ldots\ldots\ldots\ldots, m$ (12)

$$\phi_k y_{rk} + \sum_{j=1}^{n} \lambda_j y_{rj} = 0; \quad r = 1, 2, \ldots\ldots, s \tag{13}$$

$$\lambda_j \geq 0; j = 1, 2, \ldots\ldots\ldots\ldots, n \tag{14}$$

ϕ_k unconstrained

Where ϕ_k is a maximum possible proportional output amount that DMU_k can produce. The technical efficiency score, θ_k for DMU_k can be defined as:

$$\theta_k = \frac{1}{\phi_k} \tag{15}$$

Where the score produced is $0 < \theta_k \leq 1$.

SUPER EFFICIENCY

The inefficient DMUs with unique scores of less than one can be classified according to their score under the standard DEA. However, all the efficient assigned efficiency score of unity (or 100 percent), making it impossible to differentiate their performance. To overcome this problem, an alternative procedure known as the super efficiency DEA model was proposed by Andersen and Petersen (1993) under a constant return to scale (CRS) on top of the traditional method of the DEA model which eliminates the constraints associated with a particular efficient DMU. The super efficiency measures on the input and outputs sides are not restricted to either below or above 1. The input-oriented for super efficiency score, ϕ_E may be larger than 1; where firm k could have increased its inputs by a factor score ϕ_E and still not have dominated by a feasible reference unit. Similarly, for output-oriented, super efficiency score, ϕ_E can be smaller than 1 if DMU or firm k could have reduced all of its outputs by a factor ϕ_E without being dominated by a reference unit. Therefore, output-oriented model under CRS can be defined as below:

$$Maximize \phi_E \quad (16)$$

Subject to: $-x_{ki} + \sum_{j\neq 0}^{n} \lambda_j x_{ij} = 0; i = 1,2, \ldots\ldots\ldots\ldots, m$ (17)

$$\phi_E y_{rk} + \sum_{\substack{j=1 \\ J\neq 0}}^{n} \lambda_j y_{rj} \geq 0; r = 1,2, \ldots\ldots\ldots, s \quad (18)$$

$$\lambda_j \geq 0; j = 1,2, \ldots\ldots\ldots\ldots, n \quad (19)$$

ϕ_E unconstrained

Supposed that DMU_k is efficient unit, then $\phi_E \leq 1$. Therefore, the efficient DMUs have a score of $0 < \phi_E \leq 1$. It represents the maximum possible proportional decrease in an output vector retaining DMU efficiency. The score for inefficient DMUs remain unchanged.

METHODOLOGY

This paper calculates the efficiency score, and rank of the selected stock companies listed on Bursa Malaysia. The data covered a period of three years, from 2016 to 2018. Secondary data were primarily culled from company annual reports retrieved from Thomson Reuters' DataStream for this study.

The efficiency score was calculated using R-programming software, employing Benchmarking package. The DEA model was used to calculate the value of the efficiency score based on financial ratios. It includes asset turnover (AT), market capitalization (MC), debt to equity ratio (DE), and returns on equity (ROE). This research involves the following steps:

i) **Step 1**: Select the inputs and outputs. Three inputs and one output were selected as shown in Table 1, which are described as follows: The value of a company's sales and income as compared to the value of its assets, as determined by AT, is input 1. It is used to measure how well the assets are used to make money. Input 2, MC, shows the size of a company, which is known to be the most important factor in many things, including risk, which investors are interested in. Input 3, the DE ratio, is used in this study to measure a company's leverage. Output, or ROE, shows how much profit a company makes compared to the total shareholders' equity recorded on balance sheets.

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Table 1. Variables for input and output

Variables		Value symbol	Weight symbol
Return on equity	output	y_1	u_1
Asset turnover	input	x_1	v_1
Market capitalization	input	x_2	v_2
Debt to equity ratio	input	x_3	v_3

ii) **Step 2**: The DEA model (CCR) is used to calculate the efficiency score, ϕ_k of the stock companies. Equation (11) – (14) are employed to determine the relative efficiency scores of the companies based on the selected inputs and output. Furthermore, Equation (15) is used to calculate the technical efficiency score, θ_k of each company, providing a measure of how well the companies convert their inputs into outputs.

iii) **Step 3**: In this step, the stock companies are ranked based on their technical efficiency scores, θ_k. When the efficiency scores are equal to 1, it is challenging to differentiate the best-performing companies. To address this, the super efficiency model (Equation 16-19) is applied to those companies with an efficiency score of 1. The super efficiency scores, ϕ_E are then calculated.

iv) **Step 4:** The companies are reranked based on these values, allowing for a more precise differentiation among the top-performing companies.

RESULTS AND ANALYSIS

In this study, DEA which is CCR model applied to compute the efficiency score of the companies. As a reference, the efficiency score at 1 indicates the efficient companies and the score of less than 1 indicates inefficient companies. It provides information on how each individual company performed in comparison with other companies for the year under consideration. For ease of reference, each company is referred to as DMU1, …, DMU30. Table 2 shows that the efficiency score of DMUs from the year of 2016 until 2018. The result shows that there are 8 (7%) companies that have the same efficiency score at 1 (100%) and the rest are inefficient companies for the years of 2016, 2017 and 2018.

From the table, scores ϕ_k obtained are greater than one for output-oriented based. However, the efficiency score, θ_k was calculated by which $0 < \theta_k \leq 1$ is through Equation (15) as shown in Table 2. The efficient companies for the year 2018 are DMU2 (Westports Holdings Berhad), DMU3 (AWC Berhad), DMU5 (Cypark Resources Berhad), DMU10 (George Kent (Malaysia) Berhad), DMU11 (Airasia Group Berhad), DMU 15 (UOA Development Berhad), DMU16 (Yinson Holdings Berhad) and DMU17 (RGB International Berhad). The super-efficiency for CCR model was applied to make a complete ranking for all these DMUs. Therefore, the Super Efficiency score is calculated, and the score is shown in Table 3. Score efficiency calculated, ϕ_E are less than 1 for 8 of the efficient companies. The values of the ϕ_E for these DMUs are 0.732, 0.707, 0.807, 0.549, 0.986, 0.542, 0.613, and 0.780 respectively. It means DMU2 could reduce its output proportionally to 73.2% of the current outputs to remain efficient. For DMU11, it could decrease its output propositionally to 98.6% of the current outputs to remain efficient. In addition, even if the DMU15 decreased its outputs, proportionally to 54.2% of the current outputs, it can remain efficient. For these DMUs, the lower the efficiency index, ϕ_E the better the DMU (Khodabakhshi, 2010).

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Table 2. Efficiency score of DMUs from year 2016 until 2018

DMU	Companies	Year 2016		Year 2017		Year 2018	
		Score ϕ_k	Score θ_k	Score ϕ_k	Score θ_k	Score ϕ_k	Score θ_k
1	Hap Seng Consolidated Berhad	2.252	0.444	1.931	0.518	1.714	0.584
2	Westports Holdings Berhad	1.425	0.702	1.203	0.831	1	1
3	AWC Berhad	1	1	1	1	1	1
4	Bintulu Port Holdings Berhad	2.112	0.473	1.344	0.744	1.272	0.786
5	Cypark Resources Berhad	1	1	1	1	1	1
6	Deleum Berhad	1.837	0.544	1.632	0.613	2.125	0.471
7	Eita Resources Berhad	1.051	0.951	1.015	0.985	1.022	0.979
8	Freight Management Holdings Berhad	1.534	0.652	1.640	0.610	1.949	0.513
9	GD Express Carrier Berhad	1.985	0.504	2.054	0.487	4.035	0.248
10	George Kent (Malaysia) Berhad	1	1	1	1	1	1
11	Airasia Group Berhad	1.103	0.907	1.984	0.504	1	1
12	Luxchem Corporation Berhad	1.357	0.737	2.010	0.498	2.038	0.491
13	My E.G. Services Berhad	1	1	1	1	1.881	0.532
14	Pharmaniaga Berhad	3.853	0.260	3.673	0.272	3.121	0.320
15	UOA Development Berhad	1	1	1	1	1	1
16	Yinson Holdings Berhad	1	1	1	1	1	1
17	RGB International Berhad	1.159	0.863	1	1	1	1
18	Suiwah Corporation Berhad	2.314	0.432	2.096	0.477	1.844	0.542
19	Suria Capital Holdings Berhad	1.011	0.989	1.952	0.512	1.590	0.629
20	Tiong Nam Logistics Holdings Berhad	1	1	1.174	0.852	2.455	0.407
21	Uzma Berhad	1.284	0.779	2.349	0.426	2.457	0.470
22	Harbour-Link Group Berhad	1	1	1.789	0.559	1.575	0.635
23	KPJ Healthcare Berhad	4.793	0.209	4.157	0.241	3.571	0.280

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24	AYS Ventures Berhad	1.826	0.548	1	1	1.166	0.858
25	Kumpulan Fima Berhad	1.220	0.820	2.640	0.379	2.342	0.427
26	OCK Group Berhad	2.239	0.447	2.852	0.351	1.553	0.644
27	Pansar Berhad	1.622	0.617	2.327	0.430	4.115	0.243
28	Pantech Group Holdings Berhad	1.940	0.515	2.173	0.460	1.695	0.590
29	Mega First Corporation Berhad	1.454	0.688	1.844	0.542	1.502	0.666
30	CJ Century Logistics Holdings Berhad	1.849	0.541	2.965	0.337	3.226	0.350

Hence, DMU15 is ranked the first, DMU10 is ranked the second, DMU16 is ranked the third and DMU4 is ranked the fourth. Another four DMUs, which are DMU2, DMU17, DMU5 and DMU11 are ranked at 5th, 6th, 7th and 8th places respectively. The same situation is reported for year 2017. There are also 8 (7%) companies that have the same efficiency score with full efficiency at 1.

The companies are DMU3 (AWC Berhad), DMU5 (Cypark Resources Berhad), DMU10 (George Kent (Malaysia) Berhad), DMU13 (My E.G. Services Berhad), DMU15 (UOA Development Berhad), DMU16 (Yinson Holdings Berhad), DMU17 (RGB International Berhad) and DMU24 (AYS Ventures Berhad). The values of the ϕ_E for these DMUs are 0.444, 0.866, 0.683, 0.641, 0.555, 0.754, 0.938 and 0.682 respectively. Therefore, the ranks for these DMUs are at 1st, 7th, 5th, 3rd, 2nd, 6th, 8th, and 4th respectively.

Table 3**.** Ranking of DMUs based on Super Efficiency from year 2016 until 2018

DMU	Year 2016			Year 2017			Year 2018		
	Score θ_k	**Score** ϕ_E	**Ranking**	**Score** θ_k	**Score** ϕ_E	**Ranking**	**Score** θ_k	**Score** ϕ_E	**Ranking**
1	0.444	-	27	0.518	-	17	0.584	-	17
2	0.702	-	16	0.831	-	11	1	0.732	5
3	1	0.178	1	1	0.444	1	1	0.707	4
4	0.473	-	25	0.744	-	12	0.786	-	11
5	1	0.822	6	1	0.866	7	1	0.807	7
6	0.544	-	21	0.613	-	13	0.471	-	22
7	0.951	-	10	0.985	-	9	0.979	-	9
8	0.652	-	18	0.610	-	14	0.513	-	20
9	0.504	-	24	0.487	-	21	0.248	-	29
10	1	0.815	5	1	0.683	5	1	0.549	2
11	0.907	-	11	0.504	-	19	1	0.986	8

12	0.737	-	15	0.498	-	20	0.491	-	21
13	1	0.721	4	1	0.641	3	0.532	-	19
14	0.260	-	29	0.272	-	29	0.320	-	26
15	1	0.328	2	1	0.555	2	1	0.542	1
16	1	0.692	3	1	0.754	6	1	0.613	3
17	0.863	-	12	1	0.938	8	1	0.780	6
18	0.432	-	28	0.477	-	22	0.542	-	18
19	0.989	-	9	0.512	-	18	0.629	-	15
20	1	0.973	8	0.852	-	10	0.407	-	25
21	0.779	-	14	0.426	-	25	0.470	-	23
22	1	0.963	7	0.559	-	15	0.635	-	14
23	0.209	-	30	0.241	-	30	0.280	-	28
24	0.548	-	20	1	0.682	4	0.858	-	10
25	0.820	-	13	0.379	-	26	0.427	-	24
26	0.447	-	26	0.351	-	27	0.644	-	13
27	0.617	-	19	0.430	-	24	0.243	-	30
28	0.515	-	23	0.460	-	23	0.590	-	16
29	0.688	-	17	0.542	-	16	0.666	-	12
30	0.541	-	22	0.337	-	28	0.310	-	27

For the year 2016, there are also 8 (7%) companies identified as efficient and have the same efficiency score. The companies are DMU3 (AWC Berhad), DMU5 (Cypark Resources Berhad), DMU10 (George Kent (Malaysia) Berhad), DMU13 (My E.G. Services Berhad), DMU15 (UOA Development Berhad), DMU16 (Yinson Holdings Berhad), DMU20 (Tiong Nam Logistics Holdings Berhad) and DMU22 (Harbour-Link Group Berhad). The values of the ϕ_E for these DMUs are 0.178, 0.822, 0.815, 0.721, 0.328, 0.692, 0.973 and 0.963 respectively.

Therefore, the ranks for these DMUs are at 1st, 6th , 5th, 4th, 2nd, 3rd, 8th, and 7th respectively. From Table 3, the top performer for year 2018 is UPK15. However, for year 2016 and 2017, the top performer is UPK3. The bottom performer for year 2018 is UPK27 while UPK23 is the bottom performer for years 2016 and 2017. For the inefficient DMUs, the ranking is based on their efficiency score. Therefore, using the DEA and Super Efficiency method, a complete ranking for all DMUs can be obtained as shown in Table 3.

DISCUSSIONS OF FINDING

The application of the DEA in this study reveals significant insights into company efficiency. From 2016 to 2018, only 7% of companies achieved a perfect efficiency score, indicating that a majority of companies struggled with resource allocation and productivity. Financially, the efficiency scores highlight how companies manage their inputs and outputs. The results show that the most efficient companies have lower Super Efficiency scores, suggesting that these companies could maintain efficiency even with reduced outputs. This indicates robust financial health and effective management of resources. Conversely, inefficient companies face challenges in optimizing their financial ratios, which could impact their profitability and competitive position.

The CCR model remains widely used in previous research due to its simplicity and ease of application. Its straightforward assumption of constant returns to scale, makes it accessible for assessing efficiency across various industries and contexts. Moreover, the CCR model's computational efficiency and clarity in results appeal to researchers and analysts seeking quick insights into relative performance among DMUs. Its widespread adoption in earlier studies also stems from the availability of established methodologies and benchmarks that facilitate comparisons over time and across different datasets.

The efficiency rankings also highlight company governance practices. Efficient companies set benchmarks for best practices, while inefficient ones may face heightened scrutiny from shareholders, regulators, and the public, driving improvements in accountability and ethical standards. Stakeholders, including employees, investors, and customers, are directly impacted by these efficiency scores. Employees might face job insecurity, investors might adjust their strategies, and customers could experience changes in pricing and service quality.

CONCLUSION

This study effectively utilized the DEA approach to calculate technical efficiency scores for Malaysian companies from 2016 to 2018, using return on equity as the output and asset turnover, market capitalization, and debt-to-equity ratio as inputs. The straightforward implementation of this method, coupled with its ability to assess resource allocation without relying on rigid input-output assumptions, highlights its practical value. By extending the analysis through the Super Efficiency model, the study provided a refined ranking of top-performing companies, identifying those that excel in operational efficiency and resource management. These rankings not only guide investors and policymakers but also encourage less efficient companies to improve their practices, fostering a culture of continuous improvement and competitiveness.

By identifying and ranking efficient companies, the research not only informs investment and policy decisions but also contributes to the broader economic sustainability and company governance landscape. Efficient companies are better positioned to contribute to economic growth, create jobs, and sustain competitive markets, ultimately benefiting society as a whole. Furthermore, the study's insights can drive less efficient companies to adopt better practices, promoting fair competition and reducing economic disparities. This research underscores the importance of robust efficiency assessments in enhancing company performance, fostering economic stability, and driving sustainable development.

Future research should incorporate SFA to differentiate technical inefficiencies from random noise and provide a more nuanced view of company performance. Integrating panel data analysis can reveal trends over time, while considering external factors such as market volatility and regulatory changes will offer a comprehensive understanding of efficiency challenges.

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