

Performance efficiency of Malaysian selected retail companies using Data Envelopment Analysis

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ABSTRACT The retail sector plays a significant role in Malaysia's economic development, contributing to employment creation, consumer spending and overall business growth. As competition within the sector intensifies, it becomes important for the firms to utilize their resources efficiently to survive in this industry. This study evaluates the operational efficiency of seven selected retail companies in Malaysia using Data Envelopment Analysis (DEA) method. The research aims to measure efficiency levels and identify benchmark firms that utilize their resources effectively. The companies were analyzed based on input variables which are total assets, number of employees, number of stores and total liabilities while the output variables are revenue and net profit. There are two objectives to be achieved in this study. The first one is to measure the efficiency of performance for selected Malaysian retail companies and rank them. The second objective is to determine the most effective strategy to maximize the level of efficiency of the selected Malaysian retail companies. The DEA model was implemented using QM for Windows software which was used to calculate the efficiency score. Six companies recorded relatively high efficiency scores while one company recorded low efficiency level for less than 90%. For the less efficient company, the improvement strategies are proposed based on dual weight and reference sets from the efficient companies. The recommendations include adjustments in input usage and enhancements in output performance. For instance, optimizing asset utilization, increasing both revenue and net profit. In general, the findings of this study provide a basic framework for retail companies to enhance operational efficiency and improve the performance of their firms.

KEYWORDS: Data Envelopment Analysis; Efficiency; Framework; Decision Making Unit; Retail Companies

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INTRODUCTION

Retail company plays a vital role in the economy of many countries, including Malaysia. The retail sector is one of the most important parts of the market as it is a convenient and accessible way of offering goods and services directly to consumers which consist of all stores, from kiosks and small grocery stores to large supermarket chains and shopping malls (Hameli, 2018). Although retailing has existed for centuries, it has evolved significantly with the adoption of advanced technologies and the constant shifting preferences of consumers. Grocery, apparel and even drug stores are all examples of retail. The demand for retail services comes from consumer choices, involving factors like transportation availability, time consumption and the ability to store goods. Some consumers are willing to pay extra for better service while there are some who prefer to do the service themselves for a much lower price. This is considered as a trade-off between margin and services results (Gauri *et al.*, 2021).

Data Envelopment Analysis (DEA) is a linear programming mathematical model used in this study. The DEA model was first introduced by Charnes, Coopers and Rhodes (1978) following the work of Farrell (1957) and Dantzig (1951). It is the most basic model of DEA, known as the Charnes-Cooper-Rhodes (CCR) model. In general, the model was developed as a decision-making tool that evaluates the efficiency of a set of comparable units known as decision-making units (DMUs). DEA is a nonparametric method used to assess the performance of DMUs based on chosen inputs and outputs. It is also a well-known technique in research for evaluating performance clearly and

effectively while incorporating multiple input and output dimensions (Mergoni *et al.*, 2025). In the DEA model, input variables represent the resources used like assets, total liabilities and labor while output variables reflect the results achieved such as profit, revenue and customer satisfaction. By using DEA model, we can see how a company utilizes its resources to produce desired outcomes to improve their performance. The DEA model can also handle complex performance structures. Therefore, it is suitable to be used to conduct benchmarking for a retail company as various qualitative and quantitative factors are influenced.

Akinsolu & Krmac (2025) have conducted a study where container throughput and port efficiency is analyzed at selected ports in Europe and China. The regions were chosen due to the massive maritime transport operation. The results reveal varying levels of technical efficiency among ports such as Shanghai, Qingdao and Ningbo-Zhoushan. Meanwhile, ports like Rotterdam and Piraeus show optimal efficiency, reflecting effective resource management. In other study, Djordjević *et al.* (2023) have done a study on environmental efficiency of Dublin port using two-stage non radial DEA model. The two-stage DEA approach allows for separate evaluation of each operational side, leading to a comprehensive measure of overall efficiency. The study reveals that key factors that influence environmental efficiency include the number of terminals and capital expenditures. A small adjustment in these factors can improve efficiency of Dublin port. Other transportation studies have focused on airline business. COVID-19 pandemic has a great impact especially for airline industry, necessitating a focus on maintaining high efficiency for profitability (Wu *et al.*, 2024). The study focuses on the efficiency of 26 international airlines from 2019 to 2022 using a dynamic network data envelopment (DNDEA) methodology. The results reveal that no airline achieved full efficiency but is still moderately high on average.

A study to assess 44 retail store chains in Iran was done by Lagzi *et al.* (2024). The study did a performance prediction of retail industry by utilizing a regression based Stochastic Data Envelopment Analysis (SDEA) model, Balanced Scorecard (BSC), and Decision Tree. Findings from the case study indicate that the accuracy of the SDEA model is 99%. However, the decision tree shows that some stores were less efficient due to low customer count. The study chose assets, labour hours, number of employees, store age, store size and manager experience as input variables while sales, number of customers and profit as output variables. Other study done by Nong (2022) focused on the fashion retail industry and assess performance efficiency by using a combination of Delphi technique and DEA model. The study was implemented in a fashion company in the largest city of Vietnam, Ho Chi Minh City. The inputs for the study are labor hours, store size and operating cost while outputs are sales and number of customers.

Konyalıoğlu *et al.* (2024) used the fuzzy DEA for measuring and ranking the efficiency of stores in a grocery retailer in Turkey. In this study, total floor area, average inventory at cost, total number of customers and number of employees in the store are considered as the input variables. Meanwhile, while gross margin return on investment, net sales, inventory turnover and stock-out rate are considered as output variables in the fuzzy DEA. The proposed model is solved, and the inefficient stores are ranked and compared using a minimax regret approach. In other study, Radhia *et al.* (2025) evaluated the technical operational efficiency of the convenience stores in the largest retail chains in Indonesia using DEA approach to measure the relative technical efficiency. The results showed that the average scale efficiency reached 98.8%, with two scores indicated the presence of technical inefficiencies. It was stated that efficiency can be improved through the optimization of operational hours and the management of service diversification. The study contributes a significant result on retail efficiency in developing countries and provides strategic insights into the management in formulating operational policies.

Traditional efficiency measurement approaches are commonly based on cost efficiency models that assume firms operate in perfectly competitive markets. Under these assumptions, firms are considered to produce similar products using comparable inputs and individual firms are assumed to be price takers with no influence over market prices. Even so, they may not fully reflect real world market conditions. Thus, alternative methods like DEA are used as they allow efficiency to be evaluated without relying on strict market assumptions (Camanho *et al.*, 2024).

There are many studies of efficiency of airport, seaport and financial company in Malaysia. However, there is a noticeable lack of studies focusing on the efficiency of retail companies in Malaysia. This results in limited reference and benchmarking data within the industry. The lack of research has caused many retail companies in Malaysia being unaware and not enough of knowledge of the appropriate ways to evaluate and improve their operational efficiency. Without proper efficiency analysis, these companies risk falling behind in a highly competitive industry and failure to achieve optimal efficiency. By applying DEA model, it will provide valuable insights into resource utilization and operational efficiency to the retail companies. Therefore, the research objectives of this study are to measure the relative efficiency for selected Malaysian retail companies and determine the most effective strategy to maximize the level of efficiency of Malaysian retail companies.

At the end of this study, it will provide valuable insights to company stakeholders including management and investors. These insights allow them to implement targeted strategies for performance improvement. By analyzing input and output values, organizations can use resources more effectively, leading to increased operational efficiency. By this way, the retail companies will be able to provide even better services to their customers. As a result, the retail company can achieve optimal efficiency when focused on improving their operations. It is important to note that this paper is a small-scale case study which intentionally comes up with operational frameworks. It evaluates a local micro-context of efficiency and not a broad industry benchmark.

METHODOLOGY

This study has chosen the standard Charnes-Cooper-Rhodes (CCR) model assuming Constant Returns to Scale (CRS) to measure overall technical efficiency, which served as a baseline measure. This model assumes that the overall DMUs' performance is not influenced by the operational size differences.

Consider $k=1,2,3,...,n$ DMUs, each using $i=1,2,3,...,m$ inputs to produce $r=1,2,3,...,s$ outputs, with v_i and u_r indicating the weights assigned to the inputs and outputs, respectively. The DEA model evaluates the efficiency of each DMU by solving the following optimization problem for DMU k such that,

$$\text{Maximise } \sum_{r=1}^s u_r y_{rk} \quad (1)$$

Subject to:

$$\sum_{i=1}^m v_i x_{ik} = 1 \quad (2)$$

$$\sum_{r=1}^s u_r y_{rk} - \sum_{i=1}^m v_i x_{ik} \leq 0 \quad (3)$$

$$u_r, v_i \geq 0 \quad (4)$$

where

x_{ik} : input i for DMU k

y_{rk} : output r for DMU k

u_r : weights allocated to output r

v_i : weights allocated to input i

s : number of outputs

m : number of inputs

Equation (1) is a linear model that seeks to maximize the weighted outputs for a particular DMU under evaluation, using optimally selected weights. Equation (2) applies constraints that normalize the input values to 1 to ensure fairness, while Inequality (3) prevents any DMU from exceeding an efficiency score of 1 when evaluated with the same weights. Inequality (4) ensures that all weights assigned to outputs and inputs are non-negative, respectively. This ensures that the calculated efficiency score lies between 0 and 1, where a score of 1 indicates that the DMU is operating efficiently relative to others in the dataset. The efficiency score generated by DEA model reflects how effectively a company utilizes its resources to achieve desired outputs.

The selection of input and output variables are guided by prior literature on efficiency measurement using DEA, particularly in the retail sector. Total assets are commonly used as an input to represent overall resources owned by a company (Nong, 2022). The number of employees is chosen to show the labor used in daily operations (Lagzi *et al.*, 2024). Total stores are included to reflect the size of the company's operations (Li & Tsai, 2018). Total liabilities are included as well as input because they represent the company's financial commitments, which can reflect how resources are managed (Rusmita *et al.*, 2023). For output variables, net profit is used to show how well the company manages its resources into profit (Pachar *et al.*, 2020). Revenue is chosen as another output to represent the company's ability to generate sales (Ko *et al.*, 2017). These input and output variables are commonly used in previous studies and are suitable for evaluating efficiency. The list of selected input and output variables is shown in Table 1.

Table 1. List of Selected Input and Output Variables

Inputs	Outputs
Total Asset	Net Profit
Number of Employees	Revenue
Total Stores	
Liabilities	

The data of retail companies is collected from Bursa Malaysia website, which is the official online platform that functions as the Malaysian stock exchange, offering information about trading, listed companies and financial markets. Retail companies are among the listed companies that issue their annual reports on the Bursa Malaysia website, and these reports are made available for public. All input and output data are shown in Table 2.

Table 2. Raw Input and Output Data

DMU	Input				Output	
	Asset (RM'000)	No. of Employee	No. of Stores	Total Liabilities (RM'000)	Net Profit (RM'000)	Revenue (RM'000)
1	5,634,759	9,423	184	3,697,466	128,032	4,261,525
2	2,456,026	10,291	2,400	2,113,600	38,532	2,925,548
3	855,300	1,836	116	308,204	11,000	1,216,900
4	1,800,000	3,366	140	700,000	100,000	1,900,000
5	767,960	2,986	79	155,110	71,580	1,057,650
6	624,924	2,850	640	401,348	8,710	804,200
7	714,513	759	28	231,223	39,924	413,665

RESULT AND DISCUSSION

The efficiency results of seven Malaysian retail companies were calculated using QM for Windows software. All the data obtained was entered into the linear programming model to get accurate results. The results of the analysis are used to assess the efficiency of the companies. Table 3 shows the result of the relative efficiency score for the seven DMUs.

Table 3. Results of the relative efficiency scores of seven DMUs

	DMU1	DMU2	DMU3	DMU4	DMU5	DMU6	DMU7
Relative Efficiency	99.97%	83.90%	100%	100%	99.99%	90.54%	100%

The performance efficiency ranking of the seven selected retail companies in Malaysia is shown in Table 3. Six companies have achieved a relative efficiency of more than 90%, with DMU3, DMU4 and DMU7 reaching maximum efficiency. On the other hand, one company DMU2, has been identified with having lower performance with a relative efficiency of less than 90%.

By considering all factors, the decision is taken to bring the efficiency of DMU2 of 83.90% to achieve maximum efficiency level of 100%. To improve the company to a maximum efficiency, input and output variables need to be increased or decreased. DMU3 and DMU5 have been chosen to be the reference sets for the improvement of DMU2. Reference set is a set that is taken from the dual value of DMU with a good level of efficiency. The dual weight obtained from each reference set is used as an indicator to evaluate the new suggested values of inputs and outputs for DMU2. Equation (5) is a model by El-Mahgary and Lahdelma (1995) which is used to find the recommended input and output values, with M and Q are the reference sets.

$$x_{iE} = x_{iM}\lambda_{iM} + x_{iQ}\lambda_{iQ} \quad (5)$$

where,

x_{iE} = value of inputs and outputs that are needed to be revised

x_{iM} = reference value for set M

λ_{iM} = corresponding dual weight for set M

x_{iQ} = reference value for set Q

λ_{iQ} = corresponding dual weight for set Q

By using Equation (5), the revised values for all input and output for DMU2 are calculated. Table 4 shows the comparison between the actual and improved values for the input and output of DMU2.

Table 4. The Comparison between Actual and Improved Values

	Input				Output	
	Asset (RM'000)	No. of Employee	No. of Stores	Total Liabilities (RM'000)	Net Profit (RM'000)	Revenue (RM'000)
Actual Values	2,456,026	10,291	2,400	2,113,600	38,532	2,925,548
Improved Values	2,061,000	4,684	275	719,000	38,500	2,925,500

In general, the improved values for all inputs and outputs are smaller than the actual values. After applying the improvement recommendations, the efficiency score of DMU2 was computed again using DEA model. As a result, the score has increased significantly to 99.99%, as compared to the actual score of 83.90%. This shows that DMU2 can improve its performance by utilizing its resource allocation. It is important to note that the mathematical framework of standard DEA represents a theoretical optimization process on the efficient frontier rather than providing realistic operational guidance. For example, the large input reduction suggested for DMU2 illustrates the gap between theoretical benchmarking and real-world managerial execution.

CONCLUSION

This study successfully achieved its two objectives. The result of the first objective revealed that several companies operated efficiently, with efficiency scores reaching 100%, with only one company, which is DMU2, recording low efficiency levels due to relatively low output performance. The finding from the second objective indicates that performance efficiency is influenced by how effective resources are utilized. The recommended set of new generated values for the input and output can improve the efficiency score of DMU2 from 83.90% to 99.99%. A limitation of the DEA model is that it produces theoretical target projections that may not account for real-world operational boundaries. Future studies should apply weight-restricted, bounded, or non-discretionary DEA models to generate more realistic operational adjustments. In addition, future studies may include a larger sample size to allow broader comparison and better results.

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