A REVIEW OF FINANCIAL EFFICIENCY MEASUREMENT APPROACHES IN MALAYSIA'S TAKAFUL INDUSTRY

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ABSTRACT

This paper provides a comprehensive review of a financial efficiency approaches and selection on input and output variable to measure efficiency of Malaysia's takaful sector. The objective of this study is to systematically review the efficiency measurement approaches and identify the input and output variables that most commonly employed in assessing the efficiency of Malaysian takaful sector. Measuring financial efficiency is an important aspect of evaluating the performance and competitiveness of Takaful operators in the Islamic financial industry.The review was conducted by using Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) technique to identify, screened, and selecting relevant studies published between 2013 to 2025 using predefined inclusion and exclusion criteria. Based on the review, many researchers have employed various different method to evaluate efficiency, which can generally be divided into two main categories: parametric and non-parametric approaches. The Stochastic Frontier Approach (SFA) is the main parametric approach, whilst Data Envelopment Analysis (DEA) dominates the non-parametric approach.These two methods are the most widely applied in the Takaful efficiency literature. According to earlier studies, the evaluation reveal a lack of consistency in evaluating Takaful efficiency due to the wide variation in input and output variable selection, reflecting a lack of standardization in measuring Takaful efficiency. By synthesizing findings from existing literature, this paper attempts to identify emerging trends, highlight methodological inconsistencies especially in terms measurement approaches and variables utilized to evaluate the financial efficiency of Takaful companies. Through this review, the paper may assist future researchers in gaining better understanding on the financial efficiency measurement approaches used in takaful industry. Ultimately, this paper aims to encourage a more comprehensive and consistent framework for assessing the financial efficiency of the takaful industry, thereby contributing to the refinement of future research design and methodology.

Keywords: Financial Efficiency, DEA, SFA,Takaful, PRISMA

1.0 INTRODUCTION

Insurance and takaful industrieshas contributed significantly towards supporting economic growth, financial stability, and risk management for business and individuals.Insurance is a financial institution that provide clients with financial security in the event of unforeseen circumstances. Meanwhile, from the sharia standpoint, takaful refers to mutual assistance to help one another who are in need (Alam et al., 2022). In addition, based on the Takaful Act 1984, takaful is built on solidarity, brotherhood, and mutual aids among the members in

times of need (Ansari, 2022). The main difference between takaful and insurance is how the risk is being handled. In the concept of takaful, the risk are not transferred to the operators, instead, the risk are distributed among the participants based on the concept of mutual co-operation (Alam et al., 2023). The participants pays contributions into a donation (*tabarru'*) fund, and the takaful firms managed the fund on behalf of the participants.The fund are being used to compensate and help one another in the case of loss or misfortune (Zainuddin, 2013). Apart from that, the Takaful mechanism also does not include any prohibited element in Islam such as *Riba* (interest), *gharar*(uncertainty), and *maysir*(gambling) (Ansari, 2022).

In recent years, takaful research has expanded and given the rise to a number of takaful companies in Malaysia, it implies that awareness related to takaful has increased among the public(Handayani & Alam, 2022). Nevertheless, despite continuous industry development and strong regulatory support, the performance of takaful firms in Malaysia has not yet met expectation(Husin, 2019). This is mostly due to the fact that the takaful penetration rate are still relatively low and not fully matured, resulting in lower-than-expected participation rates among end users. As a result, the industry continues to face several persistent challenges, such as limited public awareness of the fundamental purpose and benefits of takaful, gaps within regulatory frameworks and corporate governance practices, shortages of skilled and knowledgeable talent, and insufficient product innovation that results in offerings that do not fully align with consumer needs(Salman & Kawata, 2022). In order to improve their performance, identify areas for improvement, and boost their competitiveness within the larger Islamic financial system, it is crucial to assess the financial efficiency of takaful operators. Additionally, Sharia financial institutions now use efficiency as a standard to determine whether the business has reached optimal level (Alam et al., 2022).

The efficiency of financial institutions has been a central topic of research for several decades. The measure of efficiency plays an important role in guiding operational and strategic decisions for takaful operators (Kader et al., 2010). Efficiency in financial institutions implies higher profitability, increased flow of funds,as well as improving capital reserves to absorb any unexpected losses and risk (Saad et al., 2006). In addition, efficiency also helps to improve product and service quality of the company which can raise customer satisfaction and overall company's performance(Mimma Kebahyang et al., 2024). Furthermore, an efficiency study can serve as a feedback tool to strengthen the competitiveness and performance of takaful systems. Identifying significant inefficiencies within the systems may open avenues for reforms and restructuring initiatives to address growing competition and improve efficiency levels (Benyoussef & Hemrit, 2019). Nevertheless, academic research on takaful are still rather limited as compared to other facets of Islamic finance such as Islamic banking (Nasir et al., 2023). In addition, Nourani et al. (2018) also highlighted that prior studies have predominantly focused on banking sector with little attention given on the efficiency of takaful or insurance industry. Furthermore, the majority of prior studies has focused on identifying determinants or factors impacting the insurance or takaful performance rather than assessing the overall effectiveness of the company. Given that this industry has the potential to significantly boost economic growth, research on efficiency is essential because it helps to ensure that resources are allocated effectively and firms are operating at optimal level (Nourani et al., 2018).

Understanding how efficiency is measured becomes essential in assessing the true performance of takaful operators. Prior research have employed various approaches to measure efficiency of insurance and takaful firms, including parametric technique such as the Stochastic Frontier Approach (SFA) and non-parametric technique such as Data Envelopment Analysis (DEA) (Kholis&Afifah, 2022). Nevertheless, differences in methodological choice as well as input-output variable selection have resulted in inconsistent findings and hindered standardization in efficiency measurement across the takaful industry. One of the issues that continues to be debated among scholars is the determination of input

and output variables in measuring efficiency (Yakob et al., 2014). Despite the numerous studies that have assessed the efficiency of insurance and takaful firms, uncertainty still exists regarding the appropriate identification of inputs and outputs variables (Abidin&Cabanda, 2011).

The majority of prior research of takaful efficiency has concentrated primarily on measuring efficiency scores using methods such as DEA, for example, Antonio et al. (2013), Faruk & Rahaman (2015), Muhamat et al. (2021), Musa et al. (2022), Chong et al. (2024), and SFA methods, including Nasution et al. (2022) andKholis&Rakhmawati (2022), rather than critically evaluating the suitability and consistency of the efficiency measurement frameworks applied. Furthermore, there is a lack of systematic review on efficiency measurement specifically within the Malaysian takaful context. Therefore, the objective of this paper is to review the financial efficiency approach applied in Malaysian takaful sector to provide a clearer understanding of the methods used, evaluate their suitability for the takaful context, and propose directions for future research to enhance consistency and comparability in efficiency assessments.

This study is based on a systematic literature review aimed to examine the methodological approach used in measuring the efficiency of Malaysian takaful sector. The research questions guiding this study are:

RQ1: What are main efficiency approaches used in Malaysian takaful studies?

RQ2: What input and output variables commonly employed in the efficiency measurement of Malaysia's takaful studies?

A comprehensive understanding on this matter is crucial to improve methodological consistency and to enhance the reliability of efficiency measurement. This study focuses on synthesizing existing evidence, pinpoint research gaps, and present a comprehensive overview of Malaysian takaful efficiency assessment.

2.0 LITERATURE REVIEW

The growing number of research on efficiency in the insurance and takaful industry, spanning both developed and developing countries, offers valuable insights related to the performance and operational effectiveness of the firms. For companies that are looking to improve their operational performance, these insights are essential as they help to identify the area of their strength and weakness. Furthermore, efficiency analysis has become a vital tool in evaluating the performance of takaful operators, as it reflects how effectively they utilize resources while upholding Shariah-compliant principles. Based on past studies, parametric and non-parametric methods are two primary method that is used to assess the efficiency of insurance and takaful firms. Among the parametric methods, the most widely utilized is Stochastic Frontier Approach (SFA). In contrast, the most employed non-parametric method is Data Envelopment Analysis (DEA) (Saad et al., 2006).

The Stochastic Frontier Approach (SFA) is an econometric technique used to evaluate a firm's efficiency in terms of the cost and production while also while considering various external factors that could influence the efficiency level. One of the main advantages of SFA is its ability to handle technical inefficiency and allows any random error, providing a more accurate assessment of performance (Musa et al., 2022). SFA includes a random error in its model to capture the unpredictable factors that affect the performance that are not caused by inefficiency. This means that SFA analysis is more realistic because it acknowledge that some inefficiencies may be caused by other factors which are beyond the companies control (Alhassan & Biekpe, 2016).Furthermore, SFA makes it easier to analyse how environmental factors may affect a firms efficiency, and it also helps to identify any outliers from the data set which can help to improve the accuracy of the findings(Kholis & Afifah, 2022).

Meanwhile, Data Envelopment Analysis (DEA) is a mathematical model based on linear programming which are widely used to assess a firm's efficiency and this method was first introduced in 1978 by Charnes, Cooper, and Rhodes and it has been widely used by many researchers(Jinn et al., 2018). One of the key advantages of the DEA approach is that it does not require data standardization. This flexibility allows researchers to use various types of input and output variables, even if the measurements are from different units (Kamarudin et al., 2019). Secondly, the DEA method is well-suited for studies with smaller sample sizes, while the SFA generally requires larger datasets with multiple parameters to produce reliable efficiency estimates (Trinh, 2024). Another important advantage of DEA method is the ability to identify the specific sources of inefficiency based on the inputs and outputs variables that are being used for the analysis(Lutfi & Suyatno, 2019). Thus, it enables researchers to identify and compare the performance differences between efficient and inefficient companies. Furthermore, it was suggested by past studies that DEA is particularly effective in examining organizations such as insurance and takaful companies as it can assess multiple outputs (Solehudin, 2025).

The purpose of this study is to discuss the opportunities and challenges of efficiency study, with a particular focus on takaful companies in Malaysia. One of the main challenges in takaful efficiency studies is the fact that different studies employed different input and output variables which is a significant issue in efficiency analysis. To examine efficiency, various researchers used various different indicators. Different researchers employed different indicators to measure efficiency. For instance, in previous studies that employed the SFA method, Nasution et al. (2022) used management expenses as the input, while net benefits and claims as well as investment income were considered as the outputs variable. Based on the result of the study, the 11 Malaysian Family takaful firms were found to be less efficient between 2017 to 2020 with a total average efficiency score of 56.83 percent.On the other hand, in the study ofKholis & Rakhmawati (2022), which also applied the SFA method, total income was used as the input, while total capital and total expenses were used as output variable. Based on the data from 2016 to 2020, the findings revealed that the average efficiency score for 11 Malaysian Takaful firms was at 61.63 percent. Comparing the two research studies which were conducted with almost the same period, the findings show a slightly different efficiency score which could be influenced by the choice of input and output variables.

Meanwhile, in studies that utilized the DEA approach, such asAli et al. (2021),it provides a comprehensive overview of efficiency of takaful operators in 16 countries including Malaysia. The efficiency of Malaysia’s takaful operators is at high level but still not achieve optimal level. In the study, three input variables were employed, namely net claims, operating expenses, and provisions, while gross contributions and investment income was used at the output. Next, in the study by Musa et al. (2022), the efficiency of family takaful and life insurance companies in Malaysia was analyzed using three input variables and two output variables. The three inputs that are being used are fees and commission expenses, underwriting risk, and operating leverage.Meanwhile, the outputs were solvency and net profit margin. Based on the empirical findings, although takaful efficiency has improved from 2010 to 2018, they are still unable to achieve optimum level of efficiency.

Based on a study by Faruk & Rahaman(2015), ithas applied commission and management expenses as inputs, meanwhile premiums and net investments as the outputs for their study in examining Bangladesh insurance companies and Malaysia takaful companies over the period of 2009 to 2011. Based on the DEA analysis, there was only one Malaysia takaful firm that has consistently achieved full efficiency under the constant return to scale model and variable return to scale model.Yakob et al. (2014)conducted a study on to assessed financial management efficiency of 20 insurance and takaful firms in Malaysia using slack-based model measure data envelopment analysis (SBM-DEA). The study

measures two aspects of financial management efficiencies which are risk and investment management. Under risk management, three inputs were considered which are investment risk, underwriting risk, and leverage, while net incurred benefit served as its output. For investment risk management, actual reserves and total investment on assets were treated as inputs, meanwhile, solvency and investment returns were used as its outputs. Based on the empirical findings, it showed that the efficiency for both risk management and investment management was at moderate level with average scores below 80 percent for 2003 to 2007 period. The result indicates that risk management inefficiencies were mostly driven by excessive leverage, underwriting, and investment. Meanwhile, for investment management, the inefficiencies are caused by overutilization of investment assets and actual reserves.

Another study by Muhamat et al. (2021) analyzed the efficiency of four general takaful operators in Malaysia using the DEA approach and this study employed two input variables, namely labor cost and management fees.Meanwhile, gross contribution is being used as the output variable. The result denotes that from 2014 to 2018, two out four general takaful firms have achieved optimum level of efficiency, while the remaining two firms were found to be technically inefficient. Furthermore, according to the study by Chong et al. (2024), which examined the efficiency of takaful and conventional insurance companies in Malaysia, four input variables were considered which are labor cost, business services, equity capital, and capital debt. Also, there are three outputs used which are premium, total investment, and claims by policyholders. In addition, a related study by Antonio et al. (2013) compared the efficiency of takaful and conventional insurance companies from 2009 to 2011 using the non-parametric Data Envelopment Analysis (DEA) approach with multiple input and output variables. There are two variables that are being used, which are gross premium and investment income, while the input consists of management expenses as well as fees and commission expenses.Despite using many types of inputs and outputs, the findings from the study has revealed that takaful firms' efficiency are still at moderate level and not yet able to achieve optimum efficiency for their operations.

Based on a study by Mohamad Yusof (2020), the paper aims to evaluate the efficiency of eight general takaful operators in Malaysia between 2013 to 2017 by applying DEA and Malmquist Productivity Index (MPI). The study used net claims paid, commission paid, and management expenses as its input, while net contribution income and investments income were used as its outputs. In general, these firms are managerially efficient, however, they are still scale inefficient which means the firms are still not operating at the most optimum level.Lee et al. (2019) conducted a similar study which is to measure the efficiencies of 11 family takaful and 8 general takaful in Malaysia from 2011 to 2015 by using DEA approach. The study examined the efficiencies by using labor, debt capital, and equity capital as inputs, and net contribution income, net investment income, and provisions of outstanding claims as its outputs. The findings indicate that family takaful are generally more cost efficient than general takaful although none of them achieve full efficiency level. The results further indicate that the firms were allocatively inefficient, suggesting that they are not effective in managing their resources to achieve maximizing output.

Lastly, a study by Sukmaningrum et al. (2022) used Malmquist Productivity Index (MPI) under DEA approach to assessed the productivity of family takaful firms in Malaysia and Indonesia from 2014 to 2019. MPI focuses explicitly on productivity level of each DMU by examining changes in efficiency and technology based on the selected input and output variables. Equity, total expenses, and total investment were used as input, while total profit and total investment income were used as outputs. The result indicates that Indonesian family takaful did not reached optimum productivity, meanwhile, Malaysian family takaful performed better and reached optimum productivity with minimal decline during 2016 to 2017. The study suggests that both operators need to improve their technological innovation and service delivery to improve productivity.

Based on previous literature, it is evident that both parametric and non-parametric approach method have provided valuable insights on the efficiency of Malaysia's takaful industry. Some studies have preferred SFA method to analyse efficiency of takaful due to its flexibility in estimating different frontier functions such as production, cost, profit, and revenue efficiency (Nasution et al., 2022). In addition, SFA method also account for random errors and external factors in the analysis, allowing efficiency estimation to better reflect firms performance (Kholis & Rakhmawati, 2022). Nevertheless, SFA relies on statistical assumptions, any inaccurate assumptions may affect the reliability and validity of the results. Meanwhile, DEA continues to be widely used approach in takaful efficiency studies due to its flexibility in handling different variables even if the measurement unit is different (Kamarudin et al., 2019). In addition, DEA also can track the sources of inefficiencies based on the input and output variables used in the study (Lutfi & Suyatno, 2019).However, DEA approach also has several limitations particularly its sensitivity to model constraints and sensitivity towards outliers which can distort the efficiency result (Alshammari et al., 2019).

Nonetheless, the results of the studies remain mixed, as some of takaful operators were found to be efficient while others continued to show operational inefficiencies.One of the main obstacles in reaching a consistent and comparable results across studies is the absence of methodological uniformity, particularly with regards to the selection of input and output variables. Currently, there is still no clear agreement on the appropriate combination of input and output variables for measuring a company's efficiency (Abidin & Cabanda, 2011). In addition, it was also mentioned by Kholis & Rakhmawati. (2022)the differences in efficiency score may be due to different variations of input and output variables that are being used in the analysis as well as the differences in the number of samples. Moreover, it has been said from previous studies that a direct comparison of efficiency scores may not be reliable if different studies used different inputand output variables (Lee et al., 2019).

3.0 METHODOLOGY

This goal of this paper is to carry out a systematic literature review focusing on efficiency of Malaysian Takaful industry.To achieve the goal, this study adopted the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guideline to help identify, screen, and select relevant articles. PRISMA provides offered a more organized framework to ensure the review process is transparent, reliable, and systematic (Alam et al., 2022). This study used Google Scholar as the primary database as it offers free full-text articles access and extensive coverage of academic papers from various field.

Relevant studies released between 2013 to 2025 were included in the review. This timeline was chosen to ensure an up-to-date review of the literature on efficiency of takaful. The author searched for articles by using pertinent keywords such as "takaful", "efficiency", "parametric approach", and "non-parametric approach". These keywords were used separately and in combination in order to collect a wide range of empirical studies. The studies inclusion criteria were peer-reviewed research articles published between 2013 to 2025, studies that focused on Malaysian takaful sector, and studies that used parametric and non-parametric approach in efficiency measurement. Meanwhile, the exclusion criteria for this study are any conference paper, theses, dissertations, working papers, and book chapters. Apart from that, studies that are not related to efficiency of the Malaysian takaful and studies that fall outside the timeframe were also excluded.

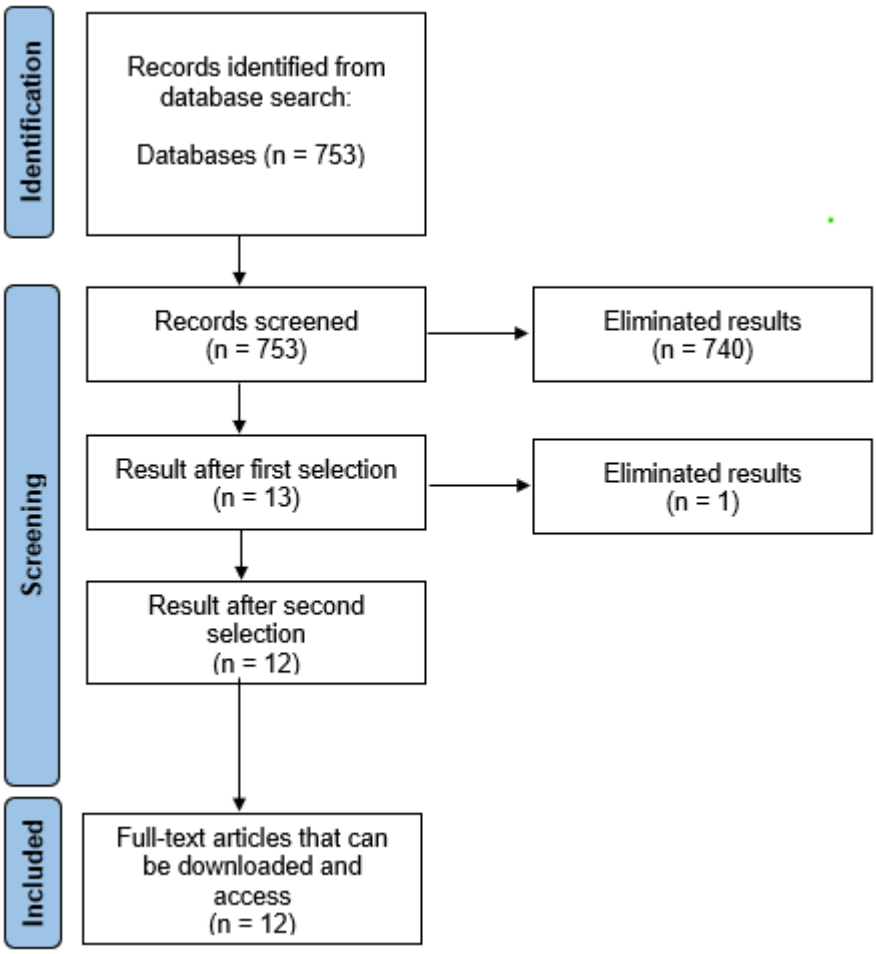


Figure 1: PRISMA Flow Diagram on Article Selection

Based on the initial search of the keywords, a total of 753 articles were identified. Nevertheless, only 13 papers were selected that has discussed on the efficiency of Malaysian takaful firms. Following the second stage of screening, only 12 papers were found to meet the inclusion criteria and selected for the final analysis.The selected studies were categorized according to its methodological approach which are parametric techniques like Stochastic Frontier Analysis (SFA) and non-parametric techniques which is Data Envelopment Analysis (DEA). This classification helps to identify and compare trends, research gaps and the inconsistencies in the selections of inputs and output variables. The author's name, publication year, methodological approach used in the study, as well as the input and output variables applied in the efficiency analysis were among the crucial details that is extracted from each study. This classification enables a more structured comparison on the ways in which different researchers have evaluated financial efficiency within the Takaful industry. Furthermore, the classification also makes it easier to understand how different method may affect the overall result of efficiency. In addition, it also helps the researcher to see more clearly the similarities and differences on the research design across studies.

By categorizing the past studies based on their respective methods, it allows for a more structured comparison of how efficiency has been assessed and examined in the literature. In addition to highlighting the variety of analytical techniques used, this classification also help to comprehend how various methodological may affect the efficiency outcomes.Apart from that, special attention was given to the choice of input and output variables as it was discovered that variations of measurements had a substantial impact on the outcome of

efficiency across various studies. The differences in the input and output measurement were found to contribute towards inconsistency in findings. By systematically synthesizing the selected papers, the review aims to provide a better understanding of the current efficiency measurement practices within Malaysia's Takaful industry.

4.0 FINDINGS AND DISCUSSIONS

Although there are many types of techniques exist under both parametric and non-parametric approaches, previous research indicates that DEA and SFA are the most commonly used method to evaluate efficiency of takaful in Malaysia due to their robust capability to handle multiple variables.One of the major findings from this review is the considerable inconsistency in how input and output variables are chosen across different studies. Table 1 present the approaches used to evaluate the efficiency study of takaful industry in Malaysia.

Based on the information presented in table 1, out of the total studied reviewed, 10 studies had used DEA approach, meanwhile, 2 studies used the SFA approach. This suggests that when it comes to efficiency analysis studies on Malaysian takaful industry, researchers prefer to use DEA approach. The stronger inclination towards the DEA approach may be due to its flexibility to handle several different inputs and outputs simultaneously, and it requires less strict assumptions as compared to SFA approach. Furthermore, DEA is also thought to be more suitable for smaller sample size, which is often the case for research studies involving Malaysian takaful industry due to a limited number of takaful firms. Additionally, DEA can pinpoint the sources of inefficiency, which can help to make a performance comparison between efficient and inefficient firms.

Table 1. Approaches Used for Efficiency Studies of Takaful

Approach	Study	No. of Studies
DEA	Antonio et al. (2013); Yakob et al.(2014); Faruk & Rahaman (2015);Lee et al. (2019);Mohamad Yusof (2020);Muhamat et al. (2021); Musa et al. (2022);Sukmaningrum et al. (2022)Chong et al. (2024); Ali et al. (2021)	10
SFA	Nasution et al. (2022); Kholis & Rakhmawati (2022)	2

Table 2 shows a summary of the input and output variables used in studies that employed Stochastic Frontier Analysis (SFA) to evaluate the efficiency of Malaysian takaful industry. Based on the table below, the input used in SFA analysis includes management expenses and total income which represent key resources used by takaful operators. On the other hand, in terms of output variables, one of the studies used net benefit and claims as well as investment income as its output. Meanwhile, for another study it used total capital and total expenses as its output. The findings indicate that both studies used different input and output variables indicating a lack of uniformity in the SFA approach.

Table 2: Input and Output Variables Used for SFA Approach

Input Variables	Output Variables	Study
Management Expenses	Net Benefit and Claims Investment Income	Nasution et al. (2022)
Total Income	Total Capital	Kholis & Rakhmawati (2022)

Total Expenses

Table 3 provides a summary of the input and output variables which are commonly applied in studies that utilize DEA approach to evaluate the efficiency of Malaysia takaful industry. The findings reveal a wide range of variables used across different studies which highlights the flexibility of the DEA method in accommodating variations of data for analysisbut also indicates a lack of consistency in variable selection.

The inputs that have been used under the DEA analysis are fees and commission expenses, underwriting risk, operating leverage, labor cost, equity capital, debt capital, management expenses, business services, leverage, actual reserves, net claims, as well as total expenses. These inputs reflect the essential resources that are needed for takaful operators' activities. Meanwhile, the output that is commonly used for DEA analysis is gross contribution, solvency margin, net profit margin, premium, investment income, net incurred benefits, solvency, total profit as well as claims made by the policyholder. Based on the analysis, the differences inthe input and output variables may create difficulties to compare findings across studies.

Based on table 3, it appears that management expenses as well as fees and commission expenses are the most frequently used variables as the indicator for input. Meanwhile, the most frequent indicators for output variables are premium or contribution as well as investment income. The analysis demonstrates that although DEA approach gives researchers flexibility in choosing various different variables, it also makes it challenging to compare results or make a generalize conclusion across the body of existing literature.

Table 3: Input and Output Variables Used for DEA Approach

Input Variables	Output Variables	Study
Fees and Commission Expenses Underwriting Risk Operating Leverage	Solvency Margin Net Profit Margin	Musa et al. (2022)
Labor Cost Management Fees	Gross Contribution	Muhamat et al. (2021)
Labor Cost Equity Capital Debt Capital Business Services	Premium Total Investment Claims by Policyholder	Chong et al. (2024)
Management Expenses Fees and Commission Expenses	Gross Premium Investment Income	Antonio et al. (2013)
Leverage Underwriting Risk Investment Risk Actual Reserves Total Investments on Asset	Net Incurred Benefits Plus Reserves Solvency Investment Return	Yakob et al. (2014)
Commission and Management Expense	Premium Net Investment Income	Faruk & Rahaman (2015)
Labor Debt Capital Equity Capital	Net Contribution Income Net Investment Income Provisions on Outstanding Claims	Lee et al. (2019)
Net Claims Paid Commission Paid Management Expenses	Net Contribution Income Net Investment Income	Mohamad Yusof, (2020)
Equity Total Expenses Total Investment	Total Profit Investment Income	Sukmaningrum et al. (2022)

According to the analysis, it has been discovered that most studies on takaful efficiency in Malaysia have employed DEA approach and only two studies has used the SFA method. Although both techniques have proven to be effective in evaluating efficiency of takaful, the findings still show considerable inconsistencies for the selection of input and output variables

across different studies. As a result, due to the lack of standardization in variable selection, it shows that there is still a significant gap in the assessment of financial efficiency of Malaysia's takaful industry.

In terms of input variables, the findingsreveal that the most commonly used input variables are management expenses and fees and commission expenses which consistently appear in multiple empirical studies applying both DEA and SFA. These variables are repeatedly chosen because it represents the primary core expenses of the takaful operator and it has strong influence on takaful day-to-day business activities and efficiencies. By effectively managing these inputs, takaful firms may reduce cost while maintaining service quality which raise customer satisfactions and foster trust on the takaful services (Muhamat et al., 2021).

In terms of output variables, the most frequently used variables are premium and investment income. Premium or contribution from participants are the main sources of income for insurance and takaful firms. Meanwhile, investment income reflects the operator's capability to generate returns from Takaful funds, which is also crucial for the sustainability and overall financial performance of the takaful operators. Although there are certainly differences in variables that are used across literature, these variables are generally used consistently throughout research, highlighting their significance in capturing the financial performance of the takaful firms.

Based on the trend observed in the reviewed literature, DEA approached emerged as the preferred method for evaluating the efficiency of takaful operators. The justification lies in DEA's non-parametric nature and flexibility, which allows researchers to accommodateinputs and outputs in the analysis without requiring an assumed functional form or strict statistical assumptions. Furthermore, DEA is especially well suited when there are multiple inputs and outputs, which makes it extremely pertinent for the Takaful sector, whose operations involved and require a variety of operational and financial resources. With all things considered, DEA's adaptability and flexibility make it a more suitable and broadly applicable technique for efficiency study for this industry.

5.0 CONCLUSION

In summary, this paper reviewed the various financial efficiency measurement approaches applied in Malaysia's takaful sector, with particular emphasize on both parametric and non-parametric methods. It was identified that the majority of existing studies on efficiency analysis relied on DEA approach, meanwhile, a smaller portion of studies has used SFA approach. This suggests that non-parametric approaches are clearly preferred among researchers due to their flexibility and adaptability to incorporate multiple inputs and outputs without requiring a strong statistical assumption.

Nevertheless, although both parametric and non-parametric approach offered a valuable insight on the efficiency of takaful operators, this review also identifies several limitations and gaps in the existing body of literature. One of the main challenges or issues is the lack of consistency on the input and output selection, which leads to disparities in the empirical findings across studies. These differences limit the capacity of researchers to draw a consistent conclusion about the efficiency trends in this industry. Furthermore, it has been mentioned that efficiency scores from different studies cannot be directly compared if the inputs, outputs, and approaches are different (Lee et al., 2019).

Therefore, a more uniform and standardized framework in terms of variable selection would significantly improve the reliability and robustness of future research studies on takaful efficiency. In particular, researcher may want to consider utilizing frequently usedvariables such as investment income and contribution for the output as it reflects their main generating income activities of takaful firms, as well as management expenses and fees and

commission expenses as their input as it capture the core financial expenses. Standardizing the variable selection within the takaful sector will help to enhance the comparability between studies, reduce inconsistencies in terms of methodologies, and help to develop a more cohesive body of literature on Takaful efficiency.

Overall, the insights gathered for these studies may help researchers as a guidance for future studies. In the long run, such improvements in the efficiency analysis of Takaful will eventually help to better understand the overall industry performance and simultaneously strengthening the Malaysia's Takaful industry.

CO-AUTHOR CONTRIBUTION

The authors declare that there are no commercial, financial, or personal relationship that could be perceived as potential of conflict of interest in the conduct of this research. Nur Azureen binti Inchiem carried out the research, analyse relevant data, and prepared the original draft of the manuscript. Imbarine Bujang supervised the overall research progress and contributed to the review and editing of the manuscript. Sarmila Udin provided advisory guidance throughout the research process and assisted in reviewing the manuscript.

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DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

This manuscript was prepared with the assistance of Quill Bot, ChatGPT, and Microsoft Co-Pilot to enhance language clarity and readability. These tools were only used for editing, text improvements, and paraphrasing. The authors takes full responsibility for all intellectual contributions, including the study design, data analysis, findings, and conclusions.

REFERENCES

Abidin, Z., & Cabanda, E. (2011). Efficiency of non-life insurance in Indonesia. *Journal of Economics, Business, and Accountancy Ventura*, *14*(3), 197. https://doi.org/10.14414/jebav.v14i3.46

Alam, A., Fianto, B. A., Ratnasari, R. T., Ahmi, A., & Handayani, F. P. (2023). History and development of takaful research: A bibliometric review. *SAGE Open*, *13*(3), 1–20. https://doi.org/10.1177/21582440231184852

Alam, A., Ratnasari, R. T., Qolbi, F. A., & Athief, F. H. N. (2022). Efficiency studies of the sharia insurance industry: A systematic literature review. *Insurance Markets and Companies*, *13*(1), 90–101. https://doi.org/10.21511/ins.13(1).2022.08

Alhassan, A. L., & Biekpe, N. (2016). Competition and efficiency in the non-life insurance market in South Africa. *Journal of Economic Studies*, *43*(6), 882–909. https://doi.org/10.1108/JES-07-2015-0128

Ali, C., Habibniya, H., & Keceli, Y. (2021). An efficiency analysis of takaful insurance Industry: A comparative study. *Journal of Asian Finance*, *8*(7), 111–0120. https://doi.org/10.13106/jafeb.2021.vol8.no7.0111

Alshammari, A. A., Alhabshi, S. M., & Saiti, B. (2019). The impact of oil prices and the financial market on cost efficiency in the insurance and Takaful sectors: Evidence from

a stochastic frontier analysis. *Economic Systems*, *43*(3–4), 100716. https://doi.org/10.1016/j.ecosys.2019.100716

Ansari, Z. (2022). A review of 20 years of takaful literature using a systematic method. *Asian Journal of Economics and Banking*, *6*(1), 2–25. https://doi.org/10.1108/ajeb-08-2021-0100

Antonio, M. S., Ali, M. M., & Akbar, N. (2013). A comparative analysis of the efficiency of takaful and conventional insurance in Malaysia. *The International Journal of Excellence in Islamic Banking and Finance*, *3*(1), 1–13. https://doi.org/10.12816/0001416

Benyoussef, S., & Hemrit, W. (2019). Measuring the relative efficiency of insurance companies in Saudi Arabia: The case study of takaful vs cooperative industries. *Cogent Economics and Finance*, *7*(1), 1–20. https://doi.org/10.1080/23322039.2019.1590818

Chong, J. K., Lee, H. S., & Liew, P. X. (2024). Is takaful (Islamic insurance) more efficient than conventional insurance? A comparative analysis of the malaysian insurance industry. *International Journal of Business and Society*, *25*(2), 509–529. https://doi.org/10.33736/ijbs.7611.2024

Faruk, O., & Rahaman, A. (2015). Measuring efficiency of conventional life insurance companies in bangladesh and takaful life insurance companies in Malaysia : A non-parametric approach. *Management Studies and Economic Systems*, *2*(2), 129–144. https://doi.org/10.12816/0019398

Handayani, F. P., & Alam, A. (2022). *History and development of takaful research : A bibliometric review*. *March 2022*, 1–26. https://doi.org/10.1177/21582440231184852

Husin, M. M. (2019). The dynamics of Malaysian takaful market: Challenges and future prospects. *Journal of Islamic Finance* , *2117*(Special Issue), 131–137.

Jinn, L. S., Hoe, L. W., & Siew, L. W. (2018). Investigation on the efficiency of financial companies in Malaysia with data envelopment analysis model. *Journal of Social Sciences Research*, *2018*(Special Issue 6), 893–898. https://doi.org/10.32861/jssr.spi6.893.898

Kader, H. A., Adams, M., & Hardwick, P. (2010). The cost efficiency of takaful insurance companies. *Geneva Papers on Risk and Insurance: Issues and Practice*, *35*(1), 161–181. https://doi.org/10.1057/gpp.2009.33

Kamarudin, F., Sufian, F., Nassir, A. M., Anwar, N. A. M., & Hussain, H. I. (2019). Bank efficiency in Malaysia a DEA approach. *Journal of Central Banking Theory and Practice*, *8*(1), 133–162. https://doi.org/10.2478/jcbtp-2019-0007

Kholis, N., & Afifah, Y. N. (2022). Measuring financial efficiency of insurance companies in Indonesia using stochastic frontier analysis approach. *Journal of Islamic Economics Lariba*, *8*(1), 196–212. https://doi.org/10.20885/jielariba.vol8.iss1.art12

Kholis, N., & Rakhmawati. (2022). Efficiency analysis of takaful companies' performance using stochastic frontier analysis approach: A comparison between Southeast Asia and The Middle East Regions. *Millah: Journal of Religious Studies*, *21*(3), 947–972. https://doi.org/10.20885/millah.vol21.iss3.art12

Lee, H. S., Cheng, F. F., Har, W. M., Md Nassir, A., & Ab Razak, N. H. (2019). Efficiency, firm-specific and corporate governance factors of the takaful insurance. *International Journal of Islamic and Middle Eastern Finance and Management*, *12*(3), 368–387. https://doi.org/10.1108/IMEFM-06-2018-0187

Lutfi, & Suyatno. (2019). Determinants of bank efficiency: Evidence from Indonesian regional development banks using data envelopment analysis. *Jurnal Ekonomi Malaysia*, *53*(3). https://doi.org/10.17576/JEM-2019-5303-05

Mimma Kebahyang, I. F., Bujang, I., Mohamed, N., & Maimunah, E. (2024). Measurement accuracy of inputs and outputs for financial efficiency of Islamic Banks. *ASEAN Journal on Science and Technology for Development*, *41*(2), 180–184. https://doi.org/10.61931/2224-9028.1574

Mohamad Yusof, N. A. (2020). Analysing the technical efficiency of general takaful industry in Malaysia: Anon-parametric approach. *Platform : A Journal of Management and Humanities*, *3*(1), 2. https://doi.org/10.61762/pjmhvol3iss1art5927

Muhamat, A. A., Basri, F., & Jaafar, M. N. (2021). A study on the efficiency of general takaful

operators in Malaysia: Post implementation of IFSA 2013. *Iranian Economic Review*, *March 2022*. https://doi.org/10.22059/IER.2021.83926

Musa, M., Alhabshi, S. M., & Haron, R. (2022). Optimization of solvency margin in family takaful and life insurance institutions in Malaysia: Application of data envelopment analysis. *Journal of Islamic Accounting and Finance Research*, *4*(1), 155–182. https://doi.org/10.21580/jiafr.2022.4.1.8792

Nasir, N. I., Hassan, R., & Ahmad Zamri Osman. (2023). Spectrum of consumer awareness in Islamic finance: Takaful industry In Malaysia. *The Journal of Muamalat and Islamic Finance Research*, *20*(2), 125–134. https://doi.org/10.33102/jmifr.513

Nasution, Z., Salsabila, L., & Setiawan, S. (2022). Efficiency analysis of Malaysian family takaful using stochastic frontier approach. *Ekonomi Islam*, *13*(2), 201–212. https://doi.org/10.22236/jei.v13i2.8604

Nourani, M., Devadason, E. S., & Chandran, V. G. R. (2018). Measuring technical efficiency of insurance companies using dynamic network dea: An intermediation approach. *Technological and Economic Development of Economy*, *24*(5), 1909–1940. https://doi.org/10.3846/20294913.2017.1303649

Salman, S. A., & Kawata, Y. (2022). Muslims' perception of Islamic insurance (Takaful) in Malaysia. *Journal of Islamic Finance*, *11*(1), 51–66. https://journals.iium.edu.my/iiibf-journal/index.php/jif/article/view/635

Solehudin, I. P. (2025). Efficiency of Shariainsurance companies in Indonesia: A data envelopment analysis (DEA) approach. *Multidisciplinary Research Studies in Social Sciences*, *1*(1), 51–60.

Sukmaningrum, P. S., Hendratmi, A., Rusmita, S. A., & Abdul Shukor, S. (2022). Productivity analysis of family takaful in Indonesia and Malaysia: Malmquist productivity index approach. *Journal of Islamic Accounting and Business Research*, *13*(4), 649–665. https://doi.org/10.1108/JIABR-03-2021-0097

Trinh, L. D. T. (2024). Determinants of efficiency of non-life insurance companies: Evidence from Vietnam. *Financial and Credit Activity: Problems of Theory and Practice*, *6*(59), 223–233. https://doi.org/10.55643/fcaptp.6.59.2024.4551

Yakob, R., Yusop, Z., Radam, A., & Ismail, N. (2014). Financial management efficiency performance of insurers and takaful operators in Malaysia. *Jurnal Pengurusan*, *40*, 25–40. https://doi.org/10.17576/pengurusan-2014-40-03

Zainuddin, S. (2013). An overview of the emergence of takaful: An islamic type of insurance policy. *International Journal of Business and Economics Research*, *2*(5), 112. https://doi.org/10.11648/j.ijber.20130205.13