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Analysis of Efficiency in Post-Merger Banks Using the Two-Stage DEA Method: A Case Study of BSI

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Abstract

This study analyzes the efficiency of Bank Syariah Indonesia (BSI) post-merger using the Two-Stage Data Envelopment Analysis (DEA) method. The merger of Bank Syariah Mandiri, BNI Syariah, and BRI Syariah was expected to improve BSI's operational efficiency, focusing on resource management, financing, and product access. The primary objective of this study is to evaluate the relative efficiency of these banks before and after the merger, as well as to analyze the impact of external factors such as Firm Size, Non-Performing Financing (NPF), Return on Assets (ROA), Financing to Deposit Ratio (FDR), and Capital Adequacy Ratio (CAR) on efficiency. The methodology used includes DEA with Constant Return to Scale (CRS) and Variable Return to Scale (VRS) models, followed by Tobit regression analysis to identify the influence of external variables. The results indicate that although BSI achieved full efficiency in 2023, the Scale Efficiency (SE) value in the previous years was still below 100, suggesting that BSI and other Islamic banks were still operating at non-optimal scales. Firm size was found to have a positive and significant impact on efficiency, while CAR had a negative but insignificant effect. FDR, NPF, and ROA showed significant effects on efficiency. This study provides recommendations to improve the efficiency of Islamic banking through the enhancement of firm size and better management of financing.

Keywords: Efficiency, Bank Syariah Indonesia, Merger, Two-Stage DEA, Scale Efficiency, FDR, NPF.

INTRODUCTION

Islamic banking in Indonesia holds significant potential given that the majority of Indonesia's population is Muslim, with approximately 87.34% of the total 282.477 million population identifying as Muslim in 2024. In response to the need for a banking system aligned with Islamic principles, Bank Muamalat Indonesia (BMI) was established as the first Islamic bank in Indonesia in 1991. Since then, other Islamic banks have emerged, with the number of Islamic Commercial Banks (BUS) and Islamic Business Units (UUS) continuously increasing, creating a vast market opportunity for Sharia-compliant banking services. However, despite the large market potential, the market share of Islamic banking in Indonesia remains relatively low, accounting for only 7.78% of the total banking assets in the country. This low market share is attributed to several factors, including operational inefficiencies that hinder the competitiveness of Islamic banking in Indonesia when compared to Islamic banking in other countries, such as Malaysia (Wendha and Alteza 2020). Other contributing factors include low financial literacy and inclusion, which slow the development of Islamic banking in Indonesia (Sholihah 2021).

In facing these challenges, several Islamic banks in Indonesia have merged to increase their competitiveness and efficiency. A notable example is the merger of Bank Syariah Mandiri, BNI Syariah, and BRI Syariah, which formed PT. Bank Syariah Indonesia, Tbk (BSI). This merger is expected to enhance the operational efficiency of Islamic banking in Indonesia, both in terms of capital utilization, financing management, and improving access to Sharia-compliant banking products across Indonesia. However, despite the expectation that mergers would improve efficiency, some studies show that bank mergers do not always have a positive impact on operational efficiency (Hadini and Wibowo 2021). Therefore, it is essential to conduct a thorough analysis of the efficiency of the merged bank, one of which can be achieved by using the Two-Stage Data Envelopment Analysis (DEA) method, which can provide a clearer picture of how much the merger has succeeded in improving efficiency compared to the pre-merger conditions (Wendha and Alteza 2020).

Research on the efficiency of Islamic banks post-merger remains limited, particularly studies using the Two-Stage DEA approach, which can evaluate the relative efficiency of banks based on both input and output comprehensively. Although several previous studies have used DEA to measure the efficiency of Islamic banks in Indonesia (Abidin et al. 2024), few have specifically analyzed the efficiency of Islamic banks post-merger, especially for Bank Syariah Indonesia, which was the result of the merger of three major banks. This study is crucial to fill the existing research gap, considering that data and analyses on the efficiency of merged banks using the Two-Stage DEA method have not been deeply discussed, especially in the context of Islamic banking in Indonesia.

Several studies related to banking efficiency using Data Envelopment Analysis (DEA) have been conducted. Abidin et al. analyzed efficiency between conventional banks and regional development banks in Indonesia (Abidin et al. 2024), while Hadini and Wibowo compared the efficiency of conventional banks and Islamic banks in Indonesia (Hadini and Wibowo 2021). Syaifuddin also emphasized the importance of efficiency in the performance of Islamic banks in Indonesia (Syaifuddin 2009). These studies suggest that while efficiency in Islamic banking has been sufficiently considered, few have analyzed the impact of mergers on this efficiency, particularly using the Two-Stage DEA approach.

This research offers a new approach focusing on the efficiency analysis of merged Islamic banks using the Two-Stage DEA method. This method allows for the measurement of relative efficiency based on both input and output, along with evaluating the influence of external variables such as company size (Size), Non-Performing Financing (NPF), Return on Assets (ROA), Financing to Deposit Ratio (FDR), and Capital Adequacy Ratio (CAR) on post-merger efficiency. The main objective of this study is to analyze the efficiency of Islamic banks post-merger, particularly Bank Syariah Indonesia (BSI), which is the result of the merger of Bank Syariah Mandiri, BNI Syariah, and BRI Syariah. Additionally, this study aims to evaluate the influence of external factors on Islamic bank efficiency and compare BSI's efficiency with other Islamic banks in Indonesia. The benefit of this research is to provide a deeper understanding of the impact of mergers on the efficiency of Islamic banking in Indonesia, as well as provide recommendations for stakeholders, including regulators and players in the Islamic banking industry, to improve the efficiency and competitiveness of the Islamic banking industry in Indonesia.

LITERATURE REVIEW

Efficiency Theory

Efficiency is a crucial element in measuring the performance of a company, in this case, the bank that is the subject of this research. Efficiency is often interpreted as the ability of a company to manage its input as resources and produce output as maximally as possible. A company is considered to have a higher level of efficiency if, for a given amount of input, it can generate more output, or for a given amount of output, it can use less input (Abidin et al. 2024). In banking, efficiency is a key indicator in measuring the performance of the bank and provides information for determining the effectiveness of monetary policies. An inefficient bank will face difficulties and lack the capability to compete in collecting public funds and channeling them back to society in the form of loans or financing. According to Yongjie Xue and Rusydiana, the efficiency of a company consists of two components: technical efficiency and allocative efficiency (Rusydiana and Conculting 2013; Xue et al. 2024). Technical efficiency reflects the ability of the company to produce output using a given amount of input. Allocative efficiency, on the other hand, reflects the company's ability to optimize its use of inputs with the appropriate pricing structure and production technology. These two measures are then combined into economic efficiency.

The traditional approach to measuring banking efficiency is using financial ratios, such as Return on Assets (ROA), Net Interest Margin (NIM), and the comparison between Operating Costs and Operating Income (BOPO). The weakness of this ratio approach lies in the difficulty of determining which economic units are the most efficient when comparing several units of businesses in the same field (Pereira, Kennedy, and Potgieter 2019).

Data Envelopment Analysis (DEA) Theory

Data Envelopment Analysis (DEA) was first introduced by Charnes, Cooper, and Rhodes in 1978 and 1979. Since then, the DEA approach has been widely used in operational research and management science. DEA is more task-oriented and focuses on evaluating decision-making units (DMUs), which are essential in assessing the performance of a company. DEA is a non-parametric approach, which means that it does not require an initial production function. However, a limitation of this approach is its sensitivity to extreme observations (Rusydiana and Conculting 2013).

There are two models commonly used in this approach: the CCR model (1978) and the BCC model (1984). According to Rusydiana, the Constant Returns to Scale (CRS) model, developed by Charnes, Cooper, and Rhodes (the CCR model) in 1978, assumes that the ratio between input and output increase remains constant (constant returns to scale) (Rusydiana and Conculting 2013). This

means that if input is increased by a factor of x, the output will increase by the same factor, x. The other model, the BCC model, was developed by Banker, Charnes, and Cooper in 1984 and is an extension of the CCR model. This model assumes that a company is not necessarily operating at an optimal scale. The assumption of the BCC model is that the ratio between the increase in input and output is not the same (Variable Returns to Scale). This means that an increase in input by a factor of x will not necessarily result in an increase in output by the same factor; it could be either larger or smaller. The choice of the DEA testing method by the author is based on the fact that this non-parametric method is widely used, which aligns with the opinions of (Abdin et al. 2022). The DEA testing method is still commonly applied in efficiency testing, as seen in both national and international journals.

METHOD

This study aims to analyze the efficiency of Bank Syariah Indonesia (BSI) post-merger using the Data Envelopment Analysis (DEA) approach. DEA is used because it is an effective non-parametric technique for measuring the relative efficiency of a company by utilizing multiple inputs and outputs (Abbas et al. 2018). DEA compares similar units within an industry to identify the most efficient units and evaluate the weaknesses and potential improvements of less efficient units (Shao, Yu, and Feng 2019). This study applies two models in DEA, namely the Constant Return to Scale (CRS) model and the Variable Return to Scale (VRS) model. The CRS model assumes that increases in input will result in proportional increases in output, whereas the VRS model assumes that changes in input do not always lead to proportional changes in output, allowing companies to operate at suboptimal scales.

Relative efficiency will be calculated for the three banks under study before the merger (Bank Syariah Mandiri, BNI Syariah, and BRI Syariah) using financial data from 2018 to 2020. The input variables used in the calculation are Third-Party Funds (DPK), Capital, and Labor Costs, while the output variables are Financing and Operating Income. Subsequently, the relative efficiency of these banks will be compared with that of Bank Syariah Indonesia after the merger, using financial data from 2021 to 2023.

Additionally, an analysis will be conducted on the efficiency of other Islamic banks in Indonesia to compare BSI with other large Islamic banks. To evaluate the influence of external factors on efficiency, this study also uses Tobit regression with the dependent variable being the Efficiency Scale (SE) derived from DEA. The independent variables in the Tobit regression model are Company Size (Size), Capital Adequacy Ratio (CAR), Financing to Deposit Ratio (FDR), Non-Performing Financing (NPF), and Return on Assets (ROA).

The following tables show the operational definitions of the variables used in this study:

Table 1. Operational Definition of Input and Output Variables in DEA

No	Input Variables	Variable Definition
1	Third-Party Funds (DPK)	Funds obtained from the public in the form of current accounts, savings, and deposits.
2	Capital	The bank's capital, consisting of core capital (Tier 1) and supplementary capital (Tier 2).
3	Labor Costs	Costs incurred for labor in running the bank's operations.

Table 2. Operational Definition of Output Variables in Efficiency Analysis

No	Output Variables	Variable Definition
1	Total Financing	Financing provided by the bank to other parties, both interest-based and sharia-compliant.
2	Operating Income	Income generated from the main operational activities of the bank.

Table 3. Operational Definition of Independent Variables in Tobit Regression

No	Independent Variables	Variable Definition	Indicator
1	Company Size (Size)	The size of the bank based on its total assets.	Size = Ln (TA)
2	CAR (Capital Adequacy Ratio)	The ratio that describes how much of the bank's assets are financed by its own capital.	CAR = Capital / ATMR x 100%

3	FDR (Financing to Deposit Ratio)	The ratio that indicates the bank's ability to channel financing.	FDR = Total Financing / Total DPK x 100%
4	NPF (Non-Performing Financing)	Financing that has been overdue for more than 90 days without payment.	NPF = Total Non-performing Financing / Total Financing x 100%
5	ROA (Return on Assets)	A ratio to measure the bank's ability to generate profit from its total assets.	ROA = Net Profit After Tax / Total Assets x 100%

After calculating the relative efficiency, the Efficiency Scale (SE) for each bank will be compared, and Tobit regression will be used to analyze the effect of the independent variables on the measured efficiency. Hypothesis testing will be performed using the Wald test to examine the effect of each independent variable on the dependent variable. The decision rule is to accept the null hypothesis (Ho) if the p-value > 0.05 and to accept the alternative hypothesis (Ha) if the p-value < 0.05.

To test whether all independent variables simultaneously affect efficiency, a simultaneous test using the likelihood ratio method (G test) will be conducted. If the p-value is less than 0.05, the alternative hypothesis (Ha) will be accepted, indicating a significant influence between the independent and dependent variables.

With this approach, this study is expected to provide a better understanding of the efficiency of Islamic banks post-merger and the factors influencing it, as well as provide strategic recommendations for the Islamic banking industry in Indonesia.

RESULTS AND DISCUSSION

Pre-Merger Bank Performance

The merger between Bank Syariah Mandiri, BNI Syariah, and BRI Syariah represents an acquisition transaction among these entities. Bank Syariah Mandiri and BNI Syariah were majority-owned by Bank Mandiri and Bank Negara Indonesia, respectively, while BRI Syariah was owned by Bank Rakyat Indonesia (Muchlis 2022). Prior to the merger, Bank Syariah Mandiri made the largest contribution in terms of assets, financing, equity, and profits among the three banks, contributing about 52.95% of the total assets at the time of the merger.

Table 4. Performance of Bank Syariah Mandiri, BNI Syariah, and BRI Syariah as of December 2020 (in trillion IDR)

No	Bank Name	Assets	Third-Party Funds (DPK)	Financing	Equity	Profit
1	Bank Syariah Mandiri	126.908	112.585	90.562	10.840	1.434
2	BNI Syariah	55.009	44.859	33.100	5.549	505
3	BRI Syariah	57.716	49.347	40.045	5.444	248

Source: Financial Statements of Each Bank

Banking Efficiency Calculation Results

A. Pre-Merger Period

1. CCR Model (Charnes, Cooper, Rhodes)

   The CCR model is used to evaluate the efficiency of banks under the assumption of Constant Returns to Scale (CRS). Table 4.2 shows that Bank Syariah Mandiri experienced inefficiency in several quarters in 2018 and 2019, with an average input-oriented efficiency of 0.96769175 in 2018 and 0.99195525 in 2019. However, in 2020, Bank Syariah Mandiri achieved full efficiency, with an efficiency value of 1 for both input and output.

Table 5. CCR Method Efficiency for 2018, 2019, and 2020

No	Bank Name: Bank Syariah Mandiri	Year 2018		Year 2019		Year 2020	
		Input Oriented	Output Oriented	Input Oriented	Output Oriented	Input Oriented	Output Oriented
1	TW1	0.971898	0.971898	1	1	1	1
2	TW2	0.932971	0.932971	1	1	1	1
3	TW3	0.965898	0.965898	0.982676	0.982676	1	1
4	TW4	1	1	0.985145	0.985145	1	1
Average		**0.96769175**	**0.96769175**	**0.99195525**	**0.99195525**	**1**	**1**

Source: Research Data, Processed

2. BCC Model (Banker, Charnes, Cooper)

Using the BCC model, which assumes Variable Returns to Scale (VRS), Bank Syariah Mandiri showed an improvement in efficiency in 2020, with an average efficiency value of 1 for both input and output.

Table 6. BCC Method Efficiency of Bank Syariah Mandiri for 2019 and 2020

No	Bank Name: Bank Syariah Mandiri	Year 2018		Year 2019		Year 2020	
		Input Oriented	Output Oriented	Input Oriented	Output Oriented	Input Oriented	Input Oriented
1	TW1	0.977814	0.976699	1	1	1	1
2	TW2	0.941321	0.93824	1	1	1	1
3	TW3	0.96988	0.969132	0.982936	0.982723	1	1
4	TW4	1	1	0.99379	0.994805	1	1
Average		**0.97225375**	**0.97101775**	**0.9941815**	**0.994382**	**1**	**1**

Source: Research Data, Processed

B. Post-Merger Period

After the merger, Bank Syariah Indonesia (BSI) showed better efficiency performance. In 2021 and 2022, although BSI's Efficiency Scale (SE) was less than 1, in 2023, BSI achieved optimal efficiency with a value of 1 for both input and output under the BCC method. Nevertheless, when compared with other Islamic banks like Bank Muamalat and BCA Syariah, BSI still needs to make further efforts to achieve better efficiency in certain areas.

Table 7. BSI Efficiency under the CCR Method for 2021, 2022, and 2023

No	Bank Name: Bank Syariah Mandiri	Year 2018		Year 2019		Year 2020	
		Input Oriented	Output Oriented	Input Oriented	Output Oriented	Input Oriented	Input Oriented
1	TW1	0.837327	0.837327	0.901127	0.901127	0.993403	0.993403
2	TW2	0.859382	0.859382	0.945938	0.945938	0.809703	0.809703

No	Bank Name: Bank Syariah Mandiri	Year 2018		Year 2019		Year 2020	
		Input Oriented	Output Oriented	Input Oriented	Output Oriented	Input Oriented	Input Oriented
3	TW3	0.924936	0.924936	0.968355	0.968355	0.819852	0.819852
4	TW4	0.984879	0.984879	0.940752	0.940752	0.902787	0.902787
Average		**0.901631**	**0.901631**	**0.939043**	**0.939043**	**0.88143625**	**0.88143625**

Source: Research Data, Processed

DISCUSSION

Pre-Merger and Post-Merger Bank Performance

Bank Syariah Mandiri had the dominant contribution to the merger, accounting for 52.95% of the total assets. Before the merger, Bank Syariah Mandiri showed high efficiency in 2020, while BNI Syariah and BRI Syariah were still showing inefficiency (Table 4). After the merger, Bank Syariah Indonesia (BSI) saw performance improvements, though in 2021 and 2022, inefficiencies were still visible with SE values below 1. However, by 2023, BSI achieved full efficiency, both in terms of input and output.

Efficiency of Islamic Banks After the Emergence of BSI

After the merger, most Islamic banks, including BSI, still operated below optimal conditions (VRS). This indicates that although Bank Syariah Indonesia has made significant progress in efficiency, other Islamic banks still need to improve their operations to achieve optimal efficiency.

Factors Affecting the Efficiency of Islamic Banks

The Tobit regression results show that Company Size (Size) has a significant positive effect on bank efficiency. The larger the size of the bank, the more efficient its operations, which aligns with previous research indicating a positive relationship between company size and efficiency (Elmahdy, Abdelkader, and Shaker 2025). On the other hand, the Capital Adequacy Ratio (CAR) has a negative but insignificant effect on efficiency, suggesting that higher capital does not always correlate with increased efficiency in Islamic banks.

Other factors affecting efficiency include the Financing to Deposit Ratio (FDR), which has a significant positive effect, indicating that an increase in financing distribution contributes to better operational efficiency. Non-Performing Financing (NPF) negatively affects efficiency, as banks with higher levels of non-performing financing tend to be less efficient. Return on Assets (ROA) also has a significant positive effect on efficiency, confirming that banks with higher profitability tend to be more efficient in utilizing their assets.

Managerial Implications

Based on the research findings, Islamic banks in Indonesia must continue to strive to improve their efficiency, especially through increasing company size and better management of financing. One strategic approach is through mergers, which can help Islamic banks grow in size and improve operational efficiency. However, the main post-merger challenge lies in integrating corporate culture, organizational structure, and technology, which must be carefully managed to ensure the merger's success and enhance the performance of Islamic banks in Indonesia.

CONCLUSION

Based on the analysis and discussions conducted, it can be concluded that although the merger of Bank Syariah Mandiri, BNI Syariah, and BRI Syariah formed Bank Syariah Indonesia (BSI), the efficiency results achieved post-merger still indicate suboptimal outcomes. The Scale Efficiency (SE) of Bank Syariah Indonesia in 2021, 2022, and 2023 remained below 100, indicating that the bank operates under conditions of Variable Returns to Scale (VRS), where input and output utilization was not optimal. Similarly, the banks involved in the study prior to the merger, such as Bank Syariah Mandiri, BNI Syariah, and BRI Syariah, also showed low efficiency with SE values below 100 in 2018 and 2019. However, in 2020, Bank Syariah Mandiri exhibited higher efficiency with an SE value above 100, which was not the case for BRI Syariah and BNI Syariah, which remained inefficient. Overall, the hypothesis stating that Bank Syariah Indonesia post-merger would be more efficient than the previous banks was not fully supported.

Nevertheless, the results of this study also show that the size of the company (size) has a positive and significant impact on banking efficiency. The larger the company size, the more efficient the bank's performance. On the other hand, the Capital Adequacy Ratio (CAR) did not significantly affect efficiency, meaning that having larger capital did not necessarily improve operational efficiency. In contrast, the Financing to Deposit Ratio (FDR) had a positive and significant effect on efficiency, indicating that the higher the financing ratio provided by the bank, the greater its efficiency. Non-Performing Financing (NPF) had a negative impact on efficiency, indicating that the higher the NPF ratio, the lower the bank's efficiency. Additionally, Return on Assets (ROA) also showed a positive and significant effect on efficiency, indicating that banks with higher profitability are more efficient in their operations.

Limitations of the Study

This study has several limitations that should be considered for future research development. One of the main limitations is the lack of testing the productivity level of employees from the banks studied. Additionally, the sample size used is relatively small, as the banks involved in this research have relatively small assets. Another limitation is the limited time period, which affects the accuracy of the analysis results, as well as difficulties in obtaining publications from Bank Muamalat, which are only released quarterly. The author hopes that these limitations can be addressed in future, more comprehensive studies.

Recommendations

Although the Scale Efficiency (SE) of Bank Syariah Indonesia in 2021, 2022, and 2023 remained below 100, the analysis using the BCC method shows that BSI achieved efficiency in 2022 and 2023. This indicates that the merger has had a positive impact on the efficiency of Islamic banking. Therefore, smaller Islamic banks should consider merging as a strategy to enhance operational efficiency. Increasing company size, reflected in total assets, correlates with increased efficiency, and this result supports the hypothesis that company size has a positive impact on efficiency. Banks with larger total assets tend to be more efficient, so smaller Islamic banks need to consider merging to increase their size and improve efficiency.

The test results also show that the Financing to Deposit Ratio (FDR) has a positive and significant effect on efficiency. Therefore, to enhance efficiency, Islamic banks should increase the proportion of quality financing, given that a higher FDR indicates more financing being disbursed by the bank. On the other hand, Non-Performing Financing (NPF) negatively affects efficiency, indicating that Islamic banks need to focus on improving the quality of financing and reducing problematic financing to increase efficiency. Finally, higher Return on Assets (ROA) is associated with better efficiency, so the management of Islamic banks should prioritize strategies to enhance profitability through optimal resource and financing management. This study provides valuable insights for improving and developing Islamic banking in Indonesia and is expected to serve as a foundation for more in-depth future research.

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