

# Efficiency of Pre-Merged State-Owned Sharia Banks In Indonesia Using 2-Stage DEA

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This study intends to conduct a comparative test of efficiency of the 3 merged state-owned banks using 5 merged Simulation models which will be measured by the 2-stage Data Envelopment Analysis (2-stage DEA) method with Islamic banks and also conventional in Indonesia. This study uses a quantitative approach using the 2-Stage Data Envelopment Analysis (DEA) method. By using in the first stage this method can measure the efficiency score generated from the input and also the output that has been determined, among others, by inputs namely Savings, Administrative Costs, Personal Costs. The outputs used are Financing and Income. In the second stage the method used is Tobit Regression which will see whether there is an influence between the dependent variables determined on the efficiency score. The dependent variable consists of 2 types, namely macrobanks consisting of GDP, Inflation, and Interest Rate. While the other is the Microbank variable including NPF, FDR, and ROA. In this study, 5 combination simulations will also be examined, which will see which combination is the most efficient. From the results of the study, it was found that the efficiency of Islamic banking as a whole is still below the efficiency of conventional banking. Meanwhile, by using 5 simulations of the merger planned by the government, namely combining BRI Syariah, BNI Syariah, and Mandiri Syariah, it was found that the merger of the 3 banks is the most optimal option in terms of efficiency. In this study also found that the dependent variable that affects the efficiency score is the ROA variable. Meanwhile, for other variables, namely NPF, FDR, GDP, Inflation, and also Interest rate does not significantly affect the efficiency score.

**Keywords: Efficiency, Pre-Merger, Islamic Bank, 2-Stages DEA**

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## INTRODUCTION

Islamic financial institutions are a phenomenon in today's financial world. The increase in Islamic financial assets reported by the International Financial Development Report (IFDI) 2020 shows a sizeable increase of 14 percent Annual Growth of Islamic finance asset in 2019, the increase in global Islamic financial assets shows a significant and consistent increase. This can be proven by an increase in total assets in 2015 amounting to 1761 billion USD to 2875 billion USD in 2019. In the report, it was also stated that the largest increase was in Islamic banking. Islamic banking experienced an increase in share by 6 percent in 2019. On the asset side, the increase can also be seen in the total assets in 2015 amounting to 1600 Billion USD to 1993 Billion USD in 2019.

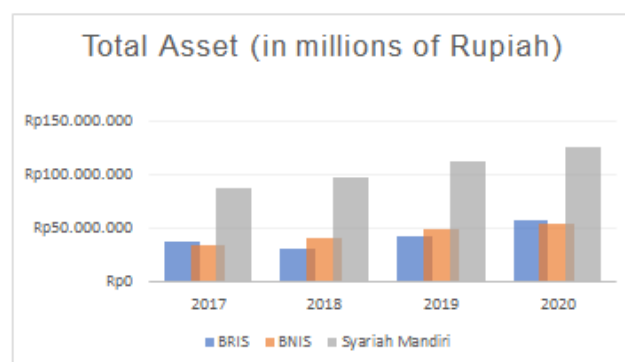
One of the centers of Islamic financial institutions in the world is in Indonesia. According to Indonesian Sharia Financial Development Report published by the [Indonesian Financial Services Authority \(2019\)](#), the assets of Islamic banks in Indonesia reached an accumulation of 538,32 Trillion Rupiah or an average increase of 9.93 percent (*yoy*). According to [Nuriyah et al. \(2018\)](#), referring to the financial statements of Islamic banks in 2016, it was also found that Rp. 312.04 trillion was controlled by sharia business units and also Islamic commercial banks and the remaining Rp. 44.1 trillion was owned by Islamic rural banks (BPRS).

According to the report presented by the [Indonesian Financial Services Authority \(2019\)](#), the total number of Islamic financial institutions in Indonesia in 2019 reached 34 institutions consisting of 14 Islamic commercial banks (BUS) and 20 Islamic business units (UUS) which total assets reached 524 trillion Rupiah with a total of 2300 BUS and UUS offices. The development of Islamic banking in Indonesia since the establishment of the first Islamic bank in 1992, namely Bank Muamalat Indonesia. Islamic banks have increased significantly every year. However, according to [Rusydziana et al. \(2019\)](#) the development experienced a positive growth, but this development is still experiencing slow progress. The slow improvement itself can be seen from the side of the total market share of Islamic banking which was still very small compared to conventional banking in 2018 with a total market share reaching 5.92% of all existing bank assets. ([OJK, 2018](#)).

Responding to these slow developments, Government agencies represented by KNEKS continue to seek solutions to deal with this slow development problem. Various ways have been planned to help increase the massive development of the Islamic economy in Indonesia. One solution is to spin off or separate the sharia business units into separate business entities and not join conventional

banks into subsidiaries or KNEKS offers another solution, namely the conversion of conventional banks to Islamic banks.

The next step taken by the government to help improve the development of Islamic banking in Indonesia and also to enlarge Islamic banking in Indonesia is by merging Islamic banks that are under the auspices of Indonesian state-owned enterprises (BUMN). This is done by the Ministry of BUMN with the hope that Islamic banking in Indonesia has a high value of efficiency and productivity. The banks that will conduct the merger consist of three large state-owned banks including Bank Rakyat Indonesia (BRI) Syariah, Bank Negara Indonesia (BNI) Syariah, Bank Mandiri Syariah (BSM).



**Figure 1:** Total Asset of three Merger State-owned bank in last 4 year

The diagram above is a graph of an asset comparison in the last 4 years between the three banks that will be merged, namely Bank BRI Syariah, Bank Mandiri Syariah, and Bank BNI Syariah to become Bank Syariah Indonesia (BSI). When viewed from the development of assets, it can be concluded that every year the three Islamic banks experienced a significant increase in assets. Out of the three Islamic banks, the one with the largest contribution to provide assets was Bank Mandiri Syariah with total assets reaching 126 trillion Rupiah by the end of 2020. Meanwhile, if combined as a whole, the assets of Bank Syariah Indonesia could reach 240 trillion Rupiah.

The merger of the three state-owned sharia banks is one of the initiatives to increase the market share of sharia banking. And it is also expected to become one of the largest Islamic banks among the existing Muslim countries. Of course, to achieve these objectives Islamic banks must achieve high efficiency and productivity values. To see how the productivity and efficiency of a merger 150 Syariah bank will be, research can be done on the 3 Islamic banks, namely BNIS, BRIS, and BSM by looking at efficiency and productivity before the merger or pre-merger is held. Therefore, this study intends to conduct a comparative test of efficiency and productivity of the 3 merged state-owned banks using 5 merged Simulation models which will be measured by the 2-stage Data Envelopment Analysis (2-stage DEA)

method with Islamic banks and also conventional in Indonesia. At the first-stage, efficiency measurements will be carried out using DEA, while at the second-stage research will be conducted to determine what macroeconomic factors affect the level of efficiency using Tobit regression.

## LITERATURE REVIEW

### Efficiency in Islamic and conventional banking

In previous studies, there have been many discussions related to the efficiency and productivity of banking, both in Indonesia and internationally. Efficiency is a measurement tool to find out how a financial institution can maximize its input and output. The link between the inputs and outputs of the production process is described by a production frontier line in the producer theory. The maximum output from each input is represented by this production frontier line. It also denotes the technology that a business unit (DMU) or industry use (market) (Farrel, 1957).

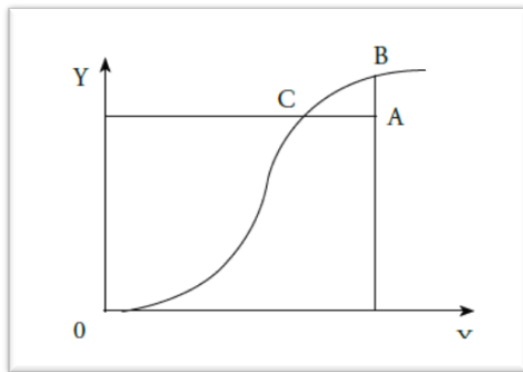


Figure 2.:Production Frontier

The maximum output from each input is represented by this production frontier line. It also denotes the technology employed by a company or sector. A technological efficient business unit is one that operates on the production frontiers. A manufacturing process having a single input ( $x$ ) and a single output ( $y$ ). The maximal output from each level is represented by the production frontier  $F^1$ . Points B and C, with productivity ( $y_1/x_0$ ) and ( $y_0/x_1$ ), respectively, are efficient points. Point A is an inefficient productivity ( $y_0/x_0$ ) point because it could theoretically increase output to  $y_1$  (the level connected with point B) without requiring additional input; alternatively it could decrease input to  $x_1$  (the level connected with point C) to yield equal  $Y_0$ .

Marlina et al (2018) also defines Productivity and efficiency are terms that demonstrate the ratio of the input-output comparison outcomes. Both ratios mean that input and output management or even both, production and productivity can be managed. The output of an economic activity unit can be measured using efficiency and productivity. If the efforts made have a full performance in both quantity and efficiency, the operation may be called efficient. An operation can

also be defined as efficient if it can produce such results with minimal effort.

In the measurement of efficiency itself, there are several categories that differentiate the management of efficiency. Ahmad et al (2020) divide efficiency into 2 categories, namely scale efficiency and technical efficiency. Economic efficiency is macroeconomic picture while the microeconomic picture is technical efficiency. Technical performance measurement is only for techniques and functional relations in the user input to output phase. Prices cannot be viewed as predetermined when calculating economic performance but price may be affected by macro-policy.

However, Marlina et al (2018) also divide efficiency into several categories, namely cost efficiency, technical efficiency, scale efficiency, and also allocation efficiency. The method of transforming inputs to output is technical efficiency. This definition only extends to the internal technical relations of inputs and outputs. A company is called economically efficient if production costs can be minimized to generate that output at a common level of technology and market prices. Scale efficiency is linked to the unit's ability to achieve economies of scale in its operations. Adoption of emerging technology or manufacturing processes is the best way to tackle inefficiency on a large scale. Technical productivity, on the other hand, is a managerial issue in which more production is needed for a given amount of resources.

Farrel (1957) distinguishes efficiency into 2 categories, namely allocation and technical efficiency. A company can be said to have reached an efficient level if the company can produce maximum output using optimal inputs. In his research also explains allocation efficiency is proportion of inputs used to produce the highest output, with each change in input having an effect on price changes.

In measuring the efficiency, itself, there are several output approaches that are used as a measuring tool. According to Berger and Humphrey (1991) the output approach used in financial institutions is divided into 3 parts, namely the asset approach where the output of this approach is loans issued by banks and other assets owned. The next output is the production approach in which the financial institution is considered a producer that provides loan and deposit account services. The number of the accounts or related transactions is often described as output. The amount of labor, capital spending on fixed assets, and other materials is used to quantify the inputs in this scenario. A financial institution is seen as an intermediary in the intermediation approach, converting and transferring financial assets from surplus to deficit units. Labor and capital expenditures, as well as interest rates on deposits, are the institutional inputs in this scenario, with output calculated in the form of loans and financial investments.

In measuring efficiency, there are various methods used as a measurement tool. Among these methods is data envelopment analysis (DEA). Jemric

and Vujcic (2002) define DEA is a tool for the analysis of relative efficiency and management performance, with multiple inputs and multiple outputs identical to that of production units (or response). It enables us to compare relative performance of banks by identifying efficient banks as benchmarks and by measuring inefficiencies in input combinations in other banks with regard to benchmarking.

In the Previous Study, there have been many studies that conducted analyzes related to the efficiency and productivity of the merged banks. Studies by Tyas and Rusydiana (2020) investigating the performance of Pre-merged BNI Syariah, Mandiri Syariah, and BRI Syariah in 2016-2019 using 3 inputs and 2 outputs using the Malmquist Productivity Index (MPI) system are among these studies. With 5 research models, different factors in the planning of the merger strategy are taken into account. The results of the calculation show that they would have an output efficiency ratio of 1,196 if the three banks are combined. On the other hand, if only two Islamic banks are combined, a merger resulting in a high level of output productivity would only occur when BNIS and BRIS are merged with a productivity level of 1,0977.

Rezitis (2007) analyzes the efficiency and productivity of bank mergers carried out by the Greek banking industry in 1993-2004. This research uses the Malmquist Productivity Index method. The results of this study indicate that the effect of acquisitions and bank mergers on the total factor of productivity growth as well as technical efficiency in Greek banks is negative. In particular, the banks that did not merge experienced an increase in technical efficiency, while the banks that did the merger experienced a decrease in the level of efficiency during the Post-Merger period. The decline in total factor productivity in the Greek merger banking system occurred due to increased technical inefficiencies and also the loss of economies of scale.

Al-Sharkas (2008) examined the impact of mergers and acquisitions on the efficiency of the American banking industry using the Stochastic Frontier Approach (SFA) and Data Envelopment Analysis (DEA) with a research period from 1986-2002. The results of this study indicate that the results of the bank merger will increase the profit and costs of the bank conducting the merger. The results also show that banks that did the merger have lower costs than banks that did not. This can happen because the merged bank makes excellent use of technological efficiency because it minimizes costs. The merged bank will also benefit from improving technology.

Siauwijaya (2017) analyzes the evaluation of banking efficiency after conducting a merger. This study uses DEA by using the Variable Return to Scale (VRS) method with input-oriented. This study found that only 6 out of 15 banks were efficient after the merger. Where there were 4 banks that experienced an optimal efficiency increase and 5 other banks experienced a decrease in efficiency after the merger.

In a study done by Lozano and Villa (2009), the DEA approach was used to evaluate expected cost and profit efficiency benefits prior to a merger. Two different DEA models are presented in this paper, one to minimize post-merger input costs and the other to maximize post-merger profit.

Then further research conducted by Rhoades (1998) which measures the efficiency of the impact of 9 cases of banks experiencing mergers that have occurred. Research was also conducted by looking at the effects of pre-merged and post-merged. The results obtained from this research are All nine of the mergers, in significant cost cutting in line with premerger projections. Four of the nine mergers were clearly successful in improving cost efficiency but five were not.

Sufian and Abdul Majid (2007) analyzed the efficiency of the merged bank located in Singapore using the Two-Stage DEA method. The results show that the merger process has resulted in higher overall efficiency than the Singapore banking group at the time of the post-merger conditions. In this study also uses the Tobit regression model to conduct a second stage which is used to determine the factors that affect bank performance, and the results show that bank profitability has a significant positive effect on bank efficiency, while poor credit quality has a significant negative effect on bank performance.

According to Amu and Chigbu (2015), who used banking data from 1981 to 2013 to analyze the relationship between pre-merger and post-merger banking efficiency in Nigeria, the banking system performs much better after mergers than before. Furthermore, the Pearson correlation coefficients demonstrate that the pre- and post-merger periods had no link. Overall, the findings reveal that the performance of the Nigerian banking industry differs significantly between pre-merger and post-merger and acquisition eras.

Finally, according to research conducted by Tyas and Rusydiana (2021) using Data Envelopment Analysis (DEA) on the efficiency of pre-merger banks in Indonesia, if the three Islamic banks are merged, they will have inefficient performance with an efficiency score of 0.86. On the other hand, merging just two Islamic banks, BNISyariah and BRISyariah, will result in optimal efficiency values.

## RESEARCH METHOD

This study will examine the efficiency of both Islamic and conventional banking in Indonesia, in particular this research focuses on 3 banks that will merge into one bank, namely BRI Syariah, BNI Syariah, and Mandiri Syariah banks. As for the other Syariah banking as many as 11 of them are Islamic bank, Bank Muamalat, Bank BCA Syariah, Bank Syariah Bukopin, Bank Victoria Syariah, Bank BJB Syariah, Bank, Dubai Islamic Bank, Bank Syariah NTB, and Bank Syariah Aceh and Maybank Syariah. For Conventional Banks

selected in the study are the 3 largest BUMN banks, namely BNI, BRI, and Bank Mandiri. The research time will take banking data starting from January 2015 to December 2020.

This study uses secondary Time Series and Cross Section data, namely monthly data from various Islamic and conventional commercial banks in the form of data from the financial statements of commercial banks in Indonesia in 2015-2019 from the Financial Services Authority (OJK) and also the Bank's annual financial statements. published annually. While the secondary data taken is in the form of input and output to perform efficiency tests on First Stage DEA. The input data include the amount of deposits, General and Administrative Expenses, and Expenses personnel. While the output data include income and financing. In the Second Stage the data is taken from Bank Indonesia (BI) reports and the Bank's Annual Report which includes macro bank variables including inflation, GDP, Interest Rate and also micro bank variables such as NPF, ROA, and FDR.

In this research using 2 stage DEA as a method and also a measurement tool to measure efficiency. First Stage: Data Envelopment Analysis (DEA) method. The DEA method is a non-parametric frontier method that uses a linear programming model to calculate the ratio of output and input for all units compared in a population. The purpose of the DEA method is to measure the efficiency level of a decision-making unit (DMU ie. bank) relative to similar banks when all of these units are at or below their frontier efficient curve. So, this method is used to evaluate the relative efficiency of some objects (performance benchmarking).

DEA was first developed by Farrell (1957) which measures the technical efficiency of one input and one output into multi input and multi output. In this study, the assumptions used are variable return to scale (VRS) and output oriented. As stated by Johnes (2006) that the output-oriented model is a suitable model to achieve economic efficiency.

in measuring efficiency itself there is a model that explains how to measure efficiency, it is as shown below :

$$Efficiency\ of\ DMU_0 = \frac{\sum_{k=1}^p \mu_k y_{k0}}{\sum_{i=1}^m v_i x_{i0}}$$

- DMU = decision making unit
- m = different inputs
- p = different outputs
- n = number of DMU evaluated
- x<sub>ij</sub> = number of input i consumed by DMU<sub>j</sub>
- y<sub>kj</sub> = number of output k produced by DMU<sub>j</sub>

Next in stage 2 is the Tobit Regression Model. The Tobit method assumes that the independent variables are non-censored; only the dependent variable is censored; all variables (both independent and non-

independent) were measured correctly; no autocorrelation; no heteroscedascity; there is no perfect multicollinearity; and the mathematical model used is correct. In using the regression analysis method for research in the social and economic fields, there are many data structures where the response variable has a value of zero for some observations, while for some other observations it has a certain value that varies. This data structure is called censored data. The research model using Tobit regression to measure banking efficiency is as follows :

$$y^*_i = \beta \times i' + \sigma \epsilon_i,$$

where:

$$y_i = y^*_i \text{ If } y^*_i > 0$$

$$y_i = 0 \text{ If } y^*_i \leq 0$$

In the Tobit model there is additional information on the coefficient of scale, namely the scale factor to be estimated  $\sigma$ . This scale factor can be used to estimate the standard deviation of the residuals, Fungsi Likelihood (L) is maximized (maximum likelihood) to estimate the parameters  $\beta$  and  $\sigma$  based on observation (bank)  $y_i$  and  $x_i$ : Where, The first product is over the observations for which the banks are 100% efficient ( $y = 0$ ) and the second product is over the observations for which banks are inefficient ( $y > 0$ ).  $F_i$  is the distribution function of the standard normal evaluated at  $= \beta \times i' / \sigma$ .

The reason for using the Tobit method in this study is because the data used in this study is censored data, namely the value of the dependent variable, namely the level of technical efficiency (EFT), is limited and may only range from 0 to 100. If the OLS method is used with data Therefore, the regression results will be biased and inconsistent. The following is a model of Tobit regression regresi :

$$EFT_i = \beta_1 + \beta_2 GDP_i + \beta_3 INF_i + \beta_4 IR_i + \beta_5 NPF_i + \beta_6 ROA_i + \beta_7 FDR_i + \epsilon_i \quad (6)$$

- EFT = Data Envelopment Analysis (DEA) Score
- GDP = Total Growth Domestic Product
- INF = Inflation
- IR = Interest Rate
- FDR = Financing Deposit Ratio
- ROA = Return on Asset
- NPF = Non-Performing financing

In this study, researchers also use 5 simulations for efficiency testing, the simulation will combine Islamic banks that will demerger with various options including:

- Efficiency of each Syariah bank and conventional bank.
- Efficiency of the three Merged Sharia banks, namely BNIS, BRIS, Mandiri Syariah.
- Efficiency of BNIS bank merger with BRIS

- Efficiency of the BNIS merger with Mandiri Syariah.
- Efficiency of the BRIS merger with Mandiri Syariah

## RESULT AND DISCUSSION

In this study, to process banking data that has been obtained to produce an efficiency score is to use the MAXDEA software. By using the output approach, the resulting efficiency score is as follows:

### Simulation 1

In this first simulation, the three banks that will merge, namely Bank BNI Syariah (BNIS), Bank Syariah Mandiri (BSM), and also Bank BRI Syariah. The researcher will calculate the efficiency score of each of the three banks and compare it with 11 other Islamic banks. and 3 conventional state-owned banks. The results obtained are as follows:

**Table 1:** Efficiency of each Syariah banks and conventional Banks

DMU	EFFICIENCY SCORE						AVERAGE SCORE	RANK
	2015	2016	2017	2018	2019	2020		
mandiri syariah	1	1	1	1	1	1	1,000000	1
BRIS	1	1	0,98479151	1	1	1	0,997465	2
Bank BRI	1,00000	0,99804	0,98147	1,00000	1,00000	1,00000	0,996584	3
Bank Mandiri	1	0,91442155	0,93174067	0,99971399	1	0,96132456	0,967867	4
Bank BNI	0,90884014	0,86037606	0,93253203	0,86026983	0,76166391	0,59898879	0,820445	5
Bank PANIN DUBAI Syariah	1	0,87409412	0,79128354	0,76392096	1	1	0,904883	6
BPD Nusa Tenggara Barat Sya	1,00000	0,86912	1,00000	1,00000	0,75883	0,76804	0,899331	7
Bank Tabungan Pensiunan Nas	0,92312	0,89875	0,71800	0,78841	1,00000	0,96759	0,882645	8
Maybank Syariah Indonesia (P	1,00000	0,99959	0,83256	1,00000	1,00000	0,45146	0,880602	9
Bukopin Syariah	0,8635432	0,83508277	0,75110559	0,80964076	0,86222555	1	0,853600	10
BNIS	0,90884	0,86038	0,93253	0,86027	0,76166	0,59899	0,820445	11
Victoria Syariah	0,75089	0,67067	0,73072	0,78110	0,85485	0,85004	0,773044	12
Bank Mega Syariah	0,70832704	0,76251536	0,76091725	0,72209181	0,78806861	0,72454816	0,744411	13
BJB Syariah	0,82125114	0,77270552	0,69863228	0,69693873	0,71944673	0,69487843	0,733975	14
Bank Aceh Syariah	1	0,60967627	0,71189005	0,71401369	0,64607156	0,60014862	0,713633	15
Muamalat Bank	0,78200685	0,75199984	0,7267916	0,62003469	0,6092659	0,62139875	0,692898	16
BCA Syariah	0,65546	0,63733	0,66138	0,69994	0,72968	0,65282	0,672769	17

It can be seen from the results of the table above that from 2015-2020, Bank Mandiri Syariah has an efficiency score of 1,000, for BRI Syariah itself it has an efficiency score of 0.997465, while for BNIS an efficiency score of 0.820445. From these results it can be concluded that for Bank Syariah Mandiri and also Bank BRI Syariah have a very high relative efficiency value and even both are almost included in perfect efficiency, while for BNI Syariah itself there is a decrease in efficiency scores, especially a very drastic decrease in efficiency in 2020. The decrease was due to the impact produced by Covid-19. When comparing and also sorting the efficiency scores of all the banks studied, it was found that Bank Mandiri Syariah and BRI Syariah took the top position, namely 1st position for Bank Mandiri Syariah, and 2nd position for BRI Syariah bank, while for BNI Syariah itself ranks 11th in the order of efficiency score comparison.

### Simulation 2

In this second simulation, the treatment carried out is to try to combine the 3 Islamic banks in question, namely Bank Mandiri Syariah, Bank BRI Syariah, and Bank BNI Syariah. The results of the Efficiency Scores of the 3 banks will be compared with the Efficiency

Scores of 11 other banks as well as 3 conventional state-owned banks. The results obtained are as follows:

**Table 2:** Efficiency of the three Merged Sharia banks BNIS, BRIS, Mandiri Syariah.

DMU	EFFICIENCY SCORE						AVERAGE SCORE	RANK
	2015	2016	2017	2018	2019	2020		
Bank BSI (BSM, BNIS, BRIS)	1	0,986487	1	1	1	1	0,997748	1
Bank BRI	1	0,998039	0,981468	1	1	1	0,996584	2
Bank Mandiri	1	0,916531	0,932348	0,9996	1	0,96132456	0,968301	3
Bank PANIN DUBAI Syariah	1	0,892198	0,825546	0,805426	1	1	0,920528	4
Bank BNI	0,856674	0,881903	0,861713	0,941725	0,962798	1	0,917469	5
Bank NTB Syariah	1	0,869116	1	1	0,779609	0,800958756	0,908281	6
Bank Tabungan Pensiunan	0,923119	0,898755	0,775002	0,850127	1	0,987274947	0,905713	7
Maybank Syariah Indonesia	1	0,999589	0,832557	1	1	0,451464327	0,880602	8
Bukopin Syariah	0,863554	0,84545	0,760985	0,809641	0,862226	1	0,856976	9
Victoria Syariah	0,750894	0,695042	0,806755	0,859902	0,968212	0,894172863	0,829163	10
Bank Aceh Syariah	1	0,609676	0,898561	0,801766	0,676673	0,630849926	0,784154	11
Bank Mega Syariah	0,728766	0,77617	0,772534	0,741795	0,81348	0,724548159	0,759549	12
Muamalat Bank	0,817188	0,840668	0,829818	0,684781	0,677471	0,674332457	0,754043	13
BJB Syariah	0,821251	0,798993	0,716594	0,708253	0,736012	0,710663229	0,748628	14
BCA Syariah	0,716595	0,707854	0,716557	0,733416	0,758754	0,682897414	0,719346	15

From the results above, it was found that the three banks combined into one, namely Bank Mandiri Syariah, Bank BRI Syariah, and also Bank BNI Syariah had an average efficiency score from 2015-2020 of 0.997748. The score obtained from the merger of the 3 banks is included in the very high Relative Efficiency score. This also makes the 3 banks when compared to other banks occupy the 1st position beating the 3 other largest state-owned conventional banks, namely BRI, Bank Mandiri, and BNI.

### Simulation 3

In this 3rd simulation, the treatment that will be carried out is to combine 2 banks, namely BRI Syariah and Bank Mandiri Syariah, the efficiency scores obtained from the two banks will be compared with other Islamic banks and also 3 other conventional banks. The results of the merger of the 2 banks are as follows:

**Table 3:** Efficiency of the BRIS merger with Mandiri Syariah

DMU	EFFICIENCY SCORE						AVERAGE SCORE	RANK
	2015	2016	2017	2018	2019	2020		
Bank BRI	1	0,998039	0,981468	1	1	1	0,996584	1
BRIS+Mandiri Syariah	0,966809	0,971196	1	1	1	1	0,989967	2
Bank Mandiri	1	0,913716	0,931352	0,998033	1	0,961325	0,967404	3
Bank PANIN DUBAI Syariah	1	0,8738	0,807609	0,765837	1	1	0,907874	4
Bank BNI	0,838221	0,868829	0,841561	0,931369	0,951798	1	0,905296	5
Bank NTB Syariah	1	0,869116	1	1	0,76871	0,783669	0,903582	6
Bank Tabungan Pensiunan	0,923119	0,898755	0,738277	0,810239	1	0,97448	0,890811	7
Maybank Syariah Indonesia	1	0,999589	0,832557	1	1	0,451464	0,880602	8
Bank BNI Syariah	1	0,960334	1	0,886935	0,784887	0,605049	0,872868	9
Bukopin Syariah	0,863535	0,834701	0,751475	0,809641	0,862226	1	0,853596	10
Victoria Syariah	0,750894	0,686359	0,778742	0,830921	0,92577	0,878406	0,808515	11
Bank Aceh Syariah	1	0,609676	0,831983	0,785266	0,658773	0,604105	0,748301	12
Bank Mega Syariah	0,710105	0,762344	0,760771	0,723843	0,787749	0,724548	0,744560	13
BJB Syariah	0,821251	0,779075	0,698408	0,696797	0,719238	0,694678	0,734908	14
Muamalat Bank	0,783387	0,757588	0,784699	0,62588	0,613767	0,632016	0,699556	15
BCA Syariah	0,665537	0,648757	0,673527	0,707724	0,736351	0,659574	0,681911	16

From the results obtained above, it can be concluded that from 2015-2020 the two banks combined, namely BRI Syariah, and also Bank Mandiri Syariah, had an average efficiency score of 0.989667. This also makes the option of merging the 2 banks into a relatively high efficiency score. And also, the option of merging the 2 banks indicates an increase in efficiency scores every year. When compared to other Islamic banking and 3 conventional banks, both banks occupy the 2nd position under BRI bank which has a relatively high efficiency value of 0.996584.

**Simulation 4**

In the 4th simulation, the next process that will be carried out is to combine 2 other Islamic banks to be merged, namely BNI Syariah and Mandiri Syariah. The efficiency results of the two banks will also be compared with 12 other Islamic banks and 3 conventional banks owned by state-owned enterprises. The results of the option to merge the two banks are as follows:

**Table 4** Efficiency of the BNIS merger with Mandiri Syariah

DMU	EFFICIENCY SCORE						AVERAGE SCORE	RANK
	2015	2016	2017	2018	2019	2020		
BNIS+Mandiri Syariah	1	0,99159533	1	1	1	1	0,998599	1
BRIS	1	1	0,98479151	1	1	1	0,997465	2
Bank BRI	1	0,99803905	0,9814677	1	1	1	0,996584	3
Bank Mandiri	1	0,9163965	0,93250044	1	1	0,96132456	0,968370	4
Bank BNI	0,85939438	0,89016682	0,86139761	0,94081297	0,96148021	1	0,918875	5
Bank PANIN DUBAI Syariah	1	0,87829568	0,79128354	0,78050029	1	1	0,908347	6
Bank Tabungan Pensiunan Nasional	0,92311883	0,8987547	0,76906582	0,84364839	1	0,985178083	0,903294	7
Bank NTB Syariah	1	0,86911569	1	1	0,75882706	0,768044389	0,899331	8
Maybank Syariah Indonesia (PT Bank	1	0,9995888	0,83255724	1	1	0,451464327	0,880602	9
Bukopin Syariah	0,86355419	0,835645	0,75379343	0,80964076	0,86222555	1	0,854143	10
Victoria Syariah	0,7508939	0,67380589	0,73072055	0,78109799	0,85484968	0,850038227	0,773568	11
Bank Mega Syariah	0,72581066	0,76442678	0,76254909	0,724868081	0,79162899	0,724548159	0,748971	12
Muamalat Bank	0,81219716	0,82108672	0,82529408	0,67515988	0,66630069	0,668970774	0,744835	13
BJB Syariah	0,82125114	0,77421635	0,70113328	0,69852193	0,72177264	0,697107037	0,735667	14
Bank Aceh Syariah	1	0,60967627	0,71495217	0,71401369	0,64738954	0,618730876	0,717460	15
BCA Syariah	0,70387979	0,69378055	0,70801042	0,72873789	0,75436242	0,678006029	0,711130	16

Furthermore, from the results of the efficiency test above, it was found that the merger of the two Islamic banks, namely BNIS and also Bank Mandiri Syariah, resulted in an average efficiency score from 2015-2020 of 0.998599. This also indicates that the merger of the two banks experienced an increase in efficiency from 2016 to 2020. The merger of the two banks is also included in the relatively high efficiency. Compared to 12 other banks as well as the 3 largest conventional banks owned by SOEs, the merger of the two banks, namely BNI Syariah and Mandiri Syariah, took the first position with the highest relative efficiency score compared to other banks.

**Simulation 5**

In this last simulation, there will be a merger of 2 Islamic banks, namely BRI Syariah and BNI Syariah. The results of the efficiency scores of the two banks will be compared with other Islamic banks and also 3 conventional state-owned banks. The results of the efficiency scores from the merger of the two banks will be displayed as below:

**Table 5:** Efficiency of the BNIS merger with BRI Syariah

DMU	EFFICIENCY SCORE						AVERAGE SCORE	RANK
	2015	2016	2017	2018	2019	2020		
Bank Syariah Mandiri	1	1	1	1	1	1	1,000000	1
Bank BRI	0,998039	0,981468	1	1	1	1	0,996584	2
Bank Mandiri	0,914422	0,931741	0,999714	1	0,96132456	0,967867	0,967867	3
BRIS+BNIS	1	1	1	0,972388	0,94581	0,794648619	0,952141	4
Bank BNI	0,838683	0,876942	0,850257	0,932144	0,953175	1	0,908533	5
Bank PANIN DUBAI Syariah	1	0,874094	0,810909	0,763921	1	1	0,908154	6
Bank NTB Syariah	1	0,869116	1	1	0,770621	0,786696419	0,904406	7
Bank Tabungan Pensiunan	0,923119	0,898755	0,717996	0,788407	1	0,967590372	0,882645	8
Maybank Syariah Indonesia	1	0,999589	0,832557	1	1	0,451464327	0,880602	9
Bukopin Syariah	0,863543	0,835083	0,751106	0,809641	0,862226	1	0,853600	10
Victoria Syariah	0,750894	0,683315	0,763187	0,814803	0,902548	0,869407682	0,797359	11
Bank Mega Syariah	0,708327	0,762515	0,760917	0,722092	0,788069	0,724548159	0,744411	12
Bank Aceh Syariah	1	0,609676	0,771645	0,765874	0,662541	0,609575727	0,736552	13
BJB Syariah	0,821251	0,782533	0,698632	0,696939	0,719447	0,694878434	0,735613	14
Muamalat Bank	0,782007	0,752	0,772679	0,620035	0,609266	0,62139875	0,692898	15
BCA Syariah	0,655461	0,637331	0,661376	0,699943	0,729682	0,652824091	0,672769	16

Furthermore, based on the results of the efficiency score table above, it was found that the simulation of the merger between the 2 banks, namely BRI Syariah and BNI Syariah, resulted in an efficiency score of 0.952141. The results of this efficiency score indicate an increase in the relative efficiency score every year. This also makes the second option of merger included in the high score of efficiency, but when compared to other banks, the merger option between BRI Syariah and BNI Syariah occupies the 4th position, which is the lowest position compared to several previous simulations. The top position is occupied by Bank Syariah Mandiri with a relative efficiency score of 1,000.

**Potential Improvement**

**Table 6:** Potential Improvement of all sharia and conventional banks

LEMBAGA KEUANGAN SYARIAH	AKTIVA TETAP (X1)	BEBAN TENAGA KERJA (X2)	DANA PIHAK KETIGA (X3)	JUMLAH PEMBIAYAAN DIBERIKAN (Y1)	PENDAPATAN OPERASIONAL (Y2)
Bank Aceh Syariah 2020	0	0	0	63,53088628	63,53088628
Bank BNI Syariah (BSI) 2020	0	-6,736219686	0	54,89623114	54,89623114
Bank BRI Syariah (BSI) 2020	0	0	0	0	0
Bank Jabar Banten Syariah 2020	0	0	0	41,07117142	41,07117142
Bank Mandiri 2020	0	0	0	0	0
Bank Mega Syariah 2020	0	0	0	32,46335221	29,27942334
Bank Muamalat Syariah 2020	-46,240881	0	0	59,30266723	98,95686141
Bank Panin Dubai Syariah 2020	0	0	0	0	0
Bank Syariah Bukopin 2020	0	0	0	0	0
Bank Syariah Mandiri (BSI) 2020	0	0	0	0	0
Bank Tabungan Pensiunan Nasional Syariah 2020	0	0	0	0	0
Bank Victoria Syariah 2020	0	0	0	0	0
BCA Syariah 2020	0	0	0	48,75598369	62,84622816
BNI 2020	0	0	0	0	0
BPD Nusa Tenggara Barat Syariah 2020	0	0	0	21,53955788	21,53955788
BRI 2020	0	0	0	0	0
Maybank Syariah Indonesia (PT Bank Net Syariah) 2020	0	0	0	0	0
<b>Average</b>	<b>-2,890055</b>	<b>-0,42101373</b>	<b>0</b>	<b>20,09749062</b>	<b>21,88943292</b>

Judging from the potential Improvement table above, which is taken From the efficiency values of all Islamic banks and also the 3 largest conventional banks owned by SOEs taken from the efficiency scores of the last year, namely 2020, it can be concluded that from the 3rd option of merging Islamic banks, namely BRI Syariah, Bank Mandiri Syariah, and also BNI Syariah that the three banks in the Fixed Assets variable have a good value, namely 0 which does not require Return of the increase in that variable.

The employee variable for Bank Mandiri Syariah and BRI Syariah has a value of 0 which means that it does not require an increase in this variable and it means that the management of the workforce of the two banks is very good. Meanwhile, for BNI Syariah itself, it has a value of -6.73621, which means that this variable makes

BNI Syariah inefficient. To return to efficiency, BNI Syariah must reduce their workload by 6%.

In the Third-Party Funds Variable, it can be seen that all of the three demerger banks have a value of 0 which means that in the management of third-party funds, the bank is already very good and efficient so that it does not require an increase in returns on that variable.

Furthermore, the variable amount of financing provided can be seen from the three merged sharia banks, the other 2 Sharia banks, namely BRI and Bank Mandiri Syariah, have a value of 0 which means that the two Sharia banks are good enough and do not require an increase in financing, while for BNI Sharia, this is quite a big task because one of the causes of the inefficiency of BNI Syariah is in terms of financing. Mekera has a potential improvement value of 54.89623114, which means that BNI Syariah must increase their financing by 54%.

The last variable is operating income variable. Similar to the financing variable, BNI Syariah's operational income variable has a potential improvement value of 54.8962, which is one of the causes that makes BNI Syariah inefficient in 2020. Therefore, BNI Syariah must increase their operating income by 54%. As for the other 2 banks, namely BRI Syariah and Bank Mandiri Syariah, they are quite good at managing their operating income.

Overall, the biggest factor that causes the inefficiency of all banks lies in the output variable, namely operating income. On the average output variable from the whole banking sector has a value of 21.889432. This means that all inefficient banks must increase their operating income by 21% in order to be efficient.

### Tobit Regression

Equation 1: Result from Tobit Regression

Variable	Coefficient	Std. Error	z-Statistic	Prob.
ROA	0.013633	0.005411	2.519601	0.0117
NPF	0.012274	0.011189	1.096946	0.2727
LNGDP	-0.014847	0.032422	-0.457929	0.6470
INTEREST_RATE	0.014113	0.012256	1.151493	0.2495
INFLATION	0.025962	0.044163	0.587874	0.5566
FDR	0.000956	0.000920	1.039560	0.2985
C	0.799499	0.408898	1.955252	0.0506

Error Distribution				
SCALE:C(8)	0.126759	0.009147	13.85775	0.0000

Mean dependent var	0.842125	S.D. dependent var	0.134954
S.E. of regression	0.132396	Akaike info criterion	-1.126387
Sum squared resid	1.542520	Schwarz criterion	-0.912692
Log likelihood	62.06659	Hannan-Quinn criter.	-1.040008
Avg. log likelihood	0.646527		

Left censored obs	0	Right censored obs	0
Uncensored obs	96	Total obs	96

Based on the results of the Tobit regression test above, it was found that of all the independent variables, namely ROA, FDR, NPF, GDP, Interest Rate, and also Inflation, which only affects the dependent variable, namely the Efficiency Score, which is only the ROA variable. ROA variable itself has a positive effect on the

efficiency score which if the ROA variable increases by one unit, it will increase the efficiency score by 0.013633.

## FINDING

From the findings above, many results have been obtained from this study, the first of which is related to the banking efficiency score itself. From the results of the banking efficiency test, which uses 5 simulation models in banking mergers, namely BRI Syariah, Bank Syariah Mandiri, and Bank BNI Syariah. From the results of the 5 simulations, it is found that the simulation model that creates the best efficiency value is to combine the three banks into one bank. This is also evidenced by the high efficiency value of 0.997748 and also places the three merged banks into the highest ranking of the most efficient banks compared to other banks. The results of this study are also inversely proportional to the research conducted by [Tyas and Rusydiana \(2021\)](#) in which they measured the efficiency level of banks conducting mergers in 2016-2019. The results obtained from his research are that the most efficient simulation model in merging 3 Islamic banks is to only combine BRI Syariah and BNI Syariah only. it will also make the merger more efficient when compared to the merger of 3 banks which will only result in an efficiency score of 0.86.

Judging from the results of the potential improvement itself which is calculated based on the efficiency value from the last year of the entire banking system, it is found that the cause of the inefficiency of all banks lies in the operating income output variable. Meanwhile, if viewed from each of the 3 banks that will conduct the merger, it is found that the bank that has the highest inefficiency is BNI Syariah bank, the cause of the bank's inefficiency lies in the variable labor load, operating income, and also the amount of operational financing. Meanwhile, for BRI Syariah and Mandiri Syariah, it is quite efficient in all variables. This can also be an evaluation for demerger banks in order to maintain good efficiency values even though the previous bank still had inefficient variables.

Table 7: Priority Management

LEMBAGA KEUANGAN SYARIAH	AKTIVA	BEBAN TENAGA	DANA PIHAK	JUMLAH PEMBIAYAAN	PENDAPATAN
	TETAP (X1)	KERIA (X2)	KETIGA (X3)	DIBERIKAN (Y1)	OPERASIONAL (Y2)
Bank BNI Syariah (BSI) 2020	PRIORITIZE	NOT PRIORITIZE	PRIORITIZE	NOT PRIORITIZE	NOT PRIORITIZE
Bank BRI Syariah (BSI) 2020	PRIORITIZE	PRIORITIZE	PRIORITIZE	PRIORITIZE	PRIORITIZE
Bank Syariah Mandiri (BSI) 2020	PRIORITIZE	PRIORITIZE	PRIORITIZE	PRIORITIZE	PRIORITIZE

And also, if viewed from the potential improvement above, it can be used as suggestions and also input for the merged bank, namely BSI. From the results above, it is found that in the management of banking management, especially in the field of assets, the three banks achieve maximum efficiency values. It can also make the three banks recommended to manage asset matters. Meanwhile, for HR management, only two banks are recommended to manage HR, namely



BRI Syariah, and also Syariah Mandiri, and BNI Syariah is not recommended in HR management. In terms of fund collection management, the three banks have achieved maximum efficiency so that all three can manage funds well. In the field of financing, BNI Syariah is not recommended to manage financing because the efficiency value is not maximal, while for the other two banks it is recommended to manage financing. And finally in the field of operating income, BNI Syariah banks are not recommended to manage income, while for the other 2 banks it is recommended to manage operating income..

And also in the test results with Tobit regression which uses several variables such as FDR, NPF, ROA, GDP, Inflation, and also interest rates. From the test results, it was found that only the ROA variable had a significant positive effect on the dependent variable, namely the efficiency score from the all banks. [Firdaus and Hosen \(2013\)](#) in their research concluded that several variables such as ROA and ROE have a positive and significant effect on efficiency and also NPF and CAR have a negative and significant effect on banking efficiency scores. And also, in research conducted by [Pambuko \(2016\)](#) said that the CAR, FDR, ROA, NPF, and NIM variables have a significant and positive effect on the efficiency value while for macroeconomic variables such as GDP and inflation do not significantly affect efficiency.

In this study, it was also found that the option of merging 3 banks, namely BNI Syariah, BRI Syariah, and also Mandiri Syariah carried out by the government was the right decision and was also supported by this research. Because when viewed from the efficiency score, the option of merging these 3 banks is the best option because it places the merged Islamic banking into the owner of the highest efficiency score compared to other Islamic and conventional banks in Indonesia.

## CONCLUSION

This study intends to conduct a comparative test of efficiency of the 3 merged state-owned banks using 5 merged Simulation models which will be measured by the 2-stage Data Envelopment Analysis (2-stage DEA) method with Islamic banks and also conventional in Indonesia, and also research to see how the influence of microbank and macroeconomic variables affect the value of banking efficiency. And the results obtained are as follows:

1. After testing the efficiency of Islamic banking in Indonesia, it was found that almost all Islamic banking in Indonesia from 2015-2020 had efficiency values below conventional banks, except for 2 banks, namely Mandiri Syariah banks and also BRI Syariah. In the pre-merger period, 12 of the 14 Islamic banks in Indonesia had low efficiency

scores under conventional banks, this also made the option of merging 3 Islamic banks into 1 bank to be able to compete with conventional ones in any way, especially efficiency. By using 5 simulation models of banking mergers, it is found that the most optimal and efficient merger option is to combine 3 Islamic banks, namely Bank Mandiri Syariah, BRI Syariah, and also BNI Syariah into one bank, namely Bank Syariah Indonesia. The results of the study also fully support the merger of 3 Islamic banks, and also state that the decision made by the government is right for the merger in terms of efficiency.

2. The results of the potential improvement seen from the last year of 2020 show that in the third option of merging Islamic banks, one of the joining banks, namely BNI Syariah, can be a serious concern. This also happened because referring to the results of potential improvement, BNI Syariah itself still has shortcomings in the variable labor load, operating income, and also the financing provided. These three variables have caused BNI Syariah to be inefficient in 2020 and this could be a problem for the banks that will be combined.

Judging from the second stage of DEA using Tobit Regression, it was found that the ROA only variable was significant and had a positive effect on the efficiency value. Meanwhile, for several other variables such as NPF, FDR, GDP, Inflation, Interest Rate does not significantly affect the efficiency value.

The recommendations for further research it is expected to be able to choose input and output variables that are more detailed in the future, so that they can provide input to Indonesian Islamic banks (BSI) to be more precise in knowing their strengths and weaknesses compared to other

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