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# EFFICIENCY AND BANK PERFORMANCE: DATA ENVELOPMENT ANALYSIS (DEA) APPROACH IN INDONESIAN'S SHARIA BANKING

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**ABSTRACT**

*The efficiencies related to business activities and needed for competitive advantage. An efficiency bank is important for its capability in mobilizing public funds or channelling funds to people who need business capital. The study tests the effect of the relationship between efficiency on the performance of Sharia banking in Indonesia. The research type is descriptive. The research object is the financial statements of 11 Sharia banks in Indonesia. The data analysis method used is Data Envelopment Analysis (DEA), ratio analysis, and panel data. The results showed that based on the DEA analysis, the overall average of Sharia banks reached an efficiency of 95.1% and the bank's efficiency impacts to NIM but contras finding on ROA. It implicates that sharia banking should be able to manage time, funds, costs as best as possible as well as avoiding risks and interests for optimizing profit.*

**JEL Classification:** E50, E58, G21, G28
***Keywords**: Sharia Banking, Efficiency, Performance, Data Envelopment Analysis (DEA)*

## I. INTRODUCTION

Sharia banking's development drives by Muslims' desire to carry out activities following sharia guidelines known as the Muamalah concept. The potential of the Indonesian Sharia Financial Services Sector is tremendous for the growth of the Sharia FSS with the dominance of the Muslim population as much as 88.1% of Indonesia's population. Globally 12.7% of Muslims in the world are in Indonesia and as the largest Muslim country in the world. It included in ten countries that are considered to have a

supportive environment for Sharia FSS. Sharia banking, in particular, contributes to the Indonesian economy, which is projected to be able to develop more rapidly.

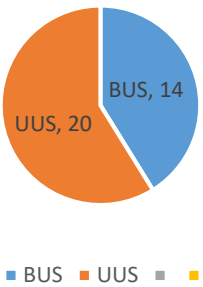


**Figure 1.** BUS and UUS listed OJK
Sources: Financial Services Authority, 2019

However, the share of the Sharia financial market is still small compared to conventional banks. In June 2018, it reached 8.47%, or the equivalent of US $ 83.62 billion of Indonesia's total financial assets. With a contribution of 5.7% Sharia banking.

**Table 1. ROA and NIM Performance Ratios for Sharia Banks 2014-2018**

| Sharia Commercial Bank Ratio | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|
| ROA | 0,41 | 0,49 | 0,63 | 0,63 | 1,28 |
| NIM | 0,62 | 0,52 | 0,68 | 0,67 | 1,42 |

*Sources: Financial Services Authority, 2020.*

In Indonesia, it is difficult for Sharia banking to compete with conventional banks, where the performance of Sharia banks is still slow, especially in strengthening capital, liquidity, and efficiency (Rahajeng, 2019). The data of Financial Services Authority (OJK) shows that the recorded probability in 2018 was only Rp. 5.12 trillion, with an asset level of Rp. 316.691 trillion, so that the recorded ROA was only 1.28%. Meanwhile, the ROA owned by conventional banks was 2.55% at the end of December 2018.

Throughout 2018-2019, the BUK intermediation function was quite good, with credit growing at an accelerated rate of 11.69% (yoy) amidst the slowing growth of deposits by 7.17% (yoy). With this funding gap, banking liquidity conditions tightened slightly, with an LDR reaching 92.00%; even though the LDR exceeded the threshold of 92%, banking liquidity conditions generally maintained, as reflected in the LA / NCD and LA / DPK ratios, which recorded at 100, 35% and 20.96%, or well above the threshold of 50% and 10%. In line with this, BUK credit risk has gradually improved, with gross NPL and net NPL dropping 20 bps (yoy) to 2.47% and 1.11%, respectively (Financial Services Authority, 2019). The performance of sharia banks (BUS and BUS) in the first quarter of 2019 inexperienced general improvement, as reflected in the increase in CAR BUS (yoy) supported by increased profitability in line with improved efficiency and improved financing quality (decreased NPF) of Sharia banks. Sharia bank liquidity is still adequate with FDR within the safe threshold (Financial Services Authority, 2019).

Profitability in measuring performance used to see the success of the bank's financial performance. There are efficiencies related to activities to control bank costs. If a bank in its business activities is inefficient, it will not be able to compete in mobilizing public funds or channelling funds to people who need business capital (Akbar, 2019).

Efficiency used as one of the ingredients for performance measurement. The concept of efficiency is more related to how far the input process is to produce an individual output (Amrulloh, 2017).

According to Ozcan (2008), data envelopment analysis (DEA) assumes that not all entities are efficient. DEA can analyze more than one input and output using a linear programming model that produces a single efficient value for each study. Apart from DEA, efficiency measurements can be carried out by various methods, namely ratio analysis, least-squares regression (LSR), total factor productivity (TFP), and stochastic frontier analysis (SFA). This study uses the data envelopment analysis method to measure efficiency due to several advantages possessed by the DEA method compared to other methods, namely that it can process many inputs and outputs. It does not require the assumption of a functional relationship between input and output variables, DMU compared directly with each

other (homogeneous); moreover, the input and output can have different measurement units.

There are several previous studies regarding efficiency that serve as a reference journal. One of the studies conducted by Kamarudin (2017) examined the efficiency of TE, PTE, and SE of domestic and foreign Sharia banks in the Malaysian banking sector using DEA analysis. In the study for the period 2006-2014, it revealed that the efficiency of Malaysian domestic banks was higher than it. The average SE of Malaysian domestic Sharia banks was 91%, and foreign was only 84.2%, Malaysian domestic PTE 90.5% and foreign 84%, and domestic SE. Malaysia 11% and foreign 20.5%.

Amrulloh (2017), examines the analysis of the relationship between the efficiency and performance of Sharia banking in Indonesia. Efficiency using DEA analysis and performance using financial ratios with CAMELS analysis, with an insignificant relationship analysis in the study. This research follows Kamarudin (2017) and Amrulloh (2017) but has a different approach to bank performance that measured by ROA and NIM. We explain in detail the efficiency of every sharia bank through DEA analysis and compare each other and analyzed by hypotheses test.

## II. LITERATURE REVIEW

Measuring the productive of assets are in generating profit or net income for the bank is an essential thing in assessing bank performance. This measurement measured by the return on assets (ROA) ratio. The ratio shows how efficient a bank is in managing its assets to generate profits for the bank. Good performance is indicated by the increase in the value of the return on assets ratio. The higher the ROA indicates that, the higher profit before tax is generated from assets owned by the bank (Akbar, 2019). Meanwhile, NIM (Net Interest Margin) is the ratio used to measure bank management's ability to manage earning assets to generate net margin income. The increase in the NIM value indicates that the bank's performance is getting better. The increase in NIM can support by reducing the cost of funds, which is the bank's margin fee to each source of bank

funds. The overall cost to be paid by the bank will determine what percentage of the bank's income. Given to customers for net bank income (Akbar, 2019).

The performance of Sharia banks determined by efficiency, which compares input and output; input that processed through a particular process will provide output according to specific criteria. A bank included in the efficient category if it uses a smaller number of input units than the input units used by other banks to produce the same output. Alternatively, using the same input unit can produce a more considerable amount of output than other banks. A more efficient bank will generally show better performance when compared to a less efficient bank. According to Darmawi (2014), higher efficiency is obtained by maximizing revenue, controlling operating costs, and consistently implementing good management.

DEA (Data Envelopment Analysis) is a linear programming technique used to evaluate the decision-making process in a unit by assessing the inefficiency of the input combination (slack variable) in the relationship between banks (Machmud and Rukmana, 2010).

In this study, there are three types of efficiency used, namely:

Technical Efficiency (TE): Technical efficiency reflects a company's ability to produce output with several available inputs or technical efficiency measurements tend to be limited to technical and operational relationships in the input to output process (Machmud and Rukmana, 2010).

Pure Technical Efficiency (PTE): Efficiency is the success of a unit in converting inputs into outputs (Hasan and Suleyman, 2014).

Scale Efficiency (SE): is the success of the branch is operating at an optimal scale. The efficiency branch scale works at the most productive scale (Hasan and Suleyman, 2014).

$$Efficiency\ DMU_0 = \frac{\sum_{k=1}^{p} \mu_k Y_{kj}}{\sum_{i=1}^{m} v_k X_{ij}}$$

| | |
|---|---|
| DMU/decision making unit | = UPK; n = UPK to be evaluated |
| m | = different inputs |
| p | = different outputs |
| X_kj | = the amount of input I consumed |

by the UPKj

Y_kj = the amount of output k produced by the UPKj

**Table 2.10 Input and Output Variables**

| Variables | Formula |
|---|---|
| **1. Technical Efficiency (TE)**<br>**2. Pure Technical Efficiency (PTE)**<br>**3. Scale Efficiency (SE)** | 1. CRS DEA or TE = PTE x SE<br>2. VRS DEA<br>3. SE = $\frac{\text{TE CRS}}{\text{TE VRS}}$ |
| **Input Components: Third Party Funds, Fixed Assets, Labor** | |
| **Output Component: Financing** | |

*Source: researcher data, 2020*

To measure bank efficiency, banks that have a DEA score equal to one (DEA = 1) are efficient, while less than one (DEA <1) is said to be less efficient or have low levels of efficiency.

Since the 1980s, this approach has widely used to measure the national banking industry's efficiency. The DEA approach is non-parametric. It is, therefore, that the DEA approach is very sensitive to extreme observations. The assumption used that there is no random error; deviation from the frontier is indicated as inefficiency (Machmud and Rukmana, 2010).

Bank performance is an analysis carried out to see the extent to which a bank has implemented proper and correct financial implementation rules. Alternatively, bank financial performance is a bank analysis of the extent to which the bank conducts financial procedures and is divided into its BUKU. The performance of a bank can be measured using the financial ratio Return on Assets (ROA) and Net Interest Margin (NIM).

This study analyzes the efficiency of Sharia banking. According to Bank Indonesia (BI), the efficiency of companies, especially banking, is closely related to the efficiency of the banking market and the efficiency of the intermediation process and efficiency in implementing monetary policy through regulation of bank loans. The lack of bank efficiency was due to the existence of a high cost of intermediation, reflecting the inefficiency of the

Indonesian banking industry. The high cost of intermediation is partly due to the high overhead costs (too many employees and a lack of professionals).

Kamarudin et al. (2017) found that the scale efficiency of Malaysian banking was higher than pure operational and technical efficiency. Meanwhile, research by Chen et al. (2005) using the DEA approach found that bank technical efficiency consistently dominates the allocation efficiency of Chinese banks. For Indonesia, Ersangga, and Apriani (2019) found that in the 2014-2016 period, there was no significant difference between the efficiency of state-owned banks and non-state-owned banks. However, the size of the bank controlled this. Amalo (2012) with a more extended range, namely 2007-2010, found that there was inefficiency in Indonesian banking based on fluctuating TE developments and a mean efficiency of 50%.

Amrulloh's research (2017) also supports previous research, namely the effect of Sharia bank efficiency on bank performance in the 2009-2011 period using the DEA approach using CAMEL performance measures. This study is different from the previous one because it uses profitability performance measures, namely ROA and NIM, better to explain the role of bank efficiency in bank performance. Furthermore, this study still uses the DEA approach as a measure of efficiency based on the argument that DEA can determine and identify several activity measures that considered efficient and inefficient. Also, the unit difference of each variable does not need to be specified in the same unit of measurement when using the DEA approach.

Banks that apply efficiency, in the long run, to grow even higher if the level of efficiency can do so that the sustainability of Sharia banks can continue. According to Amrulloh's research (2017), a benchmark for determining the soundness level of a bank after an assessment of each variable is carried out by determining the assessment result which is classified into composite rankings. The composite rating is the final rating of the bank's soundness level assessment. DEA is a procedure designed specifically to measure the value of efficiency. The DEA efficiency score is relative to the level of efficiency of the other Sharia bank units in the

sample; DEA can provide recommendations on what factors a company should do to achieve DEA efficiency.

Amrulloh's research (2017) based on the calculations results on efficiency and performance so that the analysis of the relationship between the two is based on the assumption that an efficient bank will encourage an increase in its performance. Thereby increasing the efficiency of Sharia banks obtained by calculating the DEA. is expected to be significantly associated with an increase in banking performance calculated using the CAMELS analysis.

Judging from previous research conducted by Amrulloh (2017), there is a positive correlation between efficiency and banking performance (company). Furthermore, for long-term economic growth, Sharia banking requires developing efficiency in the development of the financial industry. Thus, the hypothesis that can be formed in this study is:

H1: Bank efficiency affects ROA

H2: Bank efficiency affects the NIM.

## III. RESEARCH METHOD

This study tested the impact of bank's efficiency on its performance using DEA approach as efficiency measurement. We use samples of Sharia banks on the IDX during 2014-2018 period are 11 Sharia banks namely PT. BCA Sharia, PT. Bank Sharia Bukopin, PT. Bank BNI Sharia, PT. Bank BRI Sharia, PT. Bank Jabar Banten Sharia, PT. Bank Sharia Mandiri, PT. Maybank Sharia Indonesia, PT. Sharia National Pension Savings Bank, PT. Bank Victoria Sharia, PT. Bank Mega Sharia, PT. Panin Sharia Bank.

The method used to analyze data to test the effect of efficiency on banking performance in this study is panel data regression analysis. Panel data is a combination of time series data and cross-section data. Time series data is data consisting of one or more variables that will be observed in one observation unit within a certain period. In comparison, cross-section data is observational data from several observation units at one point in time.

The selection of panel data is because this study uses several years and many companies. It is using time-series data because in this study using a period of five years, namely 2014-2018. Furthermore, using a cross-section because this study took data from many companies (pooled) consisting of 11 Sharia banking companies listed on the IDX which were used as research samples.

The method of data analysis carried out using the DEA model to measure the efficiency of each bank. Banks that have a DEA score equal to one (DEA = 1) are efficient. In contrast, those that are less than one (DEA <1) are said to be less efficient or have a low level of efficiency. For the measurement of bank performance, DEA is a linear transportation program with the assumption of CRS input, which will show that the best performance of the bank has a ratio of 1 or 100%. With this performance only occurs when no other unit or combination of banks using the same input will produce minimal output. Equal to the amount of output received by a 100% performing bank (Amrulloh, 2017). To measure the efficiency of TE, PTE, and SE, the software used in this study using the MaxDEA software.

## IV. RESULTS AND DISCUSSION

### Results

This study measures efficiency using data envelopment analysis (DEA) following the research of Kamarudin et al. (2017). Operational efficiency or technical efficiency (Technical Efficiency), divided into two, namely scale efficiency and pure technical efficiency, PTE refers to the company's ability to avoid waste by producing much output as long as the input use allows or with little input as long as producing the possible output, while SE refers to the company's ability to work at the optimal scale

**Table 2. Average Efficiency of Sharia Banking 2014-2018**

| Sharia Bank | TE | PTE | SE |
|---|---|---|---|
| BCA Sharia | 0,993115 | 1,000000 | 0,993115 |
| BJB Sharia | 0,931730 | 0,979241 | 0,993115 |

| | | | |
|---|---|---|---|
| BNI Sharia | 0,986251 | 0,995618 | 0,990594 |
| BRI Sharia | 0,982987 | 0,985994 | 0,996907 |
| BTPN Sharia | 0,990066 | 0,997823 | 0,992242 |
| Bukopin Sharia | 0,966951 | 0,982591 | 0,983834 |
| Mandiri Sharia | 0,918598 | 0,998267 | 0,920072 |
| Maybank Sharia | 0,751862 | 0,951029 | 0,773855 |
| Mega Sharia | 0,997307 | 1,000000 | 0,997307 |
| Panin Sharia | 0,964849 | 0,991560 | 0,973104 |
| Victoria Sharia | 0,978281 | 0,999544 | 0,978713 |
| ***Mean*** | **0,951091** | **0,989243** | **0,962987** |

*Source: researcher data, 2020*

Table 2 explained that the DMU that has a constant efficiency or 100% on an average of 5 years (2014-2018) is a Panin Sharia bank. Average Technical Efficiency (TE) in 2014-2018 was 95.1%. Average Pure Technical Efficiency (PTE) in 2014-2018 was 98.9%, and Scale Efficiency (SE) in 2014- Indonesia dominated by a Muslim population of 88.1% of Indonesia's population. However, the share of the Sharia financial market is still small compared to conventional banks. From 2014 to 2018, Sharia banking was able to record a higher Compounded Annual Growth Rate (CAGR) than national banks. Nevertheless, some dynamics affect the growth rate. For example, the consolidation carried out by several Sharia banks and the slowing down of the real sector. Banks that implement efficiency in the long term for even higher growth if the level of efficiency can be carried out continuously so that Sharia banks can continue to grow from conventional banks 2018 at 96.2%.

Banks must avoid decreasing returns to scale because the bank output value will decrease if there is an addition of an input. Moreover, banks must avoid Increasing return to scale, because, although the increase in output increases when adding input, an increase in one output does not equal one input. This study showed that there is a tendency for the sample of Sharia banks to experience decreasing or increasing in the 2017-2018 range except for Victoria Bank. It may have triggered by an economic slowdown which caused financial difficulties for many debtors so that banks were forced to

loosen policies to continue to provide financial services even though they were inefficient.

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For descriptive performance using ROA and NIM, the highest average ROA value is owned by BTPN Sharia banks with a total of 8.414%. Moreover, the lowest average ROA value is owned by Maybank Sharia, namely -5.478%. Maybank Sharia bank has the highest average NIM value, with 9.05% and the lowest average NIM value is owned by BTPN Sharia bank with 0.292%. So, the bank that has the highest net profit that is embedded in total assets (ROA) is the BTPN Sharia bank, and the company that has the lowest net profit is Maybank Sharia.

**Table 3. Average ROA and NIM per Bank**

| Bank name | Average ROA | Average NIM |
|---|---|---|
| BCA Sharia | 1,06 | 4,52 |
| BJB Sharia | -2,454 | 5,152 |
| BNI Sharia | 1,374 | 1,374 |
| BRI Sharia | 0,548 | 5,998 |
| BTPN Sharia | 8,414 | 0,292 |
| Bank Bukopin Sharia | -0,004 | 2,962 |
| Bank Mandiri Sharia | 0,516 | 6,684 |

| | | |
|---|---|---|
| Bank Maybank Sharia | -5,478 | 9,05 |
| Bank Mega Sharia | 1,142 | 7,356 |
| Bank Panin Sharia | -1,406 | 3,436 |
| Bank Victoria Sharia | -1,148 | 2,906 |

*Source: Research data, 2020*

The NIM ratio shows a bank's ability to obtain operations, the higher the NIM, the more influential the bank is in the form of credit. In the Financial Services Authority (OJK) Regulation, ROA said to be good if it is> 1.45%, and for the standard NIM size, OJK is good if it is> 6%. The study data indicate that for ROA, the trend of Sharia banking performance is not good because most Sharia banks have a ROA value below 1.45% except for BTPN and Mandiri. Likewise, for the size of NIM, 6 Sharia banks have NIMs below OJK standards, and the rest BNI, BRI, Mandiri, Maybank, and Mega Sharia are said to have performed well with an average NIM value above 6%.

**Table 4. Research Data Description**

| | DEA | ROA | NIM |
|---|---|---|---|
| Mean | 0.951091 | 0.006635 | 0.050029 |
| Median | 1.000000 | 0.005900 | 0.049900 |
| Maximum | 1.000000 | 0.124000 | 0.182800 |
| Minimum | 0.263718 | -0.201300 | -0.023600 |
| Std. Dev. | 0.121914 | 0.059591 | 0.030648 |
| Skewness | -4.216988 | 0.665484 | 1.063466 |
| Kurtosis | 22.07297 | 10.39476 | 8.071061 |

*Sources: researcher data, 2020*

In general, the ROA and NIM of Sharia banking are still below OJK standards, as shown in Tabel 4.

The statistical test in panel data regression aims to determine whether the independent variable regression model has a significant effect on the dependent variable individually. We used fixed effect regressio and the result of the t statistical test as below:

**Table 5. Regression Result**

| **Dependent Variable** ***Performance ROA*** | **ROA** | **NOM** |
|---|---|---|
| **Independent Variable** | | |

| | | |
|---|---|---|
| ***Efficiency (DEA)*** | -0,0898 | 0,0458* |
| | (0,0697) | (0,0248) |
| Year dummies | Not Included | Not Included |
| Constant | Included | Included |
| Method | FE | FE |
| Adjusted R-squared | 0,2429 | 0,6381 |

This table presents the results of fixed effect panel data both of research model and robust model. The dependent variable is performance provide by return on asset (ROA) and Net Interest Margin (NIM); the independent variable is bank's efficiency proxied by value of DEA. The values in parentheses are standard errors. *significant 10%

Based on the significance test result of Tabel 5, it shows that bank efficiency affects bank performance as measured by NIM but not by ROA.

**Discussion**

The Sharia banking efficiency during the 2014-2018 period still fluctuates every year with an average efficiency of 95.1%. However, there are several DMUs which show that the average value of technical efficiency is close to 100 percent, meaning that Sharia banking said to be efficient. However, there is still a chance to be more optimal to reach 100 percent. According to the regulations of the Financial Services Authority (OJK), ROA can be said to be good if it is> 1.45%, so it can be concluded that the ROA of Sharia banking is not acceptable based on an average ROA value of 0.23%. The standard OJK NIM measure is good if it is> 6%, and the average NIM value of Sharia banking is 6.5%, so it is considered good.

The results indicate that the efficiency of DEA does not affect ROA. It is the same as Amrulloh's (2017) research which stated that ROA harms DEA. It showed that an increase in ROA would lead to a decrease in DEA efficiency. Conversely, a decrease in ROA will encourage an increase in the efficiency of the DEA calculation. This condition shows that there is no match between the ROA ratio result and the DEA efficiency because the relationship between the two results should be positive. However, the ROA results with DEA are not significant.

On the other hand, the study indicated that the efficiency of DEA has a positive effect on NIM, which shows that an increase in NIM will

encourage an increase in DEA efficiency. Conversely, a decrease in NIM will lead to a decrease in the efficiency of the DEA. This condition shows the compatibility between the results of the NIM ratio and the efficiency of DEA and in the test, the NIM and DEA result is significant.

## 5. CONCLUSION

The trend of efficiency in Indonesian Sharia banking is evenly distributed in terms of operational efficiency, pure technical efficiency, and scale efficiency. However, the average efficiency shows that the efficiency of Indonesian Sharia banks more triggered by the value of pure technical efficiency and it is different from empirical finding in other countries. Even though Indonesian's Sharia banking said efficient, but its dominance has experienced decreasing or increasing, and this needs to be a concern of banks as well as the government.

Furthermore, bank efficiency that has not been optimal has resulted in the level of profitability of Sharia banking in terms of ROA still below the OJK standard, which means that the input used to produce output is not optimal or inefficient. The profitability measure in the form of NIM has shown better results above the OJK standard.

This research finding implicates that Sharia banking should be able to manage time, funds, costs as best as possible as well as avoiding risks and interests between investors or funders. Sharia banking must be able to complete work according to a predetermined time, the processes and systems in the bank can always be improved. Sharia banking must improve ROA performance and NIM performance to increase the amount of net profit generated.

Future researchers should be able to add bank performance measures such as market performance. Also, further research may consider conducting different tests of bank performance based on pure technical efficiency categories and scale efficiency that have not been carried out in this study. Furthermore, the next research can use control variables such as bank size, bank age, or ownership to see the possibility of the difference in the efficiency effect result test with the DEA size on the bank.

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