

Indonesian Listed Bank Efficiency in 2008 – 2017 using Data Envelopment Analysis (DEA)

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Abstract: These study objectives are to examine and compare the level of efficiency conventional bank listed in IDX using Data Envelopment Analysis with Intermediation approach, Input, and Output orientation method. Input Variables are Fixed Asset, Personal Cost, Deposit and output variables are Net Interest Income, Investment, Loan. Observes 34 conventional banks and uses ten years period Bank's Financial Report from 2008 until 2017. Findings from this research shows that Bank Rakyat Indonesia is the most efficient bank and furthermore state-owned banks is the most efficient with 0.966 efficiency score, followed by local government banks, mix national and foreign private banks, and national private banks with efficiency score of 0.956, 0.903 and 0.837 respectively and the area improvement of each group consecutively are 0.025, 0.019, 0.087 and 0.148. The result also shows from correlation analysis show that there is a weak relationship between bank efficiency result and performance ratio (ROA, ROE, NIM, BOPO, LDR) in the bank's financial report.

1 INTRODUCTION

The condition of the banking sector in Indonesia has undergone many changes from time to time. This change was caused not only by the internal development of banking but also due to developments in things other than banking, such as economics, social affairs, law, and politics. Also, with this development where deregulation and the implementation of other policies have made Indonesian banking as one of the essential actors in improving macroeconomic performance in Indonesia, it can be seen from the number of funds channeled according to the OJK of more than 7000 trillion rupiahs.

The development of the banking world can be seen from many banks in Indonesia where according to Indonesia banking statistics issued by OJK in February 2018 there were 13 Sharia Banks, 102 Conventional Commercial Banks, and 1615 Rural Banks.

Among the 115 Commercial Banks, there are 43 banks selling securities or issuing emissions (becoming issuers) on the Indonesia Stock Exchange.

The banking industry is currently influenced by digital technology which has been highly developed in the past ten years, one of which is the development of companies fintech which are disruptive technologies towards the conventional banking industry.

To see banking conditions can be seen from data on profit growth and banking assets, from the table below, it shows that there is a decrease in Operational Profit growth in the banking industry in 5 years from 2011 to 2016. From graph 1, it shows that in 2012 operation profit still grew by 28 percent.



Figure 1: Growth in Operational Profit of Indonesian General Banking. Source: Indonesian Banking Statistics, OJK, (2017).



Figure 2: Growth of Indonesian General Banking Assets. Source: Indonesian Banking Statistics, OJK, (2017).

In 2013 operational profit grew 14.7 percent, not as much as the previous year, even in subsequent years, growth has narrowed, 2015 -7.3% and 2016 only 2.3%.

While if we look at graph two the growth of general banking assets in Indonesia, seen from conventional banking assets, the amount of assets from year to year is still growing. Growth still ranges from 8.6% to 16%. From this, it shows that the phenomenon of assets is getting bigger, but when compared, the operational profit does not grow in line with the growth of assets. This phenomenon needs to be observed, whether this is a sign of the poor performance of banking efficiency in Indonesia.

Because the presence and function of banking in Indonesia both for the public, large, medium or lower industries has a very significant role and influence, it is essential to pay attention to bank financial performance, where good bank performance can lead to public trust and vice versa. For this reason, it is necessary to research bank performance or efficiency in Indonesia. When efficiency measurements are taken, banks are faced with the condition of obtaining the level of optimal output with the existing level of input or getting a minimum level of input with a level of certain output. Based on ownership, banks in Indonesia can be divided into several types, including government / state-owned banks such as Bank Negara Indonesia, Bank Mandiri, Bank Rakyat Indonesia, and Bank Tabungan Negara, regional government-owned banks such as BPD Jawa Barat, BPD Jawa Timur, national private-owned banks such as BCA, Bank Bukopin, Bank Mega etc., .Also, finally the mixed-owned national-private and foreign banks, for example, Bank CIMB Niaga, Maybank BII Bank,

OCBC NISP, QNB Indonesia Bank, Bank UOB Indonesia, and others. With the existence of several types of ownership, it is also necessary to conduct efficiency comparison research on each type of bank ownership type and compare between them.

Based on the description of the phenomena and, authors intend to conduct a study of how the financial performance of the banking industry that is listed on the Indonesia Stock Exchange, where currently there are 43 registered banking companies using the method Data Envelopment Analysis using secondary data from Indonesian Banking in the Indonesian stock market during the period of 2008-2017. The researchers intend to use DEA as a data analysis method to measure the performance of the banking industry listed on the Indonesia Stock Exchange because this method uses frontier approach, where this approach identifies and investigates in the area of research objects, which objects are considered to have the best performance in the sample studied. The best performing objects are called frontier. Moreover, other objects that are not on the frontier are considered relatively inefficient compared to the best performing objects or have efficiency equal to one (Paradi et al., 2018).

In the method, Data Envelopment Analysis need input and output variables to measure the efficiency of the Decision Making Unit (DMU) where in this case each bank studied is a DMU of this study. Input and output variables selected must have an attachment with the phenomenon underlying this research. The phenomenon of increasing total assets that are not followed by the significant growth of operating income can be further detailed to get the variables for this study. Assets, in this case, consist of several things including fixed assets or assets which are long-term company properties that are used to support the company's operations in generating income. Other parts of a bank's assets are current assets which include loans which in this case are loans to borrowers who agree on returns and interest and investment which is a long-term investment from banks to third parties such as securities. The amount of funding sources influences operating income in this case, for example, deposits which are the inclusion of funds from the community in various types of savings, also influenced by personal costs which include salaries and honorariums for workers who turn the bank's operational wheels. This operating income is also obtained by one of them from net interest income, which is the net income of revenue generated from assets (loans and investments) minus the obligation to pay interest from the deposit.

From the description above, it can be one of the bases for selecting the three input variables Fixed Asset, Personal Cost, Deposit and Net Interest Income, Investment, Loan as output variables that will be used to calculate efficiency as a picture of the performance of banks listed on the Indonesia Stock Exchange. This selection also will be strengthened by previous research which will be described in the next section.

In the annual banking financial report, there are reports on the performance ratio of banks, where some of these ratios also relate to variables inputs and outputs which will be used to calculate the value of efficiency of Indonesian banking. Examples of performance ratios used are Return on Assets (ROA) where this ratio also relates to assets which are one of the input variables, and then there are operational costs to operating income (BOPO) where this ratio is also related to the personal cost which is part of the cost operational. The other ratio is a loan to deposit (LDR) which is closely related to the input variable deposit and output variable loan. Two other ratios are return on equity (ROE) and net interest margin (NIM) which are related to the output variable of net interest income.

Therefore, based on above background and previous research, it is necessary to do measurement of Indonesian listed banking using DEA method and conduct a correlation analysis between the value of banking efficiency calculated using the DEA method and five performance ratios that are in the banking financial statements and the correlation between the efficiency value and the size of the bank represented by the total asset value.

2 PREVIOUS EFFICIENCY RESEARCH

Previous studies supporting this research are as follows:

A research of Indonesian Listed Banking Efficiency using Stochastic Frontier Analysis conducted by Hendrawan and Azhar (2018), with ten years period between 2008 – 2017 and 21 sample banks gave a result that Bank Rakyat Indonesia is the most efficient bank and overall listed Indonesian banking sector is still not efficient. This research use price of funds-price of labor and price of physical capital as the input variables and output variables are total loans, net non-interest income, and securities.

Saha, and Yeok (2018) conducted a study entitled branches of efficiency of banks branches

aimed at empirically assessing the efficiency of major bank branches in Malaysia and the parameters that control them, the number of branches measured by 247 branch banks in 2014. The method used is Data Envelopment Analysis to analyze the efficiency of the bank branches using inputs interest expenses, personal expenses, establishment expenses, other operating expenses, and outputs total deposits, total loans, wealth portfolio management, Interest income, and non-interest income. After conducting an efficiency analysis of branch banks with the DEA method, followed by approach fractional regression to access the possible factors that control the efficiency of the branch banks. The results of the study indicate that branch banks operating in high concentrate branch banks relatively more efficient, and the economic conditions in the branch bank area are in control of the efficiency of the branch bank. The limitations of this study are only carried out within a period of one year, according to researchers, further research will provide better research if carried out within a period of 3 to 5 years.

DEA method can be used to measure efficiency many industry sectors not only banking, such as research by Hendrawan and Nugroho (2018), that measure and compare the efficiency of South East telecommunication industry. This research measure 14 telco operators in five South East Asia countries between 2008 until 2017 using inputs capital expenditure, operating expenses, total asset and outputs revenue, number of subscribers, and ARPU. These research findings are Telkomsel was the most efficient operator, and that annual revenue value still grew 6.08% even with ARPU declined -4.43%.

Gulati and Kumar (2017) conducted a study entitled Analysing banks' intermediation and operating efficiencies using the two-stage DEA network model: The case of India; aims to make an approach holistic in measuring overall efficiency in terms of intermediation and operational efficiency, the number of banks measured is 46 banks in the period 2011 to 2013. The method used is Data Envelopment Analysis with input fixed assets, number of employees, and loan funds, while advance output and investment for stage 1 which is the input for stage2 while stage 2 has net-interest income and noninterest income. The results of the study show that variations in efficiency intermediation are influenced by bank size factors, liquidity, loans, and intermediation cost while differences in operation efficiency between banks influenced by profitability and diversification of income.

Khan, Samsudin, Islam (2017), conducted an efficiency analysis of banks in Southeast Asia, namely 61 banks in Indonesia, Malaysia, Philippines and Thailand during the period 1998 to 2012, using the Data Envelopment Analysis method, an intermediation approach with input variables fixed assets, deposits, personal expenses, and output variables are net loans and other earnings assets. The results of this study empirically indicate that banking efficiency in these four countries has shown improvement. After being hit by the global crisis in 2007 and 2008, it shows that Malaysia and Thailand were not too affected by the crisis, and Indonesia needed a better transformation.

Determinants of bank technical efficiency: Evidence from rural and community banks in Ghana, by Michael Adusei (2016), aims to calculate Rural bank efficiency in Ghana, the number of banks measured is 101 banks. The method used is Data Envelopment Analysis with input Deposit and Shareholder Equity, while output Loans, Investment, and Profit before interest and tax. The results showed that only 20 of the 101 rural banks in Ghana were technically efficient, where efficiency was influenced by bank size, profitability and the quality of bank funding. Increasing the size and quality of rural bank funding resulted in a technical decline in efficiency while increasing profitability improved its technical efficiency.

Wong and Deng (2016) with the title of their research efficiency analysis of banks in ASEAN countries, aims to explore various aspects of efficiency from banks in the countries incorporated in ASEAN, in connection with the high economic growth in these countries at the time the research was conducted. The numbers of banks in this study were 39 banks in the period 2000 to 2010. The method used was Data Envelopment Analysis with intermediation approach where the input used was the total cost, where the total cost included expenses in terms of employee salaries, equipment, and physical capital such as land, buildings, and others. Meanwhile, the output chosen is the total loan amount, total deposit amount, and total investment. The results showed that first, banks in Malaysia were more efficient than the other three ASEAN countries studied. Second, large-scale banks in ASEAN are less efficient. Three, state banks in ASEAN showed increased efficiency during the study year compared to private banks.

Shahwan and Hassan (2013) with their research entitled Efficiency analysis of UAE banks using data envelopment analysis, aims to measure profitability, marketability and bank social disclosure efficiency

in the UAE, the number of banks measured by 20 banks in 2009. The method used is Data Envelopment Analysis with the input of total deposits, total operating expenses, and leverage and output variables are return on assets (ROA) and return on equity (ROE). The results also showed additional evidence of a positive correlation between the performance of social activities and performance profitability.

Al-Farisi and Hendrawan (2010) compare bank efficiency between conventional and sharia bank in Indonesia using sample 3 sharia banks and 102 conventional banks during 2002 – 2007 period. The study used pooled leased square and alternative profit efficiency model, and the findings are that channeled credit has a positive effect, marketable securities and labor cost have a negative effect on efficiency. Another result also shows that the three Islamic banks are within 21 of the most efficient banks.

Fadzlan Sufian (2007) conducted a study entitled Trends in the efficiency of Singapore's commercial banking groups: A non-stochastic frontier DEA window analysis approach, research was conducted on nine banks in Singapore with the method Window Analysis DEA, during the period 1993 to 2003. The results of banking efficiency are then analyzed by the level of correlation with the calculation of traditional banking performance such as the Log of Total Assets, Log of Total Loans, and Log of Total Deposits. The results of this study are that during the overall research period Singapore's banking efficiency experienced a downward trend in the initial research period and increased dramatically at the end of the study period. This study also shows that banks with smaller assets tend to be more efficient than banks that have significant assets.

3 DATA AND RESEARCH METHODOLOGY

In this research, the observation period was carried out during the years 2008 to 2017 with the number of bank samples as many as 34 conventional banks in Indonesia. Input variables are fixed assets, personal cost, and deposit. While the output variables used are net interest income, investment, and loan.

The method used to measure the efficiency of Indonesian banking is Data Envelopment Analysis. The following is the general equation of the DEA method:

$$h_s = \frac{\sum_{i=1}^m u_{is} y_{is}}{\sum_{j=1}^n v_{js} x_{js}} \quad (1)$$

Where h_s , it shows the bank's technical efficiency; u_{is} shows the weight of the output i produced by the bank s ; y_{is} is the amount of output i produced by the bank s ; v_{js} is the weight of input j given by the bank s ; and x_{js} is the amount of input j used by the bank s ; i calculated from 1 to m and j is calculated from 1 to n . The efficiency ratio (h_s) is then maximized with the following constraints:

$$\frac{\sum_{i=1}^m u_i y_{ir}}{\sum_{j=1}^n v_j x_{jr}} \leq 1 \quad \text{for } r = 1, \dots, N; u_i \text{ and } v_j \geq 0 \quad (2)$$

where N indicates the number of banks in the sample. The first inequality shows that there is no more than 1 efficiency ratio for other DMUs, while the second inequality is positively weighted. Ratio numbers will vary between 0 to 1, where DMU has an efficient number 1 (100%) and if approaching 0 is increasingly inefficient.

For the DEA model the BCC, the equation mathematical formula:

$$\begin{aligned} \text{Max. } h_s &= \sum_{i=1}^m u_i y_{is} + U_0 \\ \text{st. } \sum_{i=1}^m u_i y_{ir} - \sum_{j=1}^n v_j x_{jr} &\leq 0; r = 1, \dots, N \\ \sum_{j=1}^n v_j x_{js} &= 1 \\ u_i, v_j &\geq 0 \end{aligned} \quad (3)$$

where U_0 is a piece that can be positive or negative.

The results of processing the data will be analysed to see the performance and efficiency of the banks listed on the IDX, seen the trend and compared between banks. The results of the calculation of efficiency of each bank are grouped based on the type of bank ownership and then calculated by the average bank efficiency throughout the period. Then the graph is made so that trend analysis can be carried out, also comparing efficiency between bank ownership types. From the results of DEA calculations can also be seen the variables that cause inefficiency by comparing the value of inefficient bank variables with banks in the

frontier nearest efficiency, then this result is analyzed to find which variables need to be optimized or changed. Then the next step is measure coefficient Pearson correlation and Spearman correlation between each efficiency to bank performance and size ratios. Furthermore, from the 12 pairs of correlations, the correlation strength is observed, and calculate the value of p-value to see if there is a correlation between the two variables.

4 RESULT AND DISCUSSION

From table 1, it shows that banks listed on the Indonesian stock exchange which have the best relative average efficiency value is Bank Rakyat Indonesia (BRI) with a value of 0.991, this result strengthens previous research finding, which was using SFA method, by Hendrawan (2018) that BRI is the most effective bank. After BRI another more relatively efficient banks are Bank Victoria International with a value of 0.990, Bank Tabungan Negara with a value of 0.985, Bank Mestika Dharma with a value of 0.985, Bank Nationalnubu with a value of 0.980, BPD Jawa Timur with a value of 0.975, and the bank BTPN with a value of 0.969. Furthermore, banks with low efficiency below 0.75 are Maspion Bank, Bank Mitraniaga, Bank Ganesha and Bank Harda Internasional. Of the 34 banks studied, 14 banks were below the overall efficiency average of the bank during the 10-year study period, and 20 banks were above the average, either using the method input oriented or using output oriented. With an average of 0.887 means the method input oriented, Indonesian banks still have inefficiencies of 11.3%, and in the method, output-oriented the average efficiency is 0.892, which means that Indonesian banks have 10.8% inefficiency. Area improvement for input oriented is the highest BRI efficiency value (0.991) minus the average value of banking efficiency (0.887) which is equal to 0.104 while the area improvement for output oriented is the highest BRI efficiency value (0.992) minus the average value of banking efficiency (0.892) which is equal to 0.1.

Table 1: Average Efficiency Score.

Bank Name	Owner	Average Input Oriented Efficiency	Average Output Oriented Efficiency
Bank Rakyat Indonesia	State-Owned	0.991	0.992
Bank Victoria International	Mixed Private	0.99	0.99
Bank Tabungan Negara	State-Owned	0.985	0.986
Bank Mestika Dharma	National Private	0.985	0.986
Bank Nationalnobu	Mixed Private	0.98	0.985
BPD Jatim	Regional State-Owned	0.975	0.975
Bank Tabungan Pensiunan Nasional	Mixed Private	0.969	0.969
Bank Danamon Indonesia	Mixed Private	0.963	0.964
Bank Mandiri	State-Owned	0.956	0.959
Bank Cimb Niaga	Mixed Private	0.944	0.946
BPD Jabar & Banten	Regional State-Owned	0.938	0.939
Bank Negara Indonesia	State-Owned	0.933	0.935
Bank Permata	Mixed Private	0.93	0.932
Bank OCBC NISP	Mixed Private	0.922	0.924
Bank Central Asia	National Private	0.915	0.918
Bank Ina Perdana	Mixed Private	0.914	0.907
Bank Capital Indonesia	National Private	0.905	0.911
Bank of India Indonesia	Mixed Private	0.905	0.907
Bank Mega	National Private	0.899	0.903
Bank Maybank Indonesia	Mixed Private	0.889	0.892
Bank Agris	National Private	0.874	0.882
Bank Bukopin	National Private	0.873	0.875
Bank Nusantara parahyangan	Mixed Private	0.868	0.87
Bank Sinarmas	National Private	0.86	0.862
Bank Mayapada International	Mixed Private	0.852	0.856

Bri Agroniaga	National Private	0.852	0.861
Bank MNC Internasional	National Private	0.834	0.842
Bank Artha Graha Internasional	National Private	0.822	0.826
Bank QNB Indonesia	Mixed Private	0.812	0.825
Bank Bumi Artha	National Private	0.79	0.803
Bank Maspion Indonesia	National Private	0.741	0.761
Bank Ganesha	Mixed Private	0.708	0.739
Bank Harda Internasional	National Private	0.701	0.728
Bank Mitraniaga	National Private	0.667	0.691
Average		0.887	0.892

In the DEA method, the highest relative efficient value is the efficiency value 1, and from the 340 DMU efficiency result, this study investigates how consistent a bank to be efficient, that is by looking at the frequency of the bank achieves efficiency scores 1. It appears that banks which most often get efficiency scores 1 are Bank Rakyat Indonesia and Bank Nationalnobu which have a maximum efficiency score of 8 years from 10 years of observation, so those two banks can be regarded as the most consistent banks that operating efficiently. The next banks that are quite consistent with efficiency score 1 are Bank Mandiri 7 times, Bank Tabungan Negara 6 times and two banks as much as five times, the Bank Tabungan Pensiunan Nasional and Bank Victoria International. From this, it shows that 3 of the six banks that are most consistent in the frontier efficiency are state-owned banks. The total banks that have been at the highest efficiency value are 21 banks (62%) of the 34 banks studied, and 13 banks never have efficiency value 1.

From figure 3 it shows that the average efficiency based on input oriented and output-oriented is not differ significantly, and in a trend, the average Indonesian banking efficiency had grown since 2008 from 0.818 to 0.91 in 2017. In the two years beginning in 2008 and 2009 the efficiency of Indonesian banking during the global crisis was seen to be the lowest in 10 years of research, began to increase in 2010 to 2013, and after that was quite stable until 2017. This result shows that Indonesian banks managed to rise from the global crisis gradually and showed that Indonesian banking efficiency was stable in the last five years of the study period (2013 to by 2017).

Table 2: Summary Projection Variable Input Oriented.

	Variable	Current	Projection	Changes
Input	Fixed Asset	874,937	804,971	-8.00%
	Personnel Cost	486,417	478,888	-1.55%
	Deposit	25,440,456	25,353,247	-0.34%
Output	Net Interest Income	1,708,208	1,801,138	5.44%
	Investment	8,783,933	9,279,640	5.64%
	Loan	20,951,668	22,066,642	5.32%

From the previous results it can be seen that there are still inefficiencies in the operation of Indonesian banking, in order to achieve desired efficiency values it is necessary to change variables input or output, in the Input Oriented method, the emphasis is prioritized to reduce inputs to obtain efficient results. This change in input or output is carried out by looking at the reference of an efficient bank.

From table 3, using input-oriented, banking sector needs to optimize the variable of fixed assets which is quite significant, by 12.17%, besides that it needs to decrease input the personnel cost by 5.84% and optimization of third-party funds by 4.86%. Not only changes in input, but also need to do a little change in output as mentioned in table 3.

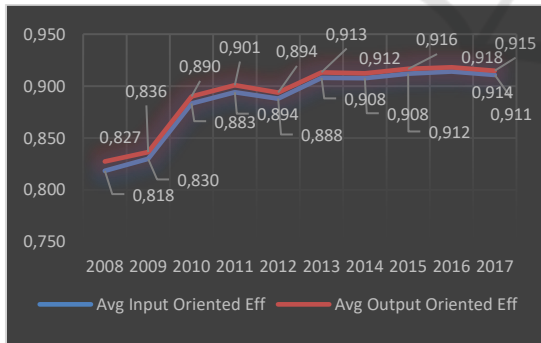


Figure 3: Average efficiency of 2008 to 2017.

Fixed assets are large enough to contribute to inefficiencies because these inputs cannot always contribute optimally in producing output.

Efficient banks that used as references are different for each bank, in this input oriented, the most widely used banks as reference are the Bank Tabungan Negara 184 times, then Bank QNB Indonesia 136 times, Bank Agris 132 times, Bank

Ina Perdana 119 times, Bank CIMB Niaga 97 times and Bank Rakyat Indonesia 92 times.

Using the output-oriented method, changes needed to achieve efficient values are emphasized by increasing variables output, as shown in table 3 below.

From the table 3 shows that the method Output oriented need to do a significant optimization of fixed asset variables, by 8%, besides needing to increase output Net Interest income by 5.44%, investment by 5.64% and loans by 5.32%. Not only changes in output and optimization of fixed assets but also need to be made a little change in other inputs mentioned in table 4. Fixed assets are large enough to contribute to inefficiencies because these inputs cannot always contribute optimally in producing output.

Table 3: Summary Projection Variable Output Oriented.

	Variable	Current	Projection	Changes
Input	Fixed Asset	874,937	768,492	-12.17%
	Personnel Cost	486,417	458,005	-5.84%
	Deposit	25,440,456	24,204,164	-4.85%
Output	Net Interest Income	1,708,208	1,722,576	0.84%
	Investment	8,783,933	8,864,670	0.92%
	Loan	20,951,668	21,069,052	0.56%

Efficient banks that are used as references are different for each bank, in this output oriented, the most widely used bank as a reference is Bank Tabungan Negara 188 times, then the QNB Bank Indonesia 140 times, Bank Agris 117 times, Bank Ina Perdana 115 times, Bank CIMB Niaga 100 times and Bank Rakyat Indonesia 101 times.

From the results of banking efficiency research listed on the Indonesian stock exchange, then efficiency by the groupings of ownership can be seen in table 4. From the results of these studies, it shows that Government Banks are relatively more efficient than other banks. This is because the community dominantly trusts the government banks because they have been operating longer, have extensive networks, supported by the government, synergized with other BUMNs and have far greater assets. The results of this study are aligned with the research from Wong and Deng (2016) where the results show that state banks in ASEAN showed increased efficiency during the study period

compared to private banks. Government banks that have the highest efficiency value are Bank BRI with efficiency values of oriented input 0.991 and 0.992 output oriented so that the area improvement of government bank is 0.025 (maximum value minus average value) for oriented inputs and 0.024 for output oriented.

Local government banks that have an efficiency of 0.96 are also more efficient than the average banking efficiency listed on the exchange, which is 0.89. This is because local governments support local government banks in synergy with other companies belonging to the provincial government. The regional government bank with the highest efficiency value is BPD Jawa Timur with an efficiency value of 0.975 for input oriented or output oriented, the area of improvement of regional government banks is 0.019 for input oriented and 0.018 for output oriented.

Table 4: Average efficiency based on bank ownership.

Bank Based on Ownership	Average efficiency (input oriented)	Average efficiency (output oriented)
State-Owned	0.966	0.968
Local Government	0.956	0.957
National Private & Foreign (Mixed)	0.903	0.908
National Private	0.837	0.846
Indonesian Banking	0.887	0.892

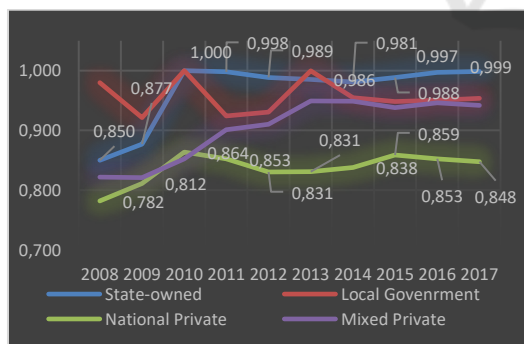


Figure 4: Average efficiency based on ownership.

Banks that are owned by National and Foreign Private have an average efficiency of 0.9, which is relatively higher than average and higher than national private-owned banks, this indicates that when foreign parties acquire private banks and there is foreigners management interference, the tendency to have better efficiency compared to banks that are

only owned by the national private sector. Mixed banks of the national and foreign private sector with the highest efficiency value are Bank Victoria International with a value of 0.99 for input and output oriented so that the improvement area for national and foreign private mixed banks is 0.087 for input oriented and 0.082 for output oriented.

National private banks are the group of banks with the lowest average efficiency, 0.837 and 0.846 lower than the average of the Indonesian banking industry listed on the Indonesia stock exchange 0.887 and 0.892. The national private bank with the highest efficiency value is Mestika Dharma Bank with a value of efficiency of oriented input 0.985 and output-oriented 0.986 so that the area of improvement of national private banks is 0.148 for input oriented and 0.14 for output oriented.

From Figure 4, it can be seen that in 2008 only local government banks that had an efficiency of close to 1, other banks were affected by the 2008 crisis, and gradually improved their efficiency. The group of regional government banks was not too affected by the 2008 crisis because they did not invest much in foreign investment. In 2010, state-owned banks became the most effective and relatively stable bank group until the end of the study period, which is 2017. Local government banks appear to have fluctuating efficiency, although always above the average, in 2008 and 2013 even local government banks have the best efficiency compared to other bank groups. National private banks and foreign national private mixed banks do not differ significantly in the value of their efficiency from 2008 to 2010, after that the group of foreign national private mix banks increased their efficiency and were stable from 2013 to 2017. Meanwhile, the national private bank group from 2011 to 2017 are in the range of average efficiency values of 0.83 to 0.85 which is the lowest efficiency value compared to other groups.

The results of data processing by looking for the Pearson coefficient and Spearman coefficient correlation between input-oriented efficiency variables with DEA method and financial performance ratio variables can be seen in table 5.

The p-value value of all correlation measurements is obtained p-value <0.001, meaning that there is a correlation between all the pairs of variables tested. It is noticeable also that in general there is a correlation with the level of low relation between the efficiency of banking with a ratio of financial performance as ROA and BOPO are using the Pearson coefficient, ROE, NIM and LDR with Pearson and Spearman. Only ROA and ROA using

Spearman coefficient have a moderate level of relationship. The correlation results are low because the financial performance ratio only uses a comparison of variables in the bank's financial statements, so it only compares within itself.

Table 5: Correlation coefficient between Efficiency and Performance Ratio.

	Input Oriented Efficiency	Output Oriented Efficiency
Return On Asset (ROA)		
Pearson Coefficient	0.344	0.342
Spearman Coefficient	0.452	0.449
Return On Equity (ROE)		
Pearson Coefficient	0.31	0.307
Spearman Coefficient	0.371	0.365
Net Interest Margin (NIM)		
Pearson Coefficient	0.266	0.267
Spearman Coefficient	0.233	0.234
BOPO		
Pearson Coefficient	-0.236	-0.236
Spearman Coefficient	-0.467	-0.465
Loan to Deposit Ratio (LDR)		
Pearson Coefficient	0.256	0.251
Spearman Coefficient	0.261	0.26
Total Asset		
Pearson Coefficient	0.338	0.341
Spearman Coefficient	0.463	0.46

While the level of efficiency using the DEA method is a relative comparison to the efficiency of other banks in one group of research objects. These results reinforce the statement that DEA measures the relative efficiency of various organizational units that can reveal the right relationship between inputs and outputs diverse, which previously could not accommodate through traditional ratio analysis.

From table 5 it is also seen that there is no correlation with a high level of relationship between total assets owned by banks with the value of efficiency in either input oriented or output oriented. The results of research show on the level of efficiency that there are several banks whose asset values are far below the average of total banking assets but have been the most efficient banks, for example, Bank Nationalnobu, Bank Victoria International, Bank Ina Perdana, and Bank Mestika Dharma. These banks have been at the frontier of

efficiency for at least four years, but in a positive relationship, it seems that many banks with substantial assets often have better efficiency. This result is inversely proportional to the results of the study from Sufian (2007) where banks in Singapore which have smaller assets tend to be more efficient than banks that have more considerable total assets.

5 CONCLUSIONS

Based on the data from the research and analysis of the calculation of the efficiency value using the DEA VRS method of input oriented and output oriented, the conclusions that can be obtained by researchers are as follows:

From the 34 banks listed on the Indonesia Stock Exchange, with a period of efficiency comparison research using the Data Envelopment Analysis method, Variable Return to Scale, Input Oriented and Output Oriented, it shows that Bank Rakyat Indonesia is the most efficient bank with an average efficiency value 0.99 using either input oriented or output oriented. Bank Rakyat Indonesia is also the most consistent bank, as seen from the frequent showing of efficiency 1 with Bank Nationalnobu as much as eight years of the observation period. In general, Indonesian banks seem to experience improved efficiency and show a stable value from 2013 to 2017. This result also shows that no significant differences between input oriented or output oriented so that the next research can choose one of them.

In order listed Indonesian banking sector to achieve efficient conditions, using input oriented or output oriented, it is seen that fixed asset is the most significant variables that need to be optimized, there are gaps 12,17 % which is not optimal based on input oriented and needs to be optimized by 8% based on output oriented.

Based on the comparison of banking efficiency grouped by type of ownership, it shows that state-owned banks are the most efficient group of banks followed by regional government-owned banks and banks belonging to a mixture of national and foreign private banks, the latter being national privately-owned banks.

Correlation analysis results show that there is a correlation with the level of relations that are relatively low to moderate between the value of banking efficiency using the DEA method and the performance ratios contained in banking financial statements such as ROA, ROE, NIM, BOPO, LDR, and total assets.

Based on this study, advise for the banking sector are Increasing efficiency can be done by reducing or optimizing input variables and increasing output variables, or a combination of both. In order to improve its efficiency, banks can use other banks that have maximum efficiency values as a reference, for example, Bank Rakyat Indonesia and Bank Tabungan Negara for large banks or Victoria banks and QNB banks for relatively small banks. Small-scale National Private Banks can merge with other National Private banks to increase efficiency, or by mergers or acquisitions with foreign banks. Banking also needs to do a benchmark with other banks rather than only rely on their financial performance ratio to understand their efficiency level.

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