

Assessing Bank's Efficiency in Indonesia Using Data Envelopment Analysis (DEA) (Evidence from Indonesia in 2008 – 2017)

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Abstract:

The purpose of this study is to assess an efficiency analysis of 85 banks in Indonesia by using Data Envelopment Analysis Method throughout 2018 - 2017. From the 85 Banks, it is divided into 5 categories namely Foreign Banks, Mixed Banks, Rural Bank, State-Owned Banks, National Foreign Exchange Banks and National Non-Foreign Exchange Banks. The results showed that during 2018 - 2017 the Bank's efficiency level in Indonesia was at the level of 0.744, more specifically the Rural Bank had the highest efficiency level with an efficiency score of 0.776, followed by Mixed Banks of 0.772, State-Owned Banks at 0.763 and National Private Banks amounting to 0.756. There are two groups of banks that have a level of efficiency score below the average such as Non-Foreign Exchange National Private Banks and Foreign Banks, with efficiency scores of 0.728 and 0.579 respectively.

Keywords: DEA, Efficiency, Indonesia's Banking Industry

1. Introduction

The banking industry has a very important position as one of the important components in supporting the progress of the Indonesian economy. Therefore the ability of the banking industry, especially conventional commercial banks to maintain performance and competitiveness, is very important. Based on the SPI report data issued by the OJK in the period 2007 to 2017, in the last decade there has been turmoil in the banking sector of the banking sector. Because the majority of banking companies in Indonesia are currently dominated by conventional commercial banks, the largest companies receive the impact of the turmoil. In 2007 the total net income of all conventional general banking was Rp. 35,015.00 billion and in 2017 the total net income was 131,144.90 billion. The average profit increases by 17.2% per year. Even though it has advantages that tend to increase every year, the ROA ratio tends to decrease. In 2008 and 2015 there was a

decrease in ROA of -0.45% in 2008 and by -0.53% in 2015.

The decrease in ROA can be concluded that even though conventional general banking income rises, the ROA value tends to decrease indicating that the banking industry has a decreased ability to generate profits from assets owned, so it is suspected that the banking sector has been inefficient in managing assets owned. One aspect of evaluating the performance of banking companies is the ability to maintain banking efficiency that will be strong against profitability. The efficiency and resilience of the banking industry has an important role in supporting the Indonesian economy. The operational continuity of the Indonesian banking sector will depend on the ability of each banking institution to maintain high competitiveness. This competitiveness can be reflected in the level of efficiency and ability of banks to deal with any disruptions that arise (Muljawan et al., 2014).

In Indonesia research on banking efficiency has been carried out by Alfarisi and Hendrawan (2010, 2012), while in Southeast Asia it was carried out by Wong and Deng (2016) which show that banking efficiency in ASEAN shows that most banks in Malaysia have better efficiency than the other three countries, the two large banks in ASEAN have lower efficiency levels, the three banks The government tends to have better efficiency improvements than private banks.

2. Literature Review

Efficiency is one of the benchmarks for evaluating the performance of a company. Evaluation of company performance is carried out on activities carried out in the company in order to run its business. The principle of efficiency in company operations is a comparison between the number of units produced (output) to the number of units used (input). So evaluation of company performance measurements can be described in the form of a ratio of the ratio between outputs with input:

Data Envelopment Analysis (DEA) is a non-parametric method that is used to measure the efficiency level of a unit commonly called a Decision Making Unit (DMU) using resources (input) and output (output) (Charnes et.al, 1978). DEA is able to measure the level of efficiency using multiple outputs and multiple inputs, this is a difficulty when measuring efficiency using a traditional approach (Cooper et al, 2007). In this study, we will use the CCR model with output oriented. The goal is how maximum the banking company produces maximum output from the current input.

Rahmawati (2015) conducted a study of Sharia Commercial Banks (BUS) in Indonesia using the Stochastic Frontier Approach (SFA) and Data Envelopment Analysis (DEA) methods in the period January 2010 to December 2013. The results of this study concluded that there were differences in the efficiency of BUS with the SFA and DEA method, the average level of efficiency of the

BUS uses the SFA method of 85.38% while the DEA is 93.25%.

Radojka et al. (2013) conducted a study to measure the level of banking efficiency in SERBIA. with 33 bank objects using the DEA method. Use two models with different input-outputs. Model A with inputs: interest expenses, non-interest expenses, and output: net interest income, net non-interest income. While model B with inputs: deposits, employees, and output: net loans and non-interest income. The results of the study show the results of the efficiency levels that differ between the two models.

Said (2013) conducted a study of the relationship between the level of risk and the level of efficiency of Islamic banking companies in MENA (Middle East and North Africa). In this study using three stages, the first stage of measuring the level of efficiency using a nonparametric Data Envelopment Analysis (DEA) technique, the second stage of risk analysis by measuring the level of credit risk, operational and liquidity risk using financial ratios, the third stage measures the correlation between credit, operations and liquidity risk for efficiency using Pearson Correlation Coefficients. The data period used from 2006 to 2009. This study provides results of credit risk and risk has a negative correlation with efficiency, while liquidation risk does not have a significant correlation with efficiency.

Firdaus and Hosen (2013) Conducted research on Islamic Commercial Banks in Indonesia to analyze the factors that affect the level of efficiency between 2010 and 2012 quarterly with a sample of 10 Islamic Commercial Banks. Based on the results of this study it was concluded that overall the development of the level of efficiency of Islamic Commercial Banks has a fluctuating trend because the level of efficiency of individual BUSs is also volatile.

Sufian (2011) conducted a study of banks in Korea with the title Benchmarking the efficiency of the Korean banking sector: a

DEA approach. This study aims to examine the sources of banking inefficiencies in Korea, banks that are the object of 29 banks in the data collection period. from 1992 to 2003. This study uses the Data Envelopment Analysis (DEA) method, uses the input number of employees and physical capital, and uses the output of the number of accounts and the number of transactions. This study provides results that consistently that technical efficiency is higher in the operation approach than the intermediation and value-added approaches.

Sufian and Habibullah (2010) conducted a study under the title of Development in the efficiency of the Thai banking sector: a DEA approach. This study aims to empirically analyze banking efficiency in Thailand in the period 1999 to 2008. In this study using a sample of 20 bank. Using the Data Envelopment Analysis (DEA) method with input Total Deposits, Fixed Assets, and Labor, and outputs namely loan, investment and NII. The results indicate that banks with higher loan intensity and better capital tend to tend to have higher efficiency. Credit risk negatively affects the efficiency of banks, as well as the global financial crisis negatively impacting Thai banks. Other results indicate that local banks in Thailand have better technical efficiency compared to foreign banks.

Sufian and Noor (2009) conducted a study of Islamic banks in the 16 MENA (Middle East and North Africa) sector, using the DEA method to measure efficiency in order to compare the performance of Islamic banking in MENA with Islamic banking in other Asian countries. The conclusion of this research is that Islamic banking in MENA has a higher technical efficiency than other Islamic banks in Asia in the study period and there is a positive relationship between the efficiency of Islamic banking and loans to intensity, size, capitalization, and profitability.

Putri and Lukviarman (2008), measuring the performance of go-to-bank banking in

Indonesia, by optimizing the level of efficiency of commercial banking in Indonesia listed on the Jakarta Stock Exchange using the Data Envelopment Analysis (DEA) method. Using the approach to financial ratios using data from 2002 to 2004. The results of this study indicate that none of the banks consistently operate efficiently in that period. Only Lippo Bank has been able to operate efficiently for 2 years in the 2003-2004 period.

3. Methodology

In this study the observation period was carried out during the years 2008 to 2017. With the number of bank samples as many as 85 conventional banks in Indonesia. Input variables to be used are total assets, total deposits and labor costs. While the output variables used are total loans and interest income.

The following is the general equation of the DEA method:

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

Where h_s , it shows the bank's technical efficiency; u_{is} shows the weight of the output i produced by the bank ; 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 ; 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 equation above shows the use of one input variable and one output. The efficiency ratio (hs) is then maximized with the following constraints:

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

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.

As explained above, there are DEA, CCR and BCC methods, where the DEA general equation derivatives for the DEA CCR model are as follows:

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

The above equation explains that the objective function of the equation is to maximize output with a constraint function

that the input value is equal to one, so the output value minus the input value is less than or equal to 0. For the DEA model the BCC is still guided by the general DEA mathematical model and modification of DEA CCR model by adding connectivity constraints to the equation so that the mathematical formula becomes:

$$\begin{aligned} \text{Max. } h_s &= \sum_{i=1}^m u_i y_{is} + U_0 \\ \text{st. } \sum_{i=1}^m u_i y_{ir} - \sum_{j=1}^m v_j x_{jr} &\leq 0 \quad ; r = 1, \dots, N \dots\dots\dots(4) \\ \sum_{j=1}^m v_j x_{js} &= 1 \\ u_i, v_j &\geq 0 \end{aligned}$$

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

4. Results

Table 1. Efficiency Score Conventional bank in Indonesia from 2008-2017

Ranking	BANK	Efficiency Score
1	THE BANGKOK BANK COMP. LTD	0.943
2	BANK RABOBANK INTERNATIONAL INDONESIA	0.893
3	BANK SUMITOMO MITSUI INDONESIA	0.891
4	BANK MIZUHO INDONESIA	0.881
5	BANK KESEJAHTERAAN EKONOMI	0.875
6	BPD NUSA TENGGARA BARAT	0.866
7	BANK MESTIKA DHARMA	0.864
8	BANK ARTHA GRAHA INTERNASIONAL	0.860
9	BPD SUMATERA UTARA	0.851
10	BPD BALI	0.851
11	BANK TABUNGAN Pensiunan Nasional	0.850
12	BANK FAMA INTERNASIONAL	0.848
13	BPD BENGKULU	0.843
14	BPD KALIMANTAN TENGAH	0.839
15	BPD SULAWESI TENGGARA	0.838
16	BANK INDEX SELINDO	0.837
17	PRIMA MASTER BANK	0.827

18	BANK TABUNGAN NEGARA	0.824
19	BANK CTBC INDONESIA	0.824
20	BANK CIMB NIAGA	0.824
21	BANK MAYAPADA INTERNATIONAL	0.821
22	BANK JASA JAKARTA	0.819
23	BPD SULAWESI UTARA	0.818
24	BANK UOB INDONESIA	0.817
25	BANK RAKYAT INDONESIA	0.812
26	BANK NUSANTARA PARAHYANGAN	0.807
27	BPD SUMATERA BARAT	0.807
28	BPD JAWA TIMUR	0.801
29	BANK SAHABAT SAMPOERNA	0.801
30	BANK MASPION INDONESIA	0.801
31	BANK DBS INDONESIA	0.792
32	BANK RAKYAT INDONESIA AGRONIAGA	0.791
33	BANK MNC INTERNASIONAL	0.783
34	BANK BUKOPIN	0.782
35	BANK CHINA CONSTRUCTION BANK INDONESIA	0.782
36	BANK QNB INDONESIA	0.781
37	BPD JAMBI	0.779
38	BPD MALUKU	0.779
39	BANK INA PERDANA	0.778
40	BANK DANAMON INDONESIA	0.775
41	BANK HARDA INTERNASIONAL	0.771
42	BPD KALIMANTAN TIMUR	0.771
43	BPD SULAWESI TENGAH	0.768
44	PT BANK PEMBANGUNAN DAERAH BANTEN, Tbk	0.766
45	BPD SUMATERA SELATAN DAN BANGKA BELITUNG	0.759
46	BPD KALIMANTAN BARAT	0.758
47	BANK OKE INDONESIA	0.757
48	BANK OF INDIA INDONESIA	0.755
49	BANK MAYBANK INDONESIA	0.755

50	BPD JAWA BARAT DAN BANTEN	0.749
51	BANK OCBC NISP	0.749
52	BANK PERMATA	0.746
53	BPD LAMPUNG	0.740
54	BPD YOGYAKARTA	0.731
55	BANK BISNIS INTERNASIONAL	0.730
56	BANK AGRIS	0.728
57	BANK SINARMAS	0.723
58	BPD KALIMANTAN SELATAN	0.718
59	THE HONGKONG & SHANGHAI BANKING CORP	0.717
60	BANK ICBC INDONESIA	0.717
61	BANK NEGARA INDONESIA	0.712
62	BANK HSBC INDONESIA	0.708
63	BANK MANDIRI	0.705
64	BPD PAPUA	0.705
65	BANK CENTRAL ASIA	0.697
66	BANK MULTIARTA SENTOSA	0.693
67	BANK GANESHA	0.693
68	BANK BUMI ARTA	0.689
69	BPD RIAU DAN KEPULAUAN RIAU	0.689
70	BANK SBI INDONESIA	0.675
71	BANK COMMONWEALTH	0.675
72	BANK ROYAL INDONESIA	0.675
73	BANK MAYORA	0.670
74	BPD DKI	0.618
75	BANK SHINHAN INDONESIA	0.612
76	STANDARD CHARTERED BANK	0.584
77	BANK VICTORIA INTERNATIONAL	0.576
78	BANK NATIONALNOBU	0.573
79	BANK AMAR INDONESIA	0.564
80	BANK MEGA	0.557
81	BANK MITRANIAGA	0.523
82	BANK BNP PARIBAS INDONESIA	0.493
83	JP. MORGAN CHASE BANK, N.A	0.437

84	BANK OF AMERICA, N.A	0.423
85	DEUTSCHE BANK AG	0.368

Based on table 1 above from the results of the efficiency measurements of all samples of Conventional Commercial Banks showing The Bangkok Bank Comp. LTD is a bank that has the highest average efficiency value in the period 2008-2017 with an average efficiency value of 0.94. Followed by Bank Rabobank International Indonesia with an average efficiency value of 0.89.

While Deutsche Bank AG is a bank with the smallest average value of efficiency in the period 2008-2017 with an average efficiency value of 0.37. The lowest efficiency value of Deutsche Bank AG occurred in 2010 with a value of 0.27. second bank of The Bangkok

Bank Comp. LTD and a type of Foreign Bank Deutsche Bank AG. This shows that the types of foreign banks consist of various bank conditions ranging from the most efficient to the most inefficient.

Basically in the DEA method the efficiency calculation process is done by comparing the efficiency of one DMU with the other DMU. Therefore there will always be DMUs who get efficiency score 1, this DMU is given the most efficient predicate. If a DMU gets an efficiency score of 1 it means the bank of the DMU gets the most efficient predicate for that year. Banks that get the most efficient predikit in a given year are presented in table 2 below.

Table 2. The most efficient bank in 2008-2017

No	BANK	Efficiency Score										Type of BANK
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
1	THE BANGKOK BANK COMP. LTD	0.96	0.94	0.86	1.00	1.00	1.00	0.86	0.99	1.00	0.81	Foreign Bank
2	BANK SUMITOMO MITSUI INDONESIA	0.85	0.71	0.89	0.89	0.85	0.87	0.95	0.93	1.00	1.00	Mixed Bank
3	BANK MIZUHO INDONESIA	0.92	0.78	0.78	0.81	0.91	0.89	0.95	0.83	1.00	0.95	Mixed Bank
4	BANK KESEJAHTERAAN EKONOMI	0.99	1.00	0.92	0.88	0.80	0.82	0.82	0.83	0.83	0.85	National Non Foreign-Exchange Bank
5	BPD NUSA TENGGARA BARAT	1.00	0.92	0.90	0.93	0.88	0.89	0.82	0.87	0.78	0.67	Rural Bank
6	BANK MESTIKA DHARMA	0.95	1.00	0.92	0.82	0.87	0.91	0.84	0.85	0.75	0.73	National Foreign-Exchange Bank
7	BANK ARTHA GRAHA INTERNASIONAL	0.88	0.82	0.76	0.81	0.86	0.84	0.84	0.79	0.99	1.00	National Non Foreign-Exchange Bank
8	BPD SUMATERA UTARA	0.95	1.00	0.86	0.71	0.84	0.88	0.86	0.85	0.81	0.76	Rural Bank
9	BANK DBS INDONESIA	0.71	0.62	0.78	0.79	0.78	0.77	0.73	0.76	0.97	1.00	Mixed Bank
10	BPD JAMBI	0.87	0.85	1.00	0.73	0.73	0.84	0.73	0.69	0.66	0.67	Rural Bank
11	BANK OKE INDONESIA	0.38	0.40	0.50	0.81	0.92	1.00	0.85	0.80	1.00	0.91	Non Foreign-Exchange Bank

12	THE HONGKONG & SHANGHAI BANKING CORP	0.66	0.75	0.65	0.65	0.69	0.70	0.76	0.71	0.60	1.00	Foreign Bank
13	BANK NATIONALNOBU	1.00	0.76	0.52	0.56	0.39	0.38	0.49	0.60	0.52	0.52	Non Foreign-Exchange Bank

Based on the data in table 2 above, it shows that 2016 and 2017 are the years where most banks get efficiency score of 1, which is as

many as four banks each year, whereas in 2014 and 2015 there is absolutely no bank that gets efficiency score 1.

Table 3. Efficiency score based on type of bank

Type of BANK	Efficiency Score										Average
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Rural Bank	0.751	0.799	0.796	0.716	0.721	0.813	0.803	0.815	0.793	0.756	0.776
Mixed Bank	0.781	0.693	0.679	0.716	0.802	0.785	0.772	0.786	0.859	0.849	0.772
State-owned Bank	0.716	0.713	0.743	0.726	0.755	0.802	0.793	0.808	0.794	0.784	0.763
National Foreign-Exchange Bank	0.746	0.728	0.743	0.743	0.780	0.788	0.766	0.759	0.758	0.745	0.756
Non Foreign-Exchange Bank	0.734	0.715	0.656	0.703	0.731	0.749	0.741	0.763	0.765	0.718	0.728
Foreign Bank	0.575	0.574	0.520	0.535	0.582	0.632	0.605	0.589	0.572	0.602	0.579
Overall	0.735	0.729	0.717	0.709	0.741	0.776	0.761	0.767	0.767	0.744	0.744

Based on the data in table 3 it can be seen that BPD rural banks have the highest average efficiency level of 0.776, followed by mixed banks with an average efficiency value of 0.772, then state-owned banks with an average efficiency value of 0.763, National Foreign-Exchange Bank with an average efficiency value of 0.756, Non Foreign-Exchange Bank with an average efficiency value of 0.728, and finally Foreign Bank with an average efficiency value of 0.579.

5. Conclusion and Implications

Based on the data from the research and analysis of the calculation of the efficiency value of Conventional Commercial Banks in Indonesia in the period 2008-2017 using the DEA method, the conclusions that can be obtained by researchers are as follows:

1. The efficiency conditions of Conventional Commercial Banks in Indonesia in the period 2008-2017 were very diverse, some banks had very good efficiency such as The Bangkok Bank Comp. LTD with an average efficiency of 0.943, but there are also banks with very low average efficiency values such as Deutsche Bank AG with an average efficiency value of 0.368.

2. On average rural is the most efficient type of bank from all other types of banks with an average efficiency value of 0.776 throughout the period 2008-2017. The rural with the highest average efficiency value is BPD West Nusa Tenggara with an average efficiency value of 0.866, while the BPD with the lowest average efficiency value is DKI BPD with an efficiency value of 0.538 on average during the period 2008-2017.

3. Foreign Bank is the type of bank that has the most diverse efficiency value, the bank with the highest efficiency among all sample banks is The Bangkok Bank Comp. LTD with an average efficiency value of 0.943 and the lowest efficiency bank among all sample banks is Deutsche Bank AG with an average efficiency value of 0.368, both banks including Foreign Banks.

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