

Analysis of Banking Efficiency in Indonesia: Data Envelopment Analysis Approach

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ABSTRACT

The banking sector is the main form intermediation of financial for the household sector in the form of consumer credit disbursement, as well as providing financial transaction services to the public. In 2020, the banking sector dominates the Indonesian financial system by 77.98%. This means that the total assets of financial institutions are generally managed by the banking sector. The banking sector is expected to play an important role in maintain their performance to be more efficient. This study aims to determine and analyze the value of banking efficiency from 2010 to 2019 at 59 banks in Indonesia consisting of BUMN banks, regional development banks and BUMS foreign exchange banks which are considered to represent the banking system in Indonesia. The type of research used is descriptive with a quantitative approach. The type of data used is secondary data. This study uses a Data Envelopment Analysis (DEA) approach. The results of this study indicate that based on the DEA method, the most efficient BPD banks occurred in 2010 namely 13 banks, for BUMS Foreign Exchange Banks the most efficient number of banks occurred in 2012 as many as 11 banks, and in BUMN Banks in 2010 all BUMN banks been efficient.

Keywords: *Banking Efficiency, DEA.*

1. INTRODUCTION

Banking is an important sector in the state financial sector, because banking is the main source of capital for those who need capital to run a business [1]. In addition, Banking is still the main form intermediation of financial for the household sector in the form of consumer credit disbursement, as well as providing financial transaction services to the public.

This role is seen in the financial structure of developing countries, including Indonesia. According to data published by Bank Indonesia, the banking sector

still dominates the Indonesian financial system, where in 2020 77.98 percent of the total assets of financial institutions are managed by the banking sector (Table 1).

According to table 1 from 2005 to 2020 the role of banking sector assets on gross domestic income (GDP) and total assets of financial institutions is much higher than the role of financial assets institutions other than banks. Banks are asked to stay and improve their performance. Hassan and Bashir [2] said that low banking performance will cause the productive sector to lack funds so that it will hamper production and economic growth.

Table 1. Indonesia's Financial Sector Comparison in 2005 – 2020

Financial Services Institution	% of GDP				% of total assets of financial institutions				Total Financial Institution			
	2005	2010	2015	2020	2005	2010	2015	2020	2005	2010	2015	2020
Financial Institutions Total	63.5	59.9	71.7	77.5	100.0	100.0	100.0	100.0	3,258	3,103	3,617	4,518
Assets												
Bank	52.0	45.6	55.4	60.5	82.0	76.0	76.6	78.0	2,143	1,828	1,755	1,615
Commercial Bank	51.3	44.9	54.5	59.5	81.0	75.0	76.1	76.7	134	122	118	109
Government bank	18.7	16.3	20.0	27.2	29.5	27.1	28.0	35.0	5	4	4	4
Non-bank	11.5	14.3	16.3	17.1	18.0	24.0	23.4	22.0	1,115	1,275	1,862	2,903

financial institutions												
Insurance	4.4	5.9	7.2	7.0	6.9	9.9	10.0	9.0	157	142	146	148
Pension fund	2.2	1.9	1.8	2.0	3.5	3.2	2.6	2.6	312	272	260	215
mutual fund	1.0	2.2	2.4	3.7	1.5	3.7	3.3	4.8	293	559	1,091	2,216
Financial institutions	3.2	3.4	4.1	3.0	5.0	5.7	5.2	3.8	236	194	203	176
Other Non-Bank												
Financial Institutions	0.7	0.9	0.8	1.4	1.1	1.5	2.3	1.8	117	108	162	148
Financial Market :												
Market Value												
bonds have not matured	15.5	14.1	15.7	27.8	--	--	--	--	--	--	--	--
Stock Market Capitalization	26.0	47.2	42.3	45.2	--	--	--	--	--	--	--	--

One of the banking performances can be measured through efficiency. The level of efficiency achieved is an illustration that the bank's performance is getting better. Efficiency of bank indicators can be seen by the large ratio of operating expenses to operating income (BOPO). The smaller the ratio, the more efficient the bank's performance. However, indicators of bank efficiency can not only be seen from the ratio of operating expenses to operating income (BOPO). This ratio is not an absolute indicator for determining bank efficiency. There are still other influencing indicators such as innovation in banking services, cooperation between banks and financial institutions, interest rates.

The efficiency indicators that have been described previously are not yet relative. This means that it cannot be compared with the scope of the comparison, so the value of the efficiency indicator only applies to determine the efficiency of the bank itself. This problem makes researchers to examine the value of banking efficiency by using the data envelopment analysis (DEA) method. Data envelopment analysis (DEA) is an efficiency measurement tool using a non-parametric approach. A characteristic of data envelopment analysis (DEA) is that the analysis can run without knowing the production function and can combine inputs and outputs in natural units without requiring them to be converted to the same unit of measure [3].

Hadad, *et al* [4] said that the efficiency approach using data envelopment analysis (DEA) is technical in nature, meaning that data envelopment analysis (DEA) only takes into account the absolute value of one variable. The basic unit that reflects the economic value of each variable such as price, weight, length, content and others is not considered. Therefore, it is possible to calculate a combination of various variables with different units. Second, the resulting efficiency value is relative or only applies within the scope of a group of UKE (Economic Activity Units) being compared.

The data envelopment analysis (DEA) approach does not use a lot of information, so less data, assumptions, and samples are needed. However, statistical conclusions cannot be drawn using data envelopment analysis (DEA). Another major difference is that the data envelopment analysis (DEA) does not include random error, as a consequence, the data envelopment analysis (DEA) approach cannot take into account factors such as price differences between regions, regulatory differences, good and bad behavior of the data, extreme observations, and so on as factors of inefficiency. Thus, the data envelopment analysis (DEA) approach can be used to measure bank efficiency more generally.

Based on this background, the author intends to conduct a study entitled Analysis of Banking Efficiency in Indonesia: Data Envelopment Analysis Approach.

Based on this background, the formulation of the problem in this research is directed to answer the following six questions: (1) What is the level of efficiency of Regional Development Banks in Indonesia? (2) What is the efficiency level of BUMN banks in Indonesia? (3) What is the efficiency level of BUMS Foreign Exchange Banks in Indonesia?

This study aims to determine the extent to which (1) the efficiency level of regional development banks in Indonesia, (2) the efficiency level of BUMN banks in Indonesia, (3) the efficiency level of BUMS foreign exchange banks in Indonesia.

2. LITERATURE REVIEW

Efficiency is an important indicator in measuring the overall performance of a company's activities. According to Dinc and Haynes [5], efficiency is defined as a company can produce at the lowest possible cost to produce optimal output. Companies that are said to be

efficient if the output produced uses only a few inputs, on the contrary if the inputs used can produce more output. Basically, efficiency is defined as the ratio of output to input. Efficiency is higher if the output per input produced is more and vice versa the efficiency value decreases if the output value per input also decreases. [6]

Efficiency measures determine how a company can maximize output and profit, at the same time minimize its costs. The concept of measuring efficiency according to Othman and Owen [6] said that there are four types of efficiency in companies, namely: first, technical efficiency (TE), meaning general efficiency which measures the ability of banks to create output with little input. Second, the efficiency scale (SE) means that [there is an optimal level, inefficiency can arise if the input used is above or below the optimal level so that there is no additional cost. Third, Price Efficiency (PE) means that banks can increase their efficiency if they buy inputs at lower prices without losing quality. Fourth, allocative efficiency (AE) means increasing efficiency by combining several bank products such as automated teller machines and mobile banking for labor exchange. Thus, it can be understood that an efficient production process if the output produced can be optimal with minimal input.

According to Berger and Mester [7], the efficiency of the banking industry can be viewed from two perspectives, namely the micro and macro perspectives. From a micro perspective, in an increasingly competitive environment, banks are required to perform efficiency in operational activities in order to survive and develop. Banks that are inefficient are likely to be out of the market because they are unable to compete with their competitors, both in terms of price and in terms of product and service quality. Banks that are not efficient will find it difficult to maintain the loyalty of their customers and are also not attractive to potential customers in order to enlarge their customer base.

Meanwhile, from a macro perspective, efficient banks can influence the financial system and financial intermediation costs. This is due to the strategic role of banks as intermediaries and producers of financial services. with efficiency values, bank performance will be better in allocating financial resources, so that in the end economic growth will increase. On the other hand, banks that operate inefficiently will have an impact on slowing economic growth and decreasing socio-economic welfare.

Research conducted by Aiello and Bonanno [8] states that the parametric method always results in a lower level of banking efficiency than non-parametric studies. Banking efficiency was higher in the study using the value added approach than the intermediation method. The efficiency value depends on the rank of the journal and on the number of observations and variables

used. This higher efficiency value is generally found in countries with liberalized banking industries.

Dong, *et al* [9] show that there is consistency between non-parametric and parametric frontiers in explaining efficiency, bank, frontier and performance scores. Based on these results, the key is that multiple frontier or non-parametric techniques are strongly recommended to assess bank performance convincingly.

Fathony [10] shows that large banks with economies of scale in their operations have a better level of efficiency than medium and small banks. Economies of scale benefit the bank by lowering the average unit cost as the loan size increases. The efficiency level for banks that have not yet reached the optimal level can improve the potential (potential for improvement) by increasing output and or reducing inputs as benchmarks for efficient banks.

Manlagnit [11] results that bank efficiency is influenced by risk, asset quality, and inefficiency among domestic banks. the increase in efficiency with the detrimental effects of the 1997 Asian financial crisis and the costs of banking reforms and changes to improve and strengthen the sector. An unstable economy, particularly banking crises can distort the incentive structure of banks, making it more difficult to allocate inputs to increase efficiency. On the policy perspective, said that the importance of the economy in encouraging the improvement of bank efficiency by using a significant potential in bank cost efficiency.

3. METHOD

The type of research used in this research is descriptive research with a quantitative approach. Descriptive research is a type of research that seeks to describe and explain what is being researched and the data used are in the form of numbers. quantitative research method is a method based on the philosophy of positivism used for the population studied, data collection with data analysis, research instruments, and goal setting to test hypotheses [12].

The type of data in this study is secondary data. Secondary data is research data obtained indirectly but through intermediary media (obtained and recorded by other parties). While the form of data is time series and cross section. Time series data is data that consists of one variable but covers several time periods for 10 years (2010-2019). While the cross section is data consisting of several places or objects of research in 59 banks. The source of data in this study was obtained from the publication of the Financial Services Authority (OJK).

The stages of the research carried out are measuring efficiency with the data envelopment analysis (DEA) method, which uses input and output variables. The

output variables used are total income and profitability. Meanwhile, the input variables are interest expense and non-interest operating expenses.

In the data envelopment analysis (DEA) method, it can be formulated in the following equation:

$$\text{Maksimum } \theta = \sum_{r=1}^s u_r y_{ro}$$

$$\text{subject to } \sum_{r=1}^s u_r y_{rj} - \sum_{i=1}^m v_i x_{ij} \leq 0, j = 1, \dots, n$$

$$\sum_{i=1}^m v_i x_{io} = 1 \text{ where } u_r, v_i \geq 0$$

Or,

$$\text{Minimum } \theta$$

$$\text{subject to } \sum_{j=1}^n \delta_j x_{ij} \leq \theta x_{io} \quad i = 1, 2, \dots, m;$$

$$\sum_{j=1}^n \delta_j y_{rj} \geq y_{ro} \quad r = 1, 2, \dots, s;$$

$$\delta_j \geq 0 \quad j = 1, 2, \dots, n$$

Model (1) is referred to as the "multiplier model" where u_r and v_i represent the output and input multipliers (weights) respectively, while model (2) is referred to as the "envelopment model" [3]. To find out whether the bank is efficient or inefficient, it uses a data envelopment analysis (DEA) model with the following hypothesis:

Ho: Efficient (DEA value = 1)

Ha: Inefficient (DEA value < 1)

In making decisions that banks are efficient or inefficient, it is based on the estimated value of data envelopment analysis (DEA). If the estimated value of

data envelopment analysis (DEA) = 1, then the bank can be said to be efficient. However, if the estimated value of data envelopment analysis (DEA) < 1, then the bank can be said to be inefficient.

4. RESULT AND DISCUSSION

The DEA method measures this efficiency value based on data that has been used as an output and input variable. Where based on the DEA method, the efficiency value of each bank sample consists of three categories, namely Government Commercial Banks (BUMN), Foreign Exchange Private Commercial Banks (BUMS Foreign Exchange), and Regional Development Banks (BPD).

Based on Table 2, it can be concluded that for banks in the BPD category in the research year, the most efficient banks occurred in 2010 as many as 13 banks with a percentage of 54.2% of the total BPD in the research sample. While the least efficient banks occurred in 2014 which was only 2 banks with a percentage of 8.3% of the total BPD in the research sample. Meanwhile, for the BUMN Bank category in 2010 all BUMN Banks were efficient, but in the span of 2013 to 2015 none of the BUMN Banks was efficient. Furthermore, for the category of BUMS Foreign Exchange Banks, the most efficient number of banks occurred in 2012 as many as 11 banks with a percentage of 35.5% of the total BUMS Foreign Exchange Banks in the research sample. However, in 2013 there were only 3 efficient BUMS Foreign Exchange Banks with a percentage of 9.7% of the total BUMS Foreign Exchange Banks in the research sample.

Table 2. Efficiency Value based on Bank Recapitulation from 2010 – 2019

Bank	Year	Efficiency Score			Total Bank	% Efficiency
		1	0.000 - 0.509	0.510 - 0.759		
Regional Development Bank	2010	13			11	54.2%
	2011	7			17	29.2%
	2012	7		7	10	29.2%
	2013	4	1	7	12	16.7%
	2014	2	1	8	13	8.3%
	2015	10		2	12	41.7%
	2016	10			14	41.7%
	2017	7			17	29.2%
	2018	8			16	33.3%
	2019	8			16	33.3%
BPD Total		76	2	24	138	31.7%
BUMN	2010	4			4	100.0%
	2011	1			3	25.0%
	2012	1			3	25.0%
	2013			1	3	0.0%
	2014			4	4	0.0%
	2015			3	1	0.0%
	2016	1			3	25.0%
	2017	2			2	50.0%

	2018	1		1	2	4	25.0%
	2019	2			2	4	50.0%
BUMN Total		12		9	19	40	30.0%
BUMS	2010	4			27	31	12.9%
	2011	10			21	31	32.3%
	2012	11		2	18	31	35.5%
	2013	3		9	19	31	9.7%
	2014	9			22	31	29.0%
	2015	5	2	10	14	31	16.1%
	2016	6		4	21	31	19.4%
	2017	7		5	19	31	22.6%
	2018	4			27	31	12.9%
	2019	6			25	31	19.4%
BUMS Total		65	2	30	213	310	21.0%

Malmquist Index: Efficiency Dynamics

One of the advantages of using DEA analysis is that this method can be used to identify the source of the change in the efficiency score itself. Malmquist index (MI) calculation can be done by decomposition of sources of efficiency changes that occur in an analyzed DMU. This Malmquist index (MI) can measure the average change in efficiency over time based on the period used in the study. A Malmquist index (MI) value of more than 1 indicates an increase in efficiency, while a Malmquist index (MI) value of less than 1 indicates a decrease in efficiency/deficiency during the study period. Meanwhile, if the Malmquist Index (MI) value is equal to 1, it can be said that the efficiency value is constant over the time period of the study.

The Malmquist Index (MI) consists of Pure Technical Efficiency Change (PECH), Technical Efficiency Change (EFFCH), Technological Change (TECHCH), Total Factor Productivity Change (TFPCH) and Scale Efficiency Change (SECH). Where PECH and SECH are the decomposition of TECHCH.

Table 3. Average Malmquist Index of Regional Development Banks in 2010 – 2019

Year	effch	techch	pech	sech	tfpch
2010					
2011	0.96	1.17	0.96	0.99	1.14
2012	0.92	1.86	0.94	0.99	1.75
2013	0.89	1.13	0.93	0.95	1.07
2014	1.12	0.95	1.02	1.05	1.07
2015	1.24	0.97	1.27	0.97	1.20
2016	1.00	1.04	1.01	1.00	1.05
2017	1.01	1.00	0.97	1.04	1.01
2018	1.07	1.02	1.01	1.05	1.08
2019	0.86	1.00	1.03	0.84	0.86
Average	1.01	1.13	1.02	0.99	1.14

Table 4. Average Malmquist Index of BUMN Banks in 2010 – 2019

Year	effch	techch	pech	sech	tfpch
2010					
2011	0.99	0.91	0.93	1.07	0.89
2012	0.73	1.33	1.01	0.72	0.96
2013	1.10	0.92	0.82	1.34	1.02
2014	0.76	1.05	0.90	0.84	0.80
2015	1.28	0.88	1.04	1.23	1.13
2016	1.26	1.10	1.36	0.93	1.38
2017	0.95	1.06	1.02	0.93	1.00
2018	1.02	0.96	0.88	1.16	0.97
2019	1.17	0.99	1.14	1.03	1.16
Average	1.03	1.02	1.01	1.03	1.03

Table 5. Average Malmquist Index of BUMS Foreign Exchange Banks in 2010 – 2019

Year	effch	techch	pech	sech	tfpch
2010					
2011	1.07	0.93	1.07	1.00	0.99
2012	0.69	1.53	0.96	0.73	1.08
2013	1.28	0.98	0.88	1.46	1.27
2014	0.99	1.00	1.15	0.86	0.99
2015	1.02	1.05	0.88	1.16	1.09
2016	1.05	1.09	1.16	0.91	1.15
2017	1.13	1.05	0.99	1.14	1.20
2018	1.00	0.96	1.06	0.96	0.97
2019	0.96	0.96	1.02	0.95	0.92
Average	1.02	1.06	1.02	1.02	1.07

Table 3, Table 4, and Table 5 are the results of the calculation of the Malmquist Total Factor Productivity Change (TFPCH) and the decomposition of the TFPCH component consisting of efficiency change (EFFCH)

and Technical Efficiency Change (TECHCH). Next, EFFCH is decomposed into Pure Technical Efficiency Change (PECH) and Scale Efficiency Change (SECH). The calculation of the change in efficiency score shows that both the BPD Bank, BUMN Bank, and BUMS Foreign Exchange Bank groups generally experienced an increase in the average level of efficiency during the analysis period. The average TFPCH value for all three is greater than 1, with the largest TFPCH average being BPD 1.14, BUMS Foreign Exchange Bank 1.07, and BUMN Bank 1.03.

According to the Deposit Insurance Corporation (LPS), throughout 2014 Indonesia's economic performance experienced a slowdown when compared to the previous year. In practice, banking performance has declined following the business cycle. Banking profitability has slowed since 2013, from the peak of profit growth which had reached an average of 25% yoy in 2012. Meanwhile, in 2014 banking profit growth fell drastically and only reached 11%, or increased by 8 trillion to Rp143 trillion.

Tight liquidity factors and declining business prospects have caused banks to tend to be defensive in running their business. The combination of slowing economic growth and tight liquidity forced banks to reduce their lending. Credit risk is also reduced in lending so that the quality of productive assets is maintained. The bank's focus during 2014 was to improve efficiency, maintain credit quality and secure liquidity conditions rather than encourage credit growth. The impact of the changing bank business attitude certainly has implications for declining bank profitability.

Slowing economic performance and tight liquidity have slowed credit growth. Meanwhile, interest costs on customer deposits must still be paid. This condition certainly has an impact on the level of efficiency of banks in Indonesia. Based on the results of this DEA, it can be concluded that during 2012 to 2015 there was a decrease in the efficiency value of Regional Development Banks (BPD), BUMN Banks, and BUMS Foreign Exchange Banks.

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5. CONCLUSION

Based on the analysis and discussion that has been described previously, it can be concluded that for banks in the BPD category in the research year, the most efficient banks occurred in 2010 as many as 13 banks with a percentage of 54.2% of the total BPD in the research sample. While the least efficient banks occurred in 2014 which was only 2 banks with a percentage of 8.3% of the total BPD in the research sample. For the BUMN Bank category in 2010 all BUMN Banks were efficient, but in the span of 2013 to 2015 none of the BUMN Banks was efficient. For the category of BUMS Foreign Exchange Banks, the most efficient number of banks occurred in 2012 as many as 11 banks with a percentage of 35.5% of the total BUMS Foreign Exchange Banks in the research sample. However, in 2013 there were only 3 efficient BUMS Foreign Exchange Banks with a percentage of 9.7% of the total BUMS Foreign Exchange Banks in the research sample.

Banks need to evaluate their operational activities so that they can be more efficient. This bank inefficiency may occur because the costs used are greater than the profits obtained or the output produced is not optimal. Therefore, banks must establish policies whether to increase resources or maximize output from existing resources. Banks or the government can cooperate with other countries to study efficient bank operations in that country. This cooperation can be carried out with foreign banks in Indonesia that have been efficient so that the feeling of foreign banks is not only taking advantage of Indonesia's economic potential without providing benefits to the Indonesian people. The Financial Services Authority (OJK) as the regulator in the banking industry is expected to always produce regulations that can stimulate the improvement of the

performance of banks, not limit the movement of banks themselves. OJK is also expected to be able to make appropriate regulations in order to stimulate increased development or performance of the banking industry so that it does not continue to lag behind foreign banks.

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