

A Comparison of DEA CCR and DEA Aggressive in Determining The Efficiency of Indonesian Islamic Banking

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Abstract: This study aims to measure the efficiency of processes in Islamic banking. Efficiency measurement needs to find out about the optimization of existing processes in Islamic banking. Efficiency assessment in Islamic banking can help in the risk management process and optimization of available resources. The main objective in a process is to maximize a number of input variables to produce a number of input variables. So the process needs to be measured and its efficiency seen. Because the main purpose of the efficiency measurement process is as evaluation material and as a basis for policies to maintain and improve process efficiency. The sample used in the study was monthly data from 2018-2022. To measure efficiency, data envelopment analysis method was used. The results of the analysis obtained were that in the DEA CCR analysis there were 35% of the total that did not achieve efficiency. In general, the DEA CCR results show that the 2022 period is the best period in achieving efficiency. Different results are shown in the DEA Aggressive that from all observed periods, the January 2022 period is the best period with an efficiency value of 2,26338.

Keywords: Aggressive, Data Envelopment Analysis, Efficiency, Islamic Banking

1 Introduction

Efficiency is a process by maximizing a number of inputs to obtain optimal output. In mathematical modeling, efficiency is a calculation of the process output or output produced against the input used in the process. (Dyson, R., Thanassoulis, 1988). The efficiency of a process is a picture of the overall performance of the process. So with such a picture, an integrated evaluation can be carried out on how to use or manage input optimally. In its application in measuring efficiency in mathematical processes, the size of the output is measured in units that depend on the production process, as well as the input variables used. As an illustration, in an activity, efforts to increase efficiency are generally related to the costs used for the production process with a small nominal value but producing large results (Istifarani & Azmi, 2020). Emphasis on the costs used is a form of effort to obtain efficiency. Referring to the illustration, it can be concluded that to achieve efficiency can be done with the same input then the output can increase. In addition, if the input is increased then it is linearly related to the increase in output produced. It can also be done by reducing input with a larger magnitude compared to the decrease in output (Mustafa et al., 2021).

Efficiency is an important measuring tool indicator for companies to show whether or not the company is good at carrying out its performance in all company activities. As an institution that plays an important role in driving economic development properly, banking is an institution that is a vital or urgent part in measuring efficiency (Ertay, T., Ruan, 2005). The urgency of measuring efficiency in banking institutions lies in the level of banking competitiveness which can be reflected through the level of company efficiency gains (Sari, 2015). The following Figure 1 interprets the presentation of images related to the development of banking efficiency data in Indonesia to support the urgency of further efficiency measurements.

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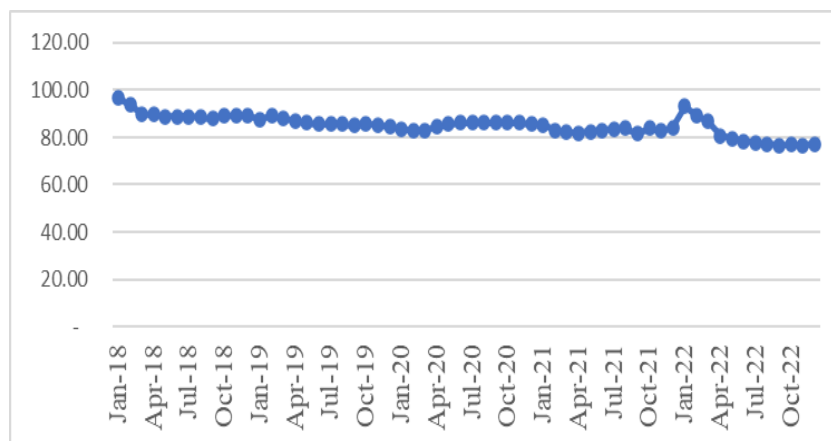


Fig. 1. Development of the Efficiency Level of Islamic Banking in Indonesia

Based on Figure 1, the achievement of banking efficiency in Indonesia shows different developments each month from year to year. The visualization results shown in Figure 1 show that the tendency of efficiency values shown in the BOPO value has the same size. Of the 60 samples used in the analysis, the last few periods showed a very healthy category, however, in the previous period it still showed unhealthy conditions. This shows that the performance of Islamic banks has not been able to manage the resources they have optimally so that continuous measurements need to be carried out to provide an evaluation of the achievement of banking performance (Pendharkar, 2021). With the level of efficiency, Islamic banking will be able to show the level of achievement of its performance so that if Islamic banking has good efficiency, Islamic banking will be easier in carrying out its role as the main institution in increasing national economic growth. Or vice versa, if banking has a low level of efficiency in Figure 1, the results of the efficiency measurement obtained can be used as a reference for evaluation materials for the performance improvement stage as well as the level of bank health which is adjusted to the use of measurement variables.

Determining variables in measuring efficiency using the data envelopment analysis approach is an important thing to do, considering that the measurement variables are variables used as evaluation material for the results of the measurement efficiency level (Panuntun & Sutrisno, 2018). In measuring efficiency using the data envelopment analysis approach, the research variables used are classified into two, namely input variables and output variables. Input variables are input variables that function as sources of production in influencing the level of results or output. While the output variable is a variable that will show the production value of the sacrifice used in determining the input variable or in other words the output variable is the output that is influenced by the presence of the input variable (Dsilva Winfred Rufuss et al., 2018). As a financial intermediary institution, determining the variables in measuring efficiency that are suitable for use in banking measurements is the intermediation approach (Aminuddin & Ismail, 2016).

The intermediation approach to measuring efficiency positions the role of the surplus unit input variable as a financial asset which is then converted into the company's deficit unit. The bank will be considered as an intermediary between parties who need funds and parties who lack funds. Input variables are total assets, number of labors, operational costs of labors, total savings of DPK, and fixed assets. While the output variables include total financing funds, net operating margin, and other operational income. Determining input variables and output variables is not an absolute thing to do (Taliwuna et al., 2019). It is possible that in measuring banking efficiency, it can be measured with other variables. This is due to the diversity of approaches to determining input output variables in measuring efficiency with data envelopment analysis (Panuntun & Sutrisno, 2019).

The importance of determining variables in measuring efficiency is a crucial step in influencing the level of efficiency obtained. In determining the placement of input variables, capital becomes a source of banking financial assets in running each of its operational businesses. With sufficient capital, banks will find it easier to obtain sources of funds in providing funding or as a protective tool for banks in facing the risk of loss or risk protection for fund owners (Lan et al., 2022). The amount of capital will provide a direct reflection of the ownership of banking company assets. With greater capital, the company's assets will also be greater. The amount of asset ownership owned by the company can be beneficial, especially in increasing the company's efficiency through maximum resource management. With this, to maximize the management of company assets, the number of human resources realized through labor must also be increased so that efficiency management will be better (Řepková, 2015).

The high number of labors, in addition to helping to increase the company's efficiency, will also have an impact on the waste of the company's financial assets if the resources owned are not able to manage operational business management well. The increase in the number of labors will have an impact on the increase in the amount of burden that must be borne by the bank. The burden that must be borne by the bank is increasing because the bank

must fulfill its obligations for the placement of human resources through the provision of salaries (Boudaghi & Farzipoor Saen, 2018). This condition will have an impact on increasing and decreasing the level of company efficiency if operational management of increasing the number of labors cannot be realized optimally. Because the position of the company's burden in providing employee salaries will have a reducing nature for the company's savings or profit sources. In addition to increasing the number of labors in an effort to increase banking efficiency, as a service institution, asset ownership is an important thing in supporting employee services in achieving more optimal company goals (Dsilva Winfred Rufuss et al., 2018). Ownership of assets, especially fixed assets, will provide benefits in increasing the amount of banking service production in obtaining profits.

The benefits of banking used in increasing efficiency come from the allocation of operational financial resources, mainly in the form of credit. Credit in banking is the main source of income that can be generated by banking operations in running their business. The higher the credit value that can be distributed by banking, the higher the rate of return that will be obtained. This rate of return is then referred to as interest income (Cheng et al., 2021). Interest income can be obtained by banks when banks are able to channel and manage credit distribution so as not to avoid all risks. When banks are able to manage credit well, the level of profit from interest income can increase the efficiency of banking performance which will have an impact on improving the health of the bank.

A healthy bank can provide various benefits to the bank's business operations. One of the most profitable benefits is increasing public trust in banks. With a healthy condition, the public will be more confident in utilizing the facilities that have been provided both in terms of operational intermediary services and in utilizing payment traffic services (Titko & Jureviciene, 2014). So that banks will be much easier in obtaining income profits from services provided in addition to interest income from credit distribution which is better known as other banking operational income. Other operational income from banking which is sourced from banking administration fees, profession-commission fees, rent, dues, clearing fees, transfer fees and other higher costs will directly impact on increasing bank efficiency through the income obtained (Miranti & Sari, 2016).

To measure efficiency in a process, a non-parametric method is used, namely DEA or Data Envelopment Analysis. Implementation in real conditions that have several inputs and several outputs. The Data Envelopment Analysis method accommodates real conditions that have several inputs and one output or several outputs in order to measure the magnitude of the efficiency value (Kim et al., 2022). The efficiency value measured using the DEA data analysis technique will have a value between 0 and 1, which means that when the efficiency value is 1, it can be categorized as efficient. However, if the efficiency value is less than 1, it is categorized as inefficient. The DEA method was introduced by Charnes, Cooper, and Rhodes, which is a non-parametric statistical method for evaluating problems in a process from multiple inputs or multiple outputs. The use of the DEA method in various fields is to conduct evaluations related to each observation unit or called the decision making unit (DMU). The DEA technique that is most often used and applied in various fields is called DEA CCR. The development of DEA CCR efficiency results by forcing the efficiency value to be 1, then the DEA method was developed with an aggressive formula or called DEA Aggressive (John Doyle, 1994).

Based on the explanation of the urgency of determining efficiency measurement variables from the determination of input and output variables, it can be seen that in its implementation there are limitations in the efficiency results obtained can only be explained based on the variables used. The importance of measuring efficiency in Islamic banking is the objective of this study by comparing efficiency with the DEA CCR and DEA Aggressive methods.

2 Literature Review

2.1 Total Assets

Total assets are an important part and an indicator in classifying the size of a company's condition, in this case a bank. Total assets also show the interest of investors to invest in banks that can be in the form of checking accounts, deposits, and other savings. Investors will be more interested when the company has a larger total asset, because with a larger total asset, it can show the company's capacity in providing smooth business operations (Muljawan et al., 2014). Total assets through banking business operations are related to the level of bank efficiency. Banking business operations total assets can increase the level of bank efficiency based on the resources owned.

2.2 Number of Labors

The workforce in banking is every person who carries out work activities, namely in the banking business which aims to produce or increase sales of services and financial services for the bank. The number of labors shows the quantity of labors employed in its operational activities to achieve the business goals managed. The number of

labors who can be employed can affect the level of efficiency through the returns that will be generated (Arsyad, 2008). Through labor, efficiency can be demonstrated by the balance of quantity between the amount of labor distributed and the amount of production that can be produced in a certain period.

2.3 Labor Operational Costs

Operational costs in banking are part of the sacrifice of company costs used for the smooth running of daily business activities. In banking business operations, one of the operational costs that arise is the cost of the workforce owned. This labor cost is one form of sacrifice from the company in order to achieve the target of the predetermined business plan. In the company's financial cycle, labor costs are included in the expenses that must be incurred (Witjaksono, 2013). Labor costs become a burden, because the expenditure of labor costs will reduce the quantity of cash and company assets. Related to the burden that must be incurred by the company, labor costs have a direct impact on the level of banking efficiency.

2.4 Total Savings

Savings are a form of savings given by bank customers to banks with an agreement that the bank can guarantee and return the amount of savings when withdrawn by the customer at any time. The quantity of savings in banking will show how much public trust in banking. Total savings in banking illustrates the total amount of savings deposited by customers. Total savings in banking operations have an important role, one of which is as a source of bank funding for credit applications by customers (Manopo, 2017). The greater the total savings deposited by customers with the bank, the greater the opportunity for the bank to utilize these savings in credit distribution so that the bank will obtain profits that can be used or utilized in providing interest on customer savings.

2.5 Fixed Assets

Fixed assets are part of a company's assets that generally have 3 main characteristics, namely physical form, as a means of production, and have a minimum period of time longer than 1 accounting period. Fixed assets in a business in a company have a core role in its operational system. Fixed assets have many benefits, including land, buildings, or all equipment that can be used as a means of supporting production of both goods and services. The higher the value of fixed assets in a company, the greater the company's capacity in producing goods or services (Maruta, 2017). In the banking financial business, the role of fixed assets is not much different compared to companies in general. In banking companies, the role of fixed assets is used as a support for business expansion in providing customer services both in the field of customer service and the provision of financial services.

2.6 Total Financing

A good increase in total financing can help people improve their welfare. The main source of income for banks is public funds, commonly referred to as third party funds. These funds can come from deposits in the form of savings, current accounts and time deposits. These third party funds are then used to encourage economic growth through the distribution of funds (Miftahurrohman, 2019). The movement of third party funds shows positive movement with the increasing amount of financial payments. The more third party funds, the higher the financing paid by the bank. The concentration of bank activities in distributing financing is caused by several problems

2.7 Net Operating Margin

Net Operating Profit Margin (NOM) is an important profitability ratio for Islamic banks and determines their ability to generate assets that generate profits. Net operating profit margin can also be interpreted as the rate of return that determines the ability of productive assets to generate profits by comparing operating income and operating costs to the average productive assets. Net operating profit margin can be viewed from two perspectives. In terms of bank competitiveness and profitability, a low profit margin indicates a competitive banking system with low intermediation costs, while from a profitability perspective, a high profit margin indicates such stability. The banking system is based on the stability of the banking system. Banks that can prehend high margins to profitability and capital to protect against risk (Ribeiro et al., 2015).

2.8 Other Operating Income

Banks as financial institutions do not only act as intermediary institutions, namely those that have a role as fund collectors or fund distributors, but also act as providers of financial traffic services. This causes the source of bank income not only to come from one source, namely bank operational income from the distribution of banking products, but also from other operations for the provision of financial traffic services that are carried out. Income obtained from the provision of financial traffic services is included in other banking operational income which will entirely become the absolute income of the bank. (Zikri et al., 2021). Other operational income becomes the absolute income of the bank in providing its services because the results of other operational income will not be distributed to other parties. There are various sources of income from other banking operations, including income from banking administration fees, profession fees or commissions, rent, contributions, clearing fees and transfer fees and other costs outside the bank's main operational activities as an intermediary institution.

3 Research Method

3.1 Research Approaches and Types

The type of research used in this study is quantitative research where a study uses data, both primary data and secondary data, with problems reviewed using methods to form models to solve the problem. The deductive research approach is a study conducted based on the formation of hypotheses related to the problems reviewed to support and emphasize the suitability and accuracy of the theory used. (Sugiyono, 2017).

3.2 Population, Sample, and Research Sampling

In this study, the target of observation is East Java Province. The data used is secondary data in the form of Islamic banking statistical reports published in 2018 to 2022. The population used in this study is all time series data from Islamic banking statistical financial reports. The sampling technique used in this study is non-probability sampling using purposive sampling. If the sample is collected in 2018 to 2023, then the sample size used in Indonesian Islamic banking is 60 samples.

3.3 Data Collection Techniques

An accordance with the data sources used in this study, the data collection technique applied is the documentation technique. The documentation technique is a method of collecting data by analyzing documents related to the observed objects and in accordance with the research variables applied in the analysis.

3.4 Technique of Data Analysis

3.4.1 DEA CCR

The approach applied and expanded by Charnes, Cooper & Rhodes in 1978 called the Data Envelopment Analysis (DEA) analysis technique is a data analysis technique to determine the magnitude of the efficiency value by maximizing a number of inputs. The model designed is called the DEA CCR model. The sample objects observed are called "decision-making units" (DMU) to measure the efficiency of each time period of the implementation of the activity process. (Toloo & Nalchigar, 2009). DEA helps to identify efficient DMUs and to establish the boundaries of the production process that is running efficiently. Here is the formula to measure DEA CCR

Objective Function :

$$\text{Max } e_a = \sum_{j=1}^k w_j y_{ja} \quad (1)$$

Constraint Function :

$$\sum_{l=1}^m v_l z_{la} = 1 \quad (2)$$

$$\sum_{j=1}^k w_j y_{jn} \leq \sum_{l=1}^m v_l z_{ln} \quad (3)$$

$$\sum_{j=1}^k w_j y_{jn} - \sum_{l=1}^m v_l z_{ln} \leq 0 \quad (4)$$

3.4.2 DEA Aggressive

Aggressive formula is the right formula to increase the efficiency difference where the input weighting can be more than 1 and is intended for peer-evaluation or measurable efficiency by considering other DMUs better than self-evaluation. The main purpose of the aggressive formula is to achieve a weighting scheme of a DMU that can be optimal in the CCR model but has the next function of minimizing the cross-efficiencies of other DMUs. (Al-Refaie & Al-Tahat, 2011). The following is a formula for measuring weighting using an aggressive scheme.

Objective Function:

$$\min \sum_{j=1}^k \left(w_{ja} \sum_{n=1}^o y_{jn} \right) - \sum_{l=1}^m \left(v_{la} \sum_{n=1}^o z_{ln} \right) \quad (5)$$

Constraint Function :

$$\sum_{l=1}^m \left(v_{la} \sum_{n=1}^m z_{ln} \right) = 1 \quad (6)$$

$$\sum_{j=1}^k w_{ja} y_{jn} - \sum_{l=1}^m v_{la} z_{ln} \leq \delta \quad (7)$$

$$\sum_{j=1}^k w_{ja} y_{ja} - e_a \sum_{l=1}^m v_{la} z_{la} = 0 \quad (8)$$

$$w_{ja}, v_{la} \geq 0$$

4 Result and Discussion

In the efficiency measurement analysis by applying the DEA CCR and DEA Aggressive methods, the efficiency value of each time period and the contribution of each input variable and output variable to the efficiency value will be measured.

4.1 Variable Characteristics

Descriptive statistics are used to see the measure of centralization and the measure of data dispersion in order to see the characteristics of the variables used in the analysis. Table 1 below is a number that shows the characteristics of the research variable data.

Table 2. Descriptive Statistics of Research Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Input Variable				
Total Assets	373664	65951	285397	531860
Number of Labors	50180	1534	44737	53854
biaya operasional tenaga kerja	4059	2318	547	9354
Total Savings	442550	77932	331943	606063
Fixed Assets	205715	26575	174670	271177
Output Variabel				
Total Financing	235821	35026	186508	322599
Net Operating Margin	1.8397	0.4859	0.4501	2.7201
Other Operating Income	4465	2162	878	8874

Based on Table 2, it shows that the input variable, namely total assets, has an average of 373,664 with a relatively large standard deviation value of 65,951 where the minimum value is 285,297 and the maximum value is 531,860. The large difference between the maximum and maximum values results in a large diversity value. This indicates that in the observed time period, Islamic banking has productive assets and unproductive assets that do not tend to be consistent. In addition, this value also shows that credit and investment in securities also tend to increase. Total savings as part of third party funds show an average of 442,550, with a relatively large difference between the maximum and minimum values. The large difference value indicates that Islamic banks have a high

level of public trust where the total savings value is increasing. Based on the table, it also shows that in the input variable, when the data used has a large value, the variance value of the data also tends to be large. In the table, the variables that have large standard deviation values are the total financing variable of 35026, the input variable is fixed assets of 26575, and other operating income variables of 2162. Then the operational costs of labor have a standard deviation of 2318 and the variable number of labors is 1534. These values indicate that in the operational costs of labor, the condition of Islamic banks is issuing increasing financing even though the increase in financing for labor is not linear with the increase in the number of labors.

4.2 DEA CCR Efficiency Analysis

The following are the results of the weighting measurements of each input variable and output variable as well as the results of measuring the efficiency value of each DMU of Islamic banking in Indonesia in 2018-2022 which are shown in Table 3 using the CCR method:

Table 3. DEA CCR Efficiency Analysis

Period	Pembobot								Efficiency
	Input Variable					Output Variable			
	I ₁	I ₂	I ₃	I ₄	I ₅	O ₁	O ₂	O ₃	
2018	2.28E-06	0	4.10E-05	0	0	0	0	1.24E-04	1
	2.75E-06	0	2.61E-05	0	0	3.00E-06	0	5.48E-05	1
	2.86E-06	0	2.34E-05	0	0	3.99E-06	0	2.98E-05	0.99973
	2.70E-06	0	6.62E-06	3.97E-07	0	2.39E-06	1.95E-01	3.41E-05	1
	3.01E-06	0	2.75E-05	0	0	4.55E-06	0	2.20E-05	1
	2.67E-06	0	2.89E-05	3.21E-07	0	4.63E-06	7.05E-04	2.17E-05	1
	3.08E-06	0	2.81E-05	0	0	4.65E-06	0	2.25E-05	0.99265
	2.44E-06	6.56E-08	2.84E-05	6.02E-07	0	4.81E-06	2.02E-03	2.07E-05	1
	2.66E-06	2.66E-06	0	3.07E-05	4.61E-07	4.86E-06	2.83E-03	2.24E-05	1
	1.80E-06	0	4.00E-05	1.19E-06	0	4.86E-06	2.09E-02	2.02E-05	1
	1.89E-06	0	1.91E-05	1.30E-06	0	5.25E-06	2.00E-02	0	1
3.48E-06	0	1.31E-05	0	0	5.36E-06	0	0	1	
2019	3.14E-07	2.78E-07	0	1.45E-06	1.37E-06	2.23E-06	2.20E-01	1.25E-05	1
	2.81E-06	0	8.71E-06	0	0	2.58E-06	1.71E-01	1.76E-05	1
	6.29E-07	0	0	1.04E-06	1.91E-06	3.30E-06	1.16E-01	1.06E-05	0.995403
	2.97E-06	0	6.35E-06	0	0	3.43E-06	1.08E-01	1.20E-05	1
	2.94E-06	0	1.16E-05	0	0	2.96E-06	1.59E-01	1.68E-05	1
	2.99E-06	0	9.96E-06	0	0	2.25E-06	2.59E-01	1.16E-05	1
	2.59E-06	3.03E-06	5.06E-06	0	0	2.84E-06	2.04E-01	5.61E-06	0.99697
	3.19E-06	0	0	0	0	4.73E-06	0	1.52E-06	1
	2.93E-06	0	3.33E-05	0	0	4.45E-06	1.33E-02	1.82E-05	0.99651
	2.41E-06	0	2.82E-05	0	9.91E-07	4.60E-06	6.25E-03	1.53E-05	0.99253
	1.65E-06	0	2.95E-05	7.89E-07	8.12E-07	4.68E-06	1.28E-02	1.58E-05	0.98928
3.19E-06	0	9.68E-06	0	0	2.58E-06	2.76E-01	0	1	
2020	1.18E-06	8.96E-07	0	3.50E-07	1.49E-06	3.82E-06	0	4.55E-06	0.96555
	1.62E-06	1.27E-06	0	0	1.45E-06	3.89E-06	0	4.24E-06	0.97568
	1.64E-06	1.29E-06	0	0	1.46E-06	3.94E-06	0	4.29E-06	0.97332
	1.66E-06	1.31E-06	0	0	1.49E-06	4.00E-06	0	4.36E-06	0.97893
	2.38E-06	2.96E-06	0	0	0	4.18E-06	0	2.15E-06	0.99037
	2.57E-06	1.89E-06	1.75E-07	0	0	4.26E-06	0	0	1
	0	3.21E-07	7.07E-06	1.77E-06	1.06E-06	4.26E-06	0	0	0.99194

Period	Pembobot								Efficiency
	Input Variable					Output Variable			
	I ₁	I ₂	I ₃	I ₄	I ₅	O ₁	O ₂	O ₃	
2020	2.51E-06	1.87E-06	1.21E-05	0	0	4.35E-06	0	0	1
	2.42E-06	2.62E-06	1.09E-05	0	0	4.33E-06	4.92E-03	0	0.99101
	2.43E-06	2.62E-06	1.10E-05	0	0	4.34E-06	4.93E-03	0	1
	1.98E-06	5.07E-06	1.23E-05	0	1.89E-07	4.40E-06	0	0	0.98733
	2.86E-06	0	1.60E-05	0	0	4.40E-06	9.91E-03	0	1
	7.54E-07	0	0	0	3.38E-06	3.69E-06	0	8.23E-06	1
2021	1.91E-06	2.62E-06	6.76E-06	0	0	3.39E-06	0	1.05E-05	0.90107
	5.71E-07	5.85E-07	0	7.99E-07	1.57E-06	3.71E-06	0	3.30E-06	0.97206
	1.54E-06	1.59E-06	2.16E-06	0	1.35E-06	3.81E-06	0	4.15E-06	1
	2.05E-06	2.43E-06	8.37E-06	0	0	3.51E-06	0	1.38E-05	1
	1.79E-06	3.17E-06	1.15E-05	0	3.25E-07	3.74E-06	0	7.75E-06	1
	0	0	2.64E-04	0	0	3.98E+23	1.64E+27	1.17E+24	1
	0	0	1.05E-05	0	4.89E-06	3.84E-06	0	9.07E-06	0.99903
	0	0	1.06E-05	0	4.95E-06	3.88E-06	0	9.18E-06	0.99954
	2.11E-06	3.19E-06	5.62E-06	0	0	3.13E-06	1.00E-01	0	1
	2.53E-06	0	0	0	0	1.12E-06	3.14E-01	0	1
	1.86E-06	5.03E-06	1.66E-05	0	0	4.03E-06	0	5.74E-06	1
	2022	8.08E-07	1.12E-05	0	0	0	2.61E-06	0	2.29E-05
1.73E-06		2.02E-06	3.38E-06	0	0	1.90E-06	1.36E-01	3.75E-06	1
1.40E-06		2.59E-06	8.57E-06	1.81E-07	0	3.03E-06	0	7.94E-06	1
1.62E-06		2.80E-06	8.06E-06	0	0	2.66E-06	5.59E-02	4.28E-06	1
2.10E-06		6.03E-06	1.66E-05	0	0	3.05E-06	2.19E-02	2.10E-06	1
1.93E-06		1.81E-06	0	0	6.68E-08	1.30E-06	2.34E-01	3.85E-06	1
1.93E-06		2.15E-06	1.34E-06	0	0	1.63E-06	2.00E-01	3.70E-06	1
7.66E-07		5.30E-06	0	7.06E-07	0	2.98E-07	3.56E-01	0	0.99684
1.15E-06		8.65E-06	1.69E-05	0	0	2.60E-06	1.17E-01	0	0.99116
2.24E-06		0	0	0	0	0	2.27E-01	4.78E-05	1
1.66E-08		0	6.83E-05	1.69E-06	0	0	0	1.18E-04	1
2.26E-06		0	0	0	0	0	3.13E-01	2.42E-05	1

The results of the data calculation obtained the weighting of input and output variables in Table 3. Based on the results of the weighting measurement using the efficiency value of DEA-CCR, it can be concluded that the input variable that has the largest contribution in increasing efficiency is the fixed asset variable with an average weighting of 4.87E-07 and the input variable that provides the lowest contribution in increasing efficiency is the labor operating cost variable with a weighting value of 1.59E-05. During the efficiency measurement period, there were several input variables that had a weighting value of 0 in several periods, this was due to the high value of the variable which caused the variable to be considered not to contribute to increasing the efficiency of a bank.

The output variable during the research period, namely from 2018 to 2022, which has the largest contribution in increasing efficiency is the Net Operating Margin (NOM) variable with an average weighting during the research period of 2.74E + 25, while the output variable that has the lowest contribution in increasing efficiency is the total financing fund variable with a weighting value of 6.63E + 21. In contrast to the input variable which has a variable weighting value of 0 which is caused by the high value of the measured variable, in the output variable the variable weighting value of 0 in the research period is caused by the low value of the resulting variable. In the 2018 period, the input variable that had the highest contribution to bank efficiency was the fixed assets variable with a weighting value of 4.61E-07 which occurred in September, while the variable that inhibited the development of bank efficiency was the labor operating cost variable where this variable has a fairly high weighting value of 4.10E-05 which occurred in January. Meanwhile, the output variable that provided the highest

contribution in 2018 was Net Operating Margin (NOM) with a weighting value of $1.95E-01$ in April, while the output variable that had the lowest contribution was the total financing fund variable with a weighting value of $5.36E-06$ in December. In the 2018 period, there were only two DMUs that experienced inefficiency, namely the DMUs in March and July, apart from that all DMUs had a value of 1 or could be said to be efficient.

Furthermore, in the 2019 period, the input variable that contributed the most to bank efficiency was the number of labors with a weighting value of $2.78E-07$. A large number of labors can make a bank efficient because employees can provide large results for bank income. Meanwhile, the input variable of operational costs in 2019 was still an obstacle to bank efficiency because it had a high weighting value of $3.33E-05$. Still the same as the 2018 period, in the 2019 period, the Net Operating Margin (NOM) output variable became the variable that provided the largest contribution and the total financing fund output variable became the variable that provided the lowest contribution, the difference being that in 2019 the Net Operating Margin (NOM) variable had a weighting value of $2.76E-01$ which was found in the December DMU and the total financing fund was $4.73E-06$ in the August DMU. In the 2019 period, there were only 7 efficient DMUs, namely January, February, April, May, June, August and December, the remaining 5 DMUs were not yet efficient.

In the 2020 period, the input variable that is the largest contributor is the total DPK savings variable with a weighting value of $3.50E-07$. Total DPK savings have a major influence on bank efficiency, the greater the total DPK savings, the more efficient the bank is said to be because the higher the total DPK savings value, the higher the bank's ability to distribute credit, thereby increasing the profits that will be obtained by the bank, so that bank performance will also increase. While the input variable that has the lowest contribution is still the same as in previous years, namely the labor operating cost variable with a weighting value of $1.60E-05$. Still the same as in previous years, the output variable that is the highest contributor is the Net Operating Margin (NOM) with a weighting value of $9.91E-03$ and the total financing fund variable as the variable that has the lowest contribution, namely $4.40E-06$. Unlike the previous period, in the 2019 period, there were only 4 DMUs that were efficient, namely the DMUs in June, August, October and December, the rest were still inefficient. There are several triggers for bank inefficiency at this time, namely the emergence of the Covid-19 pandemic which could make it difficult for banks to find new financing customers, then the possibility of banks providing large-scale financing to customers, but many customers are also in arrears in payments or financing becomes stalled.

Similar to the 2020 period, in the 2021 period, the largest contributor to the input variables was the total DPK savings variable with a weighting value of $7.99E-07$ and labor operational costs were still the input variables that provided the lowest contribution with a weighting value of $2.64E-04$. The output variables were the same as in previous years, namely the Net Operating Margin (NOM) variable which had the highest value of $1.64E+27$ and the total financing fund output variable with a weighting value of $3.98E+23$ which was the lowest contributor. However, in the 2021 period, there was an increase in efficiency, namely to 7 DMUs, namely January, April, May, June, October, November and December. The last is the 2022 period, in this period the fixed asset input variable is again the largest contributor with a value of $6.68E-08$ and the operational costs of labor are still the input variables that inhibit the efficiency of a bank with a weighting value of $6.83E-05$. While for the output variable, it is still the Net Operating Margin (NOM) which is the largest contributor with a weighting value of $3.56E-01$ and the total financing fund variable which is the lowest contributor with a weighting value of $3.05E-06$.

The development of Bank performance during the research period was fluctuating with constant improvement. However, in 2020 the bank's performance declined because there were only 4 financial reports that achieved efficiency. The large operational costs of labor that had to be incurred at that time became an obstacle to the development of a bank, especially in 2020 when the Covid-19 pandemic occurred. Furthermore, in 2021 and 2022 the development of bank performance increased again as shown in 2021 there were 7 financial reports that achieved efficiency and in 2022 there were 10 financial reports that achieved efficiency. This proves that the condition of the bank has begun to develop again after the Covid-19 pandemic in 2020.

The efficiency obtained in 2018 was due to the large contribution of the bank's fixed assets so that in this condition the bank was declared to have been able to utilize the fixed assets it owned and could be useful for the bank's operational activities and generate profits. However, in addition to maximizing the utilization of its fixed assets, the bank must also pay attention to the amount of its workforce operating costs because this variable is a factor inhibiting bank efficiency. The large operational costs incurred indicate that the bank's condition is wasteful and will reduce net profit. The condition of the large operational costs of the workforce occurred during the research period, namely from 2018 to 2022, so this is something that must be considered in managing financial management so that it is always in good and efficient condition. While efficiency in 2019 was obtained from the large contribution of the variable number of labors. This condition means that the number of labors increases greater income for the bank. Judging from the results of the research period from 2018 to 2022, the bank's condition is in an efficient state by producing maximum output, namely the Net Operating Margin (NOM) variable which has the highest weighting value. In the study, the total output variable of financing funds did not have a significant effect on bank efficiency. The reason why total funding funding did not have a significant effect was the low average weighting value generated during the research period from 2018 to 2022.

The efficiency gains in 2020 and 2021 were due to the large contribution of the total DPK savings variable. In this case, the bank was able to utilize the total DPK savings it had, even though it had experienced a decline in efficiency, the bank was able to save capital not to be used in investment activities that had a high risk of default and focused more on improving the bank's financial performance after the Covid-19 pandemic. Unstable economic conditions are also one of the factors that reduce the efficiency of a bank. Total DPK savings have a major influence on the efficiency of a bank. In 2022, the bank's condition began to improve again after the pandemic outbreak, as seen from the results of the efficiency of the return of the fixed asset variable to become the largest contributor, meaning that the bank has been able to reuse its assets for the bank's operational activities. However, during the research period from 2018 to 2022, the input variable for operational work costs was still a burden for the bank.

4.3 DEA Aggressive Efficiency Analysis

The following are the results of the weighting measurements of each input variable and output variable as well as the results of calculating the efficiency value of DMU in Islamic banking in Indonesia which are shown in Fig. 2 using the DEA Aggressive method:

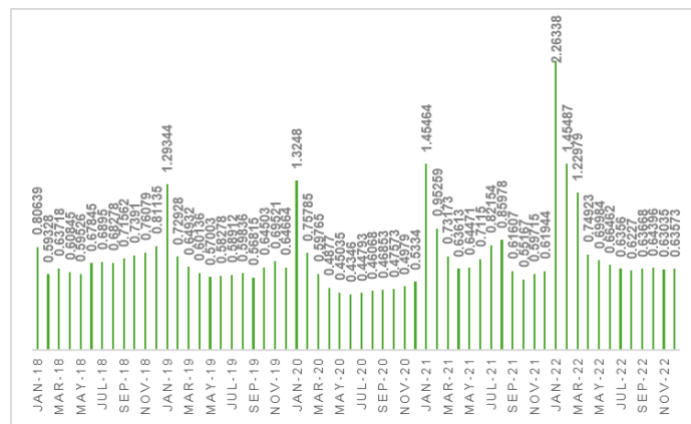


Fig. 2. Aggressive DEA Efficiency Analysis

Based on the results of efficiency analysis with aggressive weighting to measure the best performer from a certain period, it was obtained that in 2018, in general with aggressive measurements showed a maximum efficiency figure of 0.81135 in December, which means that the conditions in 2018 in Islamic banking still showed inefficient conditions because the maximum value did not reach the efficient index value. While the minimum efficiency value in 2018, namely in February, was 0.59328. In 2019, it had a maximum value of 1.29344 in January and a minimum value in September of 0.56815. The year 2020 showed the highest efficiency value, namely in January of 1.3248 with a minimum efficiency value in June of 0.4346.

The maximum efficiency value also tends to increase, where in 2021 the highest was also in January at 1.455 and the lowest efficiency value in October at 0.55167. While in January 2022 with the highest efficiency value of 2.2634 and the lowest efficiency value of 0.6227 in August 2022. Overall the highest in 2022 was in January and the lowest in October 2020. In measuring efficiency, it also requires a weighting value for each input variable and output variable. The results of the analysis show that the input variable that contributes the most to the efficiency value is the operational cost of labor. The next input variable that contributes to the measurement of efficiency with the aggressive DEA approach is the number of labors. Then the next input variable is total assets, total savings, and the input variable that has the smallest contribution is the fixed assets variable. While the measurement of efficiency which also involves input variables, the contribution of each output variable is also measured. The output variable that contributes to the measurement of efficiency is other operating income. Then the next output variable that contributes is the net operating margin and total financing funds.

The weighting conditions of input variables and output variables also show different conditions. Based on the analysis results shown in figure 2, it shows that there are several input variables and output variables that also do not contribute to the measurement of efficiency values. In general, the 2018 efficiency measurement shows that the input variables that contribute are labor operating costs and total savings. While the input variables that do not contribute are total assets, number of labors, and total savings. While in the output variable there is 1 variable that does not have an impact on efficiency, namely NOM. The 2019 condition shows that only total assets and operating costs contribute to the measurement of DEA aggressive efficiency, while all output variables including total financing funds, NOM, and other operating income contribute to efficiency.

The same condition is also shown in the measurement of efficiency in 2020 where all output variables have an impact on efficiency values and input variables that have an impact are total assets, number of labors, and labor operating costs. In 2021 and 2022, the same input and output variable conditions are used to measure efficiency where the output variables are NOM and other operating income, while number of labors and labor operating costs. However, in 2021, fixed assets also have an impact on measuring efficiency values. Overall, the input variables, namely labor operating costs and the output variables of other operating income, have an impact on the efficiency of the entire period from 2018 to 2022. This can be stated that the financing or costs incurred by Islamic banking for labor allocation are able to improve labor performance so that the management or operational processes carried out run optimally so that perfect efficiency conditions are achieved. On the other hand, which other operating incomes which can be in the form of services, investment services and others are able to optimize banking conditions so that they have an impact on efficiency values.

5 Conclusion

The results of the analysis expressed that the data characteristics of the research variables have different data patterns. In the variables of total assets, total savings, fixed assets, total financing describe conditions that are increasing from month to month. Different conditions are shown in the variables of the number of labors, capital adequacy ratio, yields that show conditions that tend to be stable. The results of measuring efficiency by applying the DEA method, namely DEA CCR and DEA with aggressive weighting, describe different values. The results of the analysis with DEA CCR, there are 38 monthly periods that are measured as efficient. However, if using the DEA method with aggressive weighting, there are only 6 monthly periods that are classified as efficient.

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