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Analysis of Bank Efficiency in Indonesia Based on Financial Ratios

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ABSTRACT

This research aims to analyze the efficiency of banks in Indonesia based on financial ratios in the Group of Banks Based on Core Capital (KBMI) 3 and 4 for the 2021-2024 period. The Network Data Envelopment Analysis (Network DEA) approach is used to measure operational efficiency and profitability comprehensively, with an asset approach to understand the bank's resource optimization. The results of the analysis show that PT Bank Mandiri (Persero) Tbk has the highest operational efficiency, while PT Bank Permata Tbk has the lowest. In terms of profitability efficiency, PT Bank Central Asia Tbk recorded the highest value, while PT Bank Maybank Indonesia Tbk recorded the lowest. Overall, PT Bank Central Asia Tbk was the most efficient, while PT Bank Maybank Indonesia Tbk was the lowest. The panel regression model shows that the ratio of Operating Costs to Operating Income (BOPO), Capital Adequacy Ratio (CAR), and Loan to Deposit Ratio (LDR) has a significant effect on Return on Assets (ROA). This research is expected to be a reference for banks in improving efficiency and competitiveness.

KEYWORDS Bank efficiency, Financial ratio, Network Data Envelopment Analysis (Network DEA), KBMI 3 and 4, Profitability

INTRODUCTION

Moving to become an institution that plays a role in the public service sector, banks are one of the important pillars in maintaining the stability of the community's economy because banks play a very important role in regulating the flow of public funds. Moreover, many of the public's financial activities rely on financing dominated by commercial banks. In carrying out its role, the performance of commercial banks needs to be evaluated periodically to ensure operational stability and efficiency. Based on the OJK, the performance of commercial banks can be evaluated through a number of main indicators, such as BOPO, CAR, LDR, and ROA.

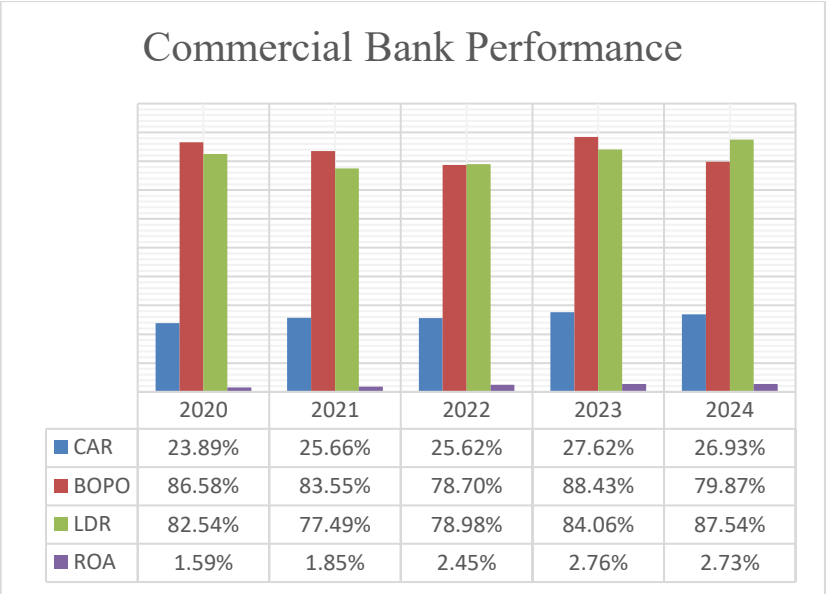

Figure 1. Performance Chart of Indonesian Commercial Banks
Source: Indonesia Stock Exchange (IDX)

The disclosure of the above data shows that the performance of commercial banks in the period 2020 to 2024 has fluctuated across various key indicators. The Capital Adequacy Ratio (*CAR*) shows an upward trend from 23.89% in 2020 to 26.39% in 2024, reflecting increasingly solid capital. On the other hand, the *BOPO* ratio decreased from 86.58% to 79.78% in the same period, indicating an increase in operational efficiency. However, *LDR* has varied with an upward trend, from 82.54% in 2020 to 87.54% in 2024. While this indicates growth in credit disbursement, this increase also has the potential to raise liquidity risks. Meanwhile, the Return on Assets (*ROA*) increased from 1.59% in 2020 to 2.73% in 2024, although the increase is not entirely consistent every year.

Overall, although there have been improvements in several aspects, banking performance is still volatile. This condition shows that the banking industry is on a positive trend, but it still requires efforts to maintain its stability. Especially when viewed from the condition of banking efficiency in ASEAN, banking efficiency in Indonesia is still categorized as riskier compared to other countries. The following is the efficiency of banking in ASEAN countries.

Table 1. Banking Efficiency of ASEAN Countries

%	***Cost to Income Ratio***			***Net Interest Margin***					***Lending Rate***		
	2019	**2020**	**2021**	**2019**	**2020**	**2021**	**2022**	**2023**	**2019**	**2020**	**2021**
Singapore	40.51	44.80	45.36	1.52	1.87	1.21	1.84	2.17	5.25	5.25	5.25
Malaysia	42.88	42.80	43.43	1.93	2.25	1.96	2.27	2.02	4.90	3.64	3.45
Thailand	45.63	43.66	44.62	3.05	3.49	2.46	2.62	3.00	4.10	6.18	3.10
Philippines	57.81	58.54	51.94	3.93	4.05	3.56	3.98	4.51	3.01	2.25	5.90
Indonesia	46.59	47.95	47.22	5.47	4.91	4.51	4.71	4.81	10.40	9.37	8.90

Source: World Bank, Financial Services Authority, Bank Indonesia

Based on the data in Table 1 regarding the Banking Efficiency of ASEAN countries, it can be seen that banking in Indonesia has a relatively lower level of efficiency compared to the other four ASEAN countries, namely Singapore, Malaysia, Thailand, and the Philippines. This can be seen from several main indicators. First, in the Cost to Income Ratio (*CIR*) indicator, Indonesia is in the second highest position among the five countries, namely 46.59% in 2019,

47.95% in 2020, and 47.22% in 2021. The high *CIR* indicates that the bank's operating costs in Indonesia are still relatively large compared to its revenue, which indicates a lower level of efficiency. In comparison, Singapore, Malaysia, and Thailand have lower *CIR* than Indonesia, reflecting better efficiency. In addition, in the Net Interest Margin (*NIM*) indicator, Indonesia recorded higher figures compared to other countries, such as 5.47% in 2019 and 4.91% in 2021. Although a high *NIM* indicates good profitability, in the context of efficiency, this can be interpreted as a high loan interest rate applied, which can be a burden on customers and reduce the bank's competitiveness in the regional market.

On the indicator Lending Rate, Indonesia occupies the highest position compared to the four other countries, namely 10.40% in 2019, 9.37% in 2020, and 8.90% in 2021, although it has decreased over the last three years. Lending rates of banks in Indonesia are still the highest, which can cause a reduction in banking competitiveness in Indonesia, decreased consumption and investment, and reduced people's purchasing power (Kozlov, 2023). Overall, this data shows that banking efficiency in Indonesia is still low compared to other ASEAN countries. The size of the Cost to Income Ratio, Net Interest Margin, and Lending Rate, which is not balanced with operational cost efficiency, is the main factor in the low competitiveness of Indonesian banks in the ASEAN regional arena. In response to these conditions, OJK urges banks in Indonesia to gradually reduce *NIM*. When banks reduce *NIM* gradually, they must become more efficient so that their financial performance is maintained. Therefore, efforts are needed to improve efficiency so that Indonesian banks can be more competitive and highly competitive in the ASEAN market. In this regard, an appropriate management strategy is needed in managing capital and risks so that banking performance is maintained sustainably. One of the steps that can be taken to achieve this is to analyze the bank's efficiency, so that the bank can optimize the use of resources, increase profitability, and minimize risks that can disrupt financial stability.

The role of banks as financial institutions is closely related to credit distribution activities. In fact, the provision of credit is one of the main functions in banking operations. The amount of credit disbursed directly affects the bank's profitability. If the bank is unable to distribute credit optimally while the funds collected from customer deposits are large enough, then this condition can cause potential losses for the bank (Komah et al., 2024). Therefore, the efficiency aspect is something that needs to be considered by the company. In the world of banking, efficiency can be interpreted as the ability of an institution to carry out its duties effectively by taking into account the ratio between inputs and outputs (Komah et al., 2024). In other words, efficiency reflects efforts to optimize the use of resources to a minimum to produce maximum output.

Ullah et al. (2023) emphasized that the efficiency of a bank plays an important role in shaping the real economy and helping inadequate economic progress. According to Alber et al. (2019), efficiency is defined as a measure of effectiveness that is associated with the use of time, effort, and skills to the minimum possible. In other words, efficiency can be seen from the review of maximum output results by applying certain inputs. This concept aligns with the Cobb-Douglas production function theory, which emphasizes that the output produced depends on the inputs used (Entezari et al., 2021). In the banking sector, this theory can explain the relationship between the resources utilized by banks and the products or profits obtained. A high level of efficiency in banking contributes to improving the quality of service for customers, providing greater returns for depositors, reducing the number of non-performing loans, and driving more optimal economic growth and development (Ullah et al., 2023). This means that the more efficient a bank is in using its resources, the higher the level of efficiency achieved, which will ultimately have a positive impact on the bank's profitability.

In banking efficiency, there are three main approaches used to describe the relationship between inputs and outputs in an institution's financial activities, namely the asset approach

(*asset approach*), the intermediary approach (*intermediation approach*), and production approaches (*production approach*) (Lestari & Huda, 2020). The production approach views financial institutions as producers that produce services in the form of savings accounts and loan credits, with output measured based on the total number of accounts under management. Meanwhile, the intermediation approach emphasizes the role of banks as financial intermediaries that distribute funds from parties with excess funds to parties in need of financing. The asset approach considers financial institutions as entities that create credit or loans, where efficiency is measured based on the bank's ability to allocate funds in the form of credit, financing, investment in securities, and other assets that are considered outputs (Lestari & Huda, 2020). This research will use the asset approach because it is more relevant for banks in evaluating bank efficiency from the perspective of productive asset management and profitability, as this approach can provide a more comprehensive picture of how banks utilize their productive assets to generate income. This approach focuses on how banks leverage their resources, such as capital and labor, to generate productive assets, including credit and investment (Tan et al., 2021). Thus, this approach provides a clearer picture of asset optimization in supporting the bank's profitability.

Henriques et al. (2020) stated that efficiency can be measured by considering profitability, with one of the determining factors being assets. Based on this, the asset approach is an approach that can be used to see and calculate the level of banking efficiency. According to Tan et al. (2021), the asset approach focuses on the role of banks in optimizing bank assets. In addition, the asset approach emphasizes assets as an output component (Khalifaturofi'ah, 2023). This illustrates that the asset approach emphasizes the value and optimal use of bank assets, thus allowing the achievement of maximum profits as a reference for efficiency.

Saqib (2013) in Abidin et al. (2021) stated that the efficiency of the financial sector has a positive impact on economic progress in developing countries. Therefore, banking efficiency can be one of the keys to the success of a bank and indirectly supports the economy in general. The asset approach involves analyzing the composition and performance of assets to ensure that they are aligned with the bank's strategic objectives. Setiawan et al. (2020) stated that the measurement of bank performance can be seen through the ratio of finance and efficiency (technical and cost). In addition, inputs used as a performance process in banks produce outputs that are used as comparative values for efficiency measurement (Andriansyah and Julia, 2023).

Related to this, in assessing efficiency, a certain measurement scale is needed that can provide a factual picture of the bank's level of success in improving its efficiency. This measurement scale is commonly known in the form of financial ratios. According to Yusuf (2017), the calculation of ratios can provide an evaluation of financial conditions in the past, present, and future. The calculation of financial ratios itself has various types and is used according to the function of analysis in research. Related to this, the financial ratios that will be used as a benchmark to assess the level of banking efficiency are *BOPO*, *CAR*, and *LDR*, which are used as a benchmark in the calculation of Return on Assets (*ROA*). *ROA* itself was chosen as the output of the calculation because it is considered to provide a clearer assessment of the bank's efficiency in managing assets that can describe the bank's profits.

Based on several studies conducted previously, there are still inconsistencies in the research results. In the research conducted by Blessky et al. (2023), *CAR* was able to have a negative effect on *ROA*, while the research by Adhim (2022) and Ikhwan and Riani (2022) revealed that *CAR* did not affect *ROA*. In addition, Adhim (2022) also revealed that *ROA* can be influenced by *BOPO* and *LDR*. This aligns with the research of Ikhwan and Riani (2022) and Antika et al. (2024), who found that *LDR* affects *ROA* in a study focused on financial data during the Covid-19 pandemic. Furthermore, Antika et al. (2024) also revealed that *BOPO* has no effect on *ROA*. The efficiency analysis conducted by Tika Sari et al. (2022) showed that there was no impact or changes caused by *CAR* on the efficiency of large banks; conversely, a

significant influence on efficiency was shown by the *BOPO* variable. The inconsistency of the results of previous studies opens opportunities for researchers to fill the research gap and reaffirm the influence of the *BOPO*, *CAR*, and *LDR* variables in showing bank efficiency and their influence on *ROA*.

There are several methods of calculating bank efficiency, such as Data Envelopment Analysis (DEA), Stochastic Frontier Analysis (SFA), Free Disposal Hull (FDH), Thick Frontier Approach (TFA), and Distribution-Free Approach (DFA). According to previous studies, Data Envelopment Analysis (DEA) is often considered superior to other methods of measuring bank efficiency due to its flexible and non-parametric approach. In contrast to methods such as Stochastic Frontier Analysis (SFA), which require explicit assumptions about the form of the production function or cost, DEA does not require such assumptions, thereby avoiding potential bias due to model specification errors. Research conducted by Muttaqin et al. (2020) mentioned that the SFA method for KBMI 3 and 4 banks is categorized as less efficient or even inefficient, while the DEA method is categorized as very efficient. In addition, DEA is capable of handling different types of inputs and outputs simultaneously, which is particularly relevant in the context of banking where efficiency does not depend on just one factor but on a combination of assets, labor, credit granted, interest income, and net profit. This flexibility makes DEA more effective in measuring the relative efficiency of banks, especially when their operational structures are diverse and complex.

However, in this study, the four financial ratio variables to analyze the bank's efficiency will use the Network Data Envelopment Analysis (Network DEA). The Network DEA method is needed because conventional DEA approaches have limitations in capturing the complex internal structure of banking processes. DEA only measures efficiency in aggregate without considering the relationships between processes that occur within the bank (Tan et al., 2021). In fact, in the banking context, operational activities do not occur in a single stage but rather each unit has several parts or stages that contribute in different ways to overall efficiency. To overcome these limitations, the DEA Network was developed. This method divides the processes within a unit into interconnected stages, making it clearer how inputs are converted into outputs within the system. The two-stage model in the NDEA illustrates that the results of the first stage will be the input for the second stage (Tan et al., 2021). Therefore, this method can provide significant information by giving a detailed assessment of efficiency based on the valuation of a bank's final assets.

Banks themselves are generally divided into several groups based on various criteria, such as core capital, ownership, and operational functions. In classification based on core capital, the Financial Services Authority (*Otoritas Jasa Keuangan*, *OJK*) divides banks into four groups known as Bank Groups based on Core Capital (*Kelompok Bank Berdasarkan Modal Inti*, *KBMI*). Specifically, banks in *KBMI* 3 and 4 are considered to have a strategic role in the Indonesian banking system and have significant core capital. The Financial Services Authority (2021) states that banks included in the *KBMI* 3 category have a core capital of more than IDR 14 trillion up to IDR 70 trillion, while banks included in the *KBMI* 4 category have core capital greater than IDR 70 trillion. Khalifaturofi'ah (2023) states that banks with larger capital tend to be more stable and easier to make large profits. Therefore, these banks are considered able to support the stability of the national economy because they can provide support in financing and the development of banking innovations. In addition, the group of banks included in *KBMI* 3 and *KBMI* 4 is considered able to provide comprehensive and detailed information in identifying the level of banking efficiency in general.

Based on this description, this research is considered important because it can fill the gap in previous research by reviewing banking efficiency by taking into account asset profits in *KBMI* 3 and 4, which can certainly provide a clear picture in finding an effective and sustainable banking strategy. In addition, this study will complement previous research that

only reviewed banking efficiency in Islamic banks or banks that are members of *KBMI* 3 and 4, while this study will review data and information from commercial banks registered in *KBMI* 3 and 4 in the period from 2021 to 2024. This study specifically aims to analyze the level of operational efficiency and profitability of banks included in *KBMI* groups 3 and 4 in Indonesia in the 2021–2024 period using the Network Data Envelopment Analysis (NDEA) approach. In addition, this study also aims to examine the influence of financial ratios, which include *BOPO*, *CAR*, and *LDR*, on the bank's profitability performance as measured through Return on Assets (*ROA*). By applying the Network DEA approach, this study is considered able to provide a more comprehensive efficiency analysis. In addition, this research is also expected to provide deeper insight into the factors that affect the profitability efficiency of banks, so as to support the achievement of optimal performance.

RESEARCH METHOD

Based on the information that has been collected about the variables and methods that will be used in this study uses a quantitative approach with a descriptive-verifiable method, a conceptual framework is prepared that is expected to facilitate the understanding of this research:

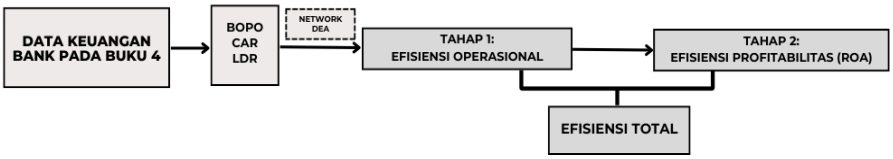

Figure 2. Research Stages

The chart illustrates that the research process will begin with the collection of financial data of *KBMI* 3 and 4 banks that have been selected. Furthermore, *BOPO*, *CAR*, and *LDR* are calculated as inputs from each bank that are the focus of the research. The data from the calculation results will be collected and processed using the Network DEA method, which specifically uses the Two-Stage Network DEA. This calculation is carried out in two stages, namely to obtain the value of Operational Efficiency and Profitability Efficiency (*ROA*), which is the basis for determining the total efficiency value. Then, a comparison of the values obtained marks the ranking of banks that can carry out maximum efficiency. Thus, the researcher can draw conclusions about the efficiency of the relevant banks based on the final value of the efficiency obtained from all stages of analysis.

Because this research is conducted in two stages, the variables are divided into two groups based on their stages:

Phase 1 (Operational Efficiency)

In calculating operational efficiency, the inputs used are independent variables, which then produce an output in the form of Operating Income.

Independent variables (inputs):

- *BOPO* (Operating Costs to Operating Income): Measures the efficiency of operational costs.
- *CAR* (Capital Adequacy Ratio): Measures the adequacy of a bank's capital.
- *LDR* (Loan to Deposit Ratio): Measures the effectiveness of credit disbursement to third-party funds.

Dependent variable (output):

- Operating Income: The bank's operating results that are the output of the first stage.

Phase 2 (Profitability Efficiency)

In stage 2, profitability efficiency is calculated using the results of Operating Income obtained from the calculation of Stage 1 to serve as the initial input of Stage 2. After the

calculation is carried out, a profitability value in the form of *ROA* will be obtained, which will then be used to calculate the total efficiency value of banks registered in *KBMI* 3 and 4.

Independent variable (input):

- Operating Revenue: The output from the first stage that is used as input for the second stage.

Dependent variable (output):

- *ROA* (Return on Assets): Measures the profitability of a bank based on the assets owned.

This study takes the population of banks that are classified as the Banks Group Based on Core Capital (*Kelompok Bank Berdasarkan Modal Inti*, *KBMI*) 3 and 4, namely banks with core capital exceeding IDR 14 trillion. The financial data sources used cover the period 2021 to 2024, starting from the time the *KBMI* system was implemented in the banking sector until the latest financial statements were issued. In this study, the sampling technique used is non-probability sampling with the purposive sampling method. The purposive sampling method is a sample selection technique based on certain characteristics that have been determined by the researcher in accordance with the predetermined inclusion criteria (Creswell & Creswell, 2018). The research samples used are as follows:

1. *KBMI* 3 and 4 companies during the 2021–2024 period.
2. *KBMI* 3 and 4 companies that publish complete quarterly financial statements for the 2021–2024 period.

This research utilizes secondary data in the form of quarterly financial statements. Secondary data is data obtained from available sources. Some of the secondary data sources used include official government publications, reports released by companies, previous research results, company websites, and data available online (Now & Bougie, 2017). This research uses the company's quarterly financial statement data published by the company and obtained directly from Copyright © Official Company.

This study uses data analysis techniques that include Network Data Envelopment Analysis to describe the efficiency level of the bank as well as panel data regression with the help of the Eviews 12 application to test the proposed hypothesis. The basis for the panel data regression analysis is to see the influence between independent and dependent variables.

RESULT AND DISCUSSION

Statistics Descriptive

Stage 1

Descriptive statistical analysis was used to determine the data overview of the results of *Network Data Envelopment Analysis (NDEA*) processing in Stage 1. In this study, the results of data description using descriptive statistics of Excel programs are presented in the following table:

Table 1. Operational Efficiency

Statistic	Stage 1: Operational Efficiency														
	2021				2022				2023				2024		
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
Mean	0.795	0.839	0.856	0.847	0.874	0.836	0.856	0.878	0.837	0.829	0.818	0.874	0.763	0.836	0.847
Median	0.742	0.861	0.879	0.834	0.834	0.879	0.920	0.894	0.905	0.838	0.802	1.000	0.851	0.866	0.846
Standard Deviation	0.179	0.157	0.140	0.124	0.181	0.167	0.149	0.121	0.179	0.177	0.155	0.159	0.237	0.173	0.136
Maximum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Minimum	0,501	0.532	0.602	0.548	0.527	0.479	0.538	0.629	0.455	0.425	0.485	0.579	0.120	0.503	0.612

Source: processed secondary data 2024

Based on the data contained in the table Phase 1: operational efficiency, the following is a descriptive statistical analysis:

1. **Average (Mean)**

   The average operational efficiency fluctuates from year to year, with the highest value in Q4 2022 at 0.877 and the lowest value in Q1 2024 at 0.763. In 2021, the average operational efficiency was in the range of 0.795 to 0.855. Entering 2022, this value increased slightly compared to the previous year, with a range of 0.801 to 0.877. However, in 2023 there was a slight decline, with the average ranging from 0.818 to 0.873. The year 2024 began with a significant decline in Q1 of 0.763, but increased again in Q2 and Q3 with values of 0.835 and 0.847, respectively. Overall, the average operating efficiency remained stable above 0.75, reflecting relatively good performance.

2. **Middle value (Median)**

   The median operational efficiency shows a pattern almost similar to the average, indicating a data distribution that tends to be symmetrical without many extreme outliers. The highest median value was recorded in Q4 2023 at 1,000, while the lowest value occurred in Q1 2021 with 0.742. Throughout 2021, the median increased from 0.742 in Q1 to 0.879 in Q3, before decreasing slightly to 0.834 in Q4. The upward trend continued in 2022, with the median peaking at 0.894 in Q4. The year 2023 showed fluctuations, but in Q4 it reached the 1,000 mark, indicating that there is some data that reaches maximum efficiency. Meanwhile, in 2024, the median will remain stable in the range of 0.846 to 0.866, reflecting a still fairly high performance.

3. **Standard Deviation**

   Standard deviation reflects the degree of variation in the data, where lower values indicate higher consistency. The highest value was recorded in Q1 2024 at 0.236, indicating a greater variation in the period. In contrast, the lowest value occurred in Q4 2022 with 0.121, indicating a higher level of stability. In 2021, the standard deviation tended to decrease from 0.178 in Q1 to 0.140 in Q3. The downward trend continued in 2022, with data variation getting smaller and reaching a low in Q4 of 0.121. Entering 2023, the standard deviation has increased slightly but remains relatively stable in the range of 0.155 to 0.176. Meanwhile, Q1 2024 showed a significant jump to 0.236, reflecting a considerable increase in variation in operational efficiency, likely due to external factors or policy changes.

4. **Maximum Value**

   The maximum value is always 1 in each quarter from 2021 to 2024. This means that there are entities that achieve perfect efficiency in every period.

5. **Minimum grade**

   The minimum value reflects the lowest level of efficiency achieved in a quarter. In Q3 2024, the highest minimum value was recorded at 0.612, while the lowest value occurred in Q1 2024 with 0.120. Throughout 2021, the minimum value was in the range of 0.501 to 0.602. In 2022, the variation was even greater with the lowest point occurring in Q2 of 0.475. The year 2023 showed smaller fluctuations than the previous year, with a minimum value range between 0.425 to 0.597. However, in Q1 2024, there was a drastic decrease to 0.120, which indicates the existence of entities with very low efficiency.

Stage 2

Descriptive statistical analysis was used to determine the data overview of the results of *Network Data Envelopment Analysis* (NDEA) processing in Phase 2. In this study, the results of data description using descriptive statistics of Excel programs are presented in the following table:

Table 2. Profitability Efficiency

Statistic	Stage 2: Efficiency Profitability														
	2021				2022				2023				2024		
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
Mean	0.131	0.214	0.175	0.196	0.206	0.180	0.507	0.459	0.175	0.180	0.507	0.449	0.196	0.450	0.503
Median	0.051	0.038	0.068	0.120	0.049	0.068	0.456	0.418	0.179	0.183	0.487	0.433	0.200	0.380	0.442

Standard Deviation	0.238	0.344	0.273	0.268	0.308	0.290	0.272	0.237	0.147	0.191	0.470	0.417	0.167	0.300	0.293
Maximum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.147	0.196	0.439	0.382	0.165	1.000	1.000
Minimum	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.152	0.204	0.422	0.373	0.170	0.000	0.000

Source: processed secondary data 2024.

The descriptive statistics in this table illustrate the development of profitability efficiency from 2021 to 2024 based on several parameters, namely Mean, Median, Standard Deviation, Maximum Value, and Minimum Value, which are recorded every quarter (Q1–Q4). This analysis aims to understand the trend of profitability efficiency in the period.

1. **Average Profitability Efficiency**

   The mean value indicates the average profitability efficiency in each quarter. In general, there was a significant increase from 2021 to 2022, particularly in Q3 and Q4 of 2022, where the average value increased to 0.507 and 0.459 compared to the previous quarter. This trend continues in 2023 and 2024, where average efficiency remains high, especially in Q3 2023 (0.507) and Q2-Q3 2024 (0.450 and 0.503). This increase shows an improvement in profitability efficiency in several periods, which can be caused by optimizing the company's financial performance.

2. **Middle Value (Median)**

   The median profitability efficiency tends to follow a similar pattern to the mean, reflecting a relatively symmetrical distribution of data. In 2021, the median value is still very low, with a range between 0.038 in Q2 to 0.120 in Q4. Entering 2022, there has been a significant increase, especially in Q3 (0.456) and Q4 (0.418), which indicates that more and more entities are achieving better levels of efficiency. This trend continued in 2023, where the highest median was recorded in Q3 (0.487) and Q4 (0.433). Meanwhile, in 2024, the median experienced a more stable increase, ranging from 0.200 in Q1 to 0.442 in Q3, which signifies increasingly even profitability across various entities. Overall, the year-over-year increase in median profitability reflects a broader increase in profitability efficiency.

3. **Data Dispersion (Standard Deviation)**

   Standard deviation reflects the degree of variation in profitability efficiency. In 2021, the variation was quite high with values ranging from 0.238 in Q1 to 0.344 in Q2, indicating a significant difference in efficiency between entities. Entering 2022, the variation began to decrease, especially in Q4 with a value of 0.237, which indicates a more uniform efficiency. 2023 is still subject to fluctuations in variation, with the highest spike in Q3 at 0.470, signaling a larger efficiency differential between entities. Meanwhile, in 2024, the variation increased in Q2 with a value of 0.300, but returned more stable in Q3 at 0.293. Overall, the variation in efficiency tends to decrease over time, indicating an increasingly consistent improvement trend.

4. **Maximum Value**

   The maximum value tends to be stable at 1,000 for most quarters, indicating that some entities are managing to achieve maximum profitability efficiency. However, in Q1 to Q3 of 2023, the maximum value experienced a significant decline, being in the range of 0.147 to 0.439, which indicates that no entity achieved full profitability efficiency during the period. Overall, despite the general increase in profitability efficiency, few entities are consistently able to achieve the maximum level of profitability efficiency.

5. **Minimum Score**

   The minimum value is generally at 0.000 for most quarters, except in a few periods in 2023 and 2024, where the value is slightly higher, ranging from 0.152 to 0.422. This indicates that there are still entities with very low or even zero profitability efficiency.

Overall, despite the increase in some quarters, the presence of entities with low profitability efficiency remains a concern to be considered in efforts to improve profitability.

Results of Network Data Envelopment Analysis (NDEA)

Based on *the Network Data Envelopment Analysis* (NDEA) analysis, there are total efficiency results from the total mean value presented as follows:

Table 3. Total Efficiency

No	Bank	Mean Total	Rank Total
1	PT Bank Mandiri (Persero) Tbk	0.424	4
2	PT Bank Rakyat Indonesia (Persero) Tbk	0.491	2
3	PT Bank Central Asia Tbk	0.545	1
4	PT Bank Negara Indonesia (Persero) Tbk	0.391	5
5	PT Bank Pan Indonesia Tbk	0.170	13
6	PT Bank Danamon Indonesia Tbk	0.471	3
7	PT Bank CIMB Niaga Tbk	0.410	6
8	PT Bank Permata Tbk	0.168	14
9	PT Bank SMBC Indonesia Tbk	0.172	12
10	PT Bank OCBC NISP Indonesia Tbk	0.210	11
11	PT Bank Maybank Indonesia Tbk	0.165	16
12	PT Bank Syariah Indonesia	0.370	6
13	PT Bank Tabungan Negara (Persero) Tbk	0.246	9
14	PT Bank Mega Tbk	0.439	7
15	PT Bank Mayapada Internasional Tbk	0.000	17
16	PT Bank Pembangunan Daerah Jawa Barat dan Banten	0.157	15
17	PT Bank HSBC Indonesia	0.299	8

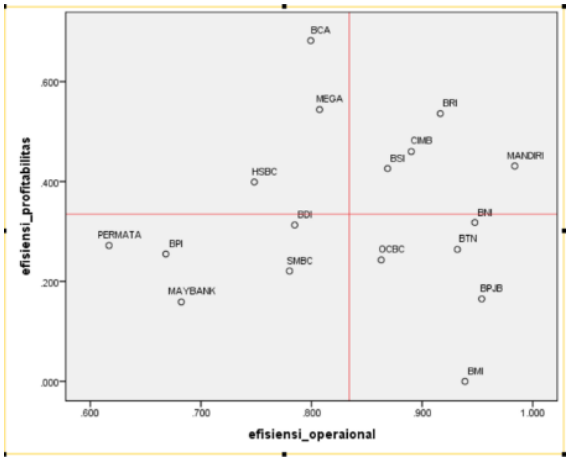

Figure 3. Total Efficiency Graph

Stage 1

The results of the analysis using *Network Data Envelopment Analysis* (NDEA) obtained the results of operational efficiency in the processing *of Capital Adequacy Ratio* (CAR), Operating Expenses (BOPO), *Loan to Deposit* Ratio (LDR), and Operating Income with the following results:

Table 4. NDEA Operational Efficiency Table

No	Bank	Stage 1 : EFFICIENCY OPRASIONAL															MEAN	RANK
		2021				2022				2023				2024				
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3		
1	PT Bank Mandiri (Persero) Tbk	0.990	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.895	0.871	1.000	1.000	1.000	1.000	0.984	1
2	PT Bank Rakyat Indonesia (Persero) Tbk	1.000	0.975	0.879	0.911	0.818	0.828	1.000	0.881	1.000	0.796	0.935	1.000	0.905	0.973	0.846	0.916	6
3	PT Bank Central Asia Tbk	0.742	0.819	1.000	0.802	1.000	0.766	0.792	0.816	0.744	0.763	0.726	0.720	0.776	0.762	0.761	0.799	11
4	PT Bank Negara Indonesia (Persero) Tbk	1.000	1.000	1.000	0.996	0.897	0.942	0.993	0.980	1.000	0.838	0.762	1.000	0.899	0.908	1.000	0.948	3
5	PT Bank Pan Indonesia Tbk	0.562	0.779	1.000	0.548	0.527	0.613	0.571	1.000	0.520	0.473	0.802	0.680	0.517	0.608	0.824	0.668	16
6	PT Bank Danamon Indonesia Tbk	0.618	1.000	0.659	0.773	1.000	1.000	0.922	0.754	0.686	0.800	1.000	0.664	0.595	0.630	0.671	0.785	12
7	PT Bank CIMB Niaga Tbk	1.000	1.000	1.000	0.795	1.000	0.924	0.846	0.888	0.905	1.000	0.662	1.000	0.729	0.813	0.791	0.890	7
8	PT Bank Permata Tbk	0.501	0.532	1.000	0.575	0.664	0.475	0.538	0.629	0.455	0.425	0.485	1.000	0.472	0.503	1.000	0.617	17
9	PT Bank SMBC Indonesia Tbk	0.675	0.668	0.652	0.834	0.609	0.879	0.892	0.779	0.679	0.710	0.705	0.799	1.000	1.000	0.820	0.780	13
10	PT Bank OCBC NISP Indonesia Tbk	1.000	0.759	0.743	0.711	0.665	0.775	0.782	0.938	0.850	1.000	1.000	1.000	0.851	1.000	0.871	0.863	9
11	PT Bank Maybank Indonesia Tbk	0.710	0.706	0.602	0.817	0.597	0.606	0.745	0.676	0.679	0.734	0.719	0.597	0.851	0.583	0.612	0.682	15
12	PT Bank Syariah Indonesia	0.728	0.861	0.780	1.000	1.000	0.985	1.000	0.920	0.927	1.000	1.000	1.000	0.120	0.855	0.856	0.869	8
13	PT Bank Tabungan Negara (Persero Tbk)	0.908	1.000	0.920	1.000	0.912	1.000	0.920	1.000	0.828	0.846	0.778	1.000	1.000	0.866	1.000	0.932	5
14	PT Bank Mega Tbk	0.594	0.754	0.740	0.809	0.665	0.742	1.000	0.767	1.000	0.820	1.000	0.784	0.778	1.000	0.656	0.807	10
15	PT Bank Mayapada Internasional Tbk	0.792	0.921	0.860	0.915	0.804	0.989	0.946	1.000	0.990	1.000	1.000	1.000	0.864	1.000	1.000	0.939	4
16	PT Bank Pembangunan daerah Jawa Barat dan Banten	1.000	0.914	0.920	0.920	0.945	1.000	0.920	0.894	1.000	1.000	0.824	0.971	1.000	1.000	1.000	0.954	2
17	PT Bank HSBC Indonesia	0.701	0.568	0.789	1.000	0.530	0.682	0.685	1.000	0.962	1.000	0.641	0.640	0.621	0.708	0.697	0.748	14

Source : NDEA output, secondary data processed in 2024

Based on the results of the table above, it is obtained that the operational efficiency of banks in the list is measured based on the Mean value, where the higher the value, the better the level of operational efficiency of the bank in managing its resources and operations. From the results of the analysis, PT Bank Mandiri (Persero) Tbk ranks first with a Mean value of 0.984, showing that this bank has the highest level of efficiency compared to other banks. In addition, several other banks that also show a high level of operational efficiency and are in the top five are PT Bank Negara Indonesia (Persero) Tbk, PT Bank Pembangunan Daerah Jawa Barat dan Banten, PT Bank Mayapada Internasional Tbk, and PT Bank Tabungan Negara (Persero) Tbk. This reflects the success of these banks in optimizing their operational management.

Meanwhile, banks that are in the category of high operational efficiency but are not included in the top five, such as PT Bank Rakyat Indonesia (Persero) Tbk, PT Bank CIMB Niaga Tbk, PT Bank Syariah Indonesia, and PT Bank OCBC NISP Indonesia Tbk, showed quite good performance with a MEAN value between 0.86 to 0.91. Although their operational efficiency is already quite high, there is still an opportunity to improve the effectiveness of resource management in order to compete with banks with better ratings. PT Bank Mega Tbk, which ranked 10th with a MEAN value of 0.807, also showed quite good operational efficiency, although it was still below banks with higher operational efficiency.

On the other hand, banks that are in the medium operational efficiency category include PT Bank Central Asia Tbk, PT Bank SMBC Indonesia Tbk, PT Bank Danamon Indonesia Tbk, and PT Bank HSBC Indonesia, which have a Mean value ranging from 0.74 to 0.80. Although their operational efficiency is still in the category of being quite good, the banks in this group still have room to make improvements in operational optimization to be more competitive in the banking industry. PT Bank HSBC Indonesia, as one of the foreign banks on this list, ranks 14th with a Mean value of 0.748, which shows that its operational efficiency is still below some national banks.

In the lowest operational efficiency category, there are three banks that have a Mean value below 0.70, namely PT Bank Maybank Indonesia Tbk, PT Bank Pan Indonesia Tbk, and PT Bank Permata Tbk. PT Bank Permata Tbk has the lowest operational efficiency value with a Mean of 0.617, which indicates that this bank faces a major challenge in improving its operational effectiveness. Banks in this category need to evaluate their management and cost management strategies in order to improve their operational efficiency and competitiveness in the banking industry.

Overall, government-owned banks or state-owned banks such as Bank Mandiri, BNI, BRI, and BTN tend to show higher operational efficiency compared to some private and foreign banks. This advantage can be attributed to the larger scale of the economy, support from the government, as well as success in digital transformation and optimization of banking services. However, private and foreign banks also have the potential to improve their operational efficiency through technological innovation, business process improvement, and cost management optimization in order to compete more effectively in the banking sector.

In addition, based on the average value of each quarter, the operational efficiency of KBMI 3 and 4 banks shows a trend that varies from 2021 to 2024. In 2021, efficiency increased gradually from the first quarter (0.795) to peak in the third quarter (0.856), although it decreased slightly in the fourth quarter (0.847). The year 2022 recorded significant improvements with higher efficiency, especially in the fourth quarter (0.878), demonstrating effectiveness in operational management and increased revenue. The year 2023 maintained a relatively stable level of efficiency despite a decline in the third quarter (0.818), which then increased again in the fourth quarter (0.874). However, in 2024, there was a decrease in efficiency in the first quarter (0.763) which was likely due to increased operating costs or adjustments to the strategy at the beginning of the year. Even so, efficiency managed to recover in the second and third quarters, close to the previous year's level. In general, the first quarter tends to show lower efficiency than other quarters, while the fourth quarter often records the highest efficiency, indicating the bank's efforts to maximize annual performance. To continuously improve efficiency, banks are advised to evaluate operational strategies at the beginning of the year, adopt best practices from the periods of highest efficiency, and proactively strengthen cost controls.

Stage 2

Based on the results of the analysis using *Network Data Envelopment Analysis* (NDEA), profitability efficiency results were obtained in the processing of efficiency results in Phase 1 with *Return on Asset (ROA)* which provides the following output results.

Table 5. NDEA Profitability Efficiency Table

Bank	Stage 2 : EFFICIENCY PROFITABILITAS															MEAN	RANK
	2021				2022				2023				2024				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3		
PT Bank Mandiri (Persero) Tbk	0.152	0.093	0.370	0.720	0.176	0.118	0.839	0.578	0.102	0.118	0.839	0.720	0.120	0.760	0.760	0.431	5
PT Bank Rakyat Indonesia (Persero) Tbk	0.051	0.105	0.631	0.720	0.107	0.055	0.777	0.875	0.727	0.055	0.777	0.720	0.760	0.784	0.894	0.536	3
PT Bank Central Asia Tbk	1.000	0.429	0.555	1.000	1.000	0.096	1.000	0.704	0.146	0.096	1.000	1.000	0.205	1.000	1.000	0.682	1
PT Bank Negara Indonesia (Persero) Tbk	0.036	0.042	0.370	0.540	0.138	0.068	0.720	0.393	0.060	0.068	0.720	0.540	0.089	0.418	0.570	0.318	8
PT Bank Pan Indonesia Tbk	0.037	0.027	0.370	0.529	0.030	0.015	0.456	0.385	0.044	0.015	0.456	0.529	0.154	0.311	0.463	0.255	12
PT Bank Danamon Indonesia Tbk	0.333	1.000	0.280	0.545	0.026	0.020	0.365	0.513	0.031	0.020	0.365	0.545	0.067	0.302	0.284	0.313	9
PT Bank CIMB Niaga Tbk	0.018	0.667	0.370	0.540	0.667	0.176	0.830	0.433	0.068	0.176	0.830	0.540	0.164	0.704	0.722	0.460	4
PT Bank Permata Tbk	0.056	1.000	0.185	0.180	0.033	0.028	0.372	0.306	0.035	0.028	0.372	0.180	0.170	0.760	0.380	0.272	10
PT Bank SMBC Indonesia Tbk	0.123	0.020	0.569	0.225	0.049	0.015	0.514	0.494	0.047	0.015	0.514	0.225	0.080	0.190	0.232	0.221	14
PT Bank OCBC NISP Indonesia Tbk	0.067	0.022	0.500	0.360	0.051	0.017	0.365	0.410	0.200	0.017	0.365	0.360	0.094	0.380	0.437	0.243	13
PT Bank Maybank Indonesia Tbk	0.111	0.000	0.308	0.300	0.049	0.100	0.253	0.283	0.023	0.100	0.253	0.300	0.000	0.000	0.311	0.159	16
PT Bank Syariah Indonesia	0.023	0.031	0.474	0.360	0.022	1.000	0.365	0.418	0.083	1.000	0.365	0.360	1.000	0.442	0.442	0.426	6
PT Bank Tabungan Negara (Persero Tbk)	0.000	0.000	0.200	0.180	0.286	0.500	0.234	0.193	1.000	0.500	0.234	0.180	0.040	0.218	0.190	0.264	11
PT Bank Mega Tbk	0.143	0.133	1.000	0.692	0.048	0.750	0.730	1.000	0.091	0.750	0.730	0.692	0.154	0.380	0.864	0.544	2
PT Bank Mayapada Internasional Tbk	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	17
PT Bank Pembangunan daerah Jawa Barat dan Banten	0.025	0.033	0.402	0.186	0.024	0.017	0.223	0.433	0.286	0.017	0.223	0.186	0.040	0.190	0.190	0.165	15
PT Bank HSBC Indonesia	0.044	0.038	0.468	0.563	0.800	0.077	0.570	0.385	0.025	0.077	0.570	0.563	0.194	0.803	0.814	0.399	7

Based on the analysis of Phase 2, the profitability efficiency for the 2021–2024 period is PT Bank Central Asia Tbk (BCA) which ranks first with an average of 0.682, showing the highest profitability efficiency and strong performance consistency, especially with several quarters reaching a value of 1,000. In second place, PT Bank Mega Tbk has an average of 0.544, with a fairly good efficiency performance, despite fluctuations in several quarters. PT Bank

Rakyat Indonesia (Persero) Tbk (BRI) is ranked third with the same average, which is 0.536, and shows a fairly stable trend of increasing profitability efficiency in recent years.

In fourth position, PT Bank CIMB Niaga Tbk with an average of 0.460 showed a significant improvement in profitability efficiency, especially in 2022 and 2023 with high values in several quarters. PT Bank Mandiri (Persero) Tbk ranks fifth with an average of 0.431, recording a significant increase since 2022, especially in the last quarters with a value of 0.760. PT Bank Syariah Indonesia also has an average of 0.426, with stable performance and the achievement of a maximum efficiency of 1,000 in several quarters, indicating increased competitiveness in the Islamic banking sector.

PT Bank HSBC Indonesia is ranked seventh with an average of 0.399, showing quite high fluctuations but still having a quarter with excellent performance. PT Bank Negara Indonesia (Persero) Tbk (BNI) followed in eighth place with an average of 0.318, recording a small increase every year without a major surge. PT Bank Danamon Indonesia Tbk was ranked ninth with an average of 0.313, had a significant surge in Q2 2021 with a value of 1,000, but its performance declined after that. PT Bank Permata Tbk ranks tenth with an average of 0.272, showing a similar trend to the initial surge but less consistent in the long term.

At the bottom, PT Bank Tabungan Negara (Persero) Tbk (BTN) occupies the 11th position with an average of 0.264, followed by PT Bank Pan Indonesia Tbk in 12th place with 0.255, and PT Bank OCBC NISP Indonesia Tbk in 13th place with 0.243. Meanwhile, PT Bank SMBC Indonesia Tbk occupies the 14th position with an average of 0.221, followed by PT Bank Pembangunan Daerah Jawa Barat dan Banten in the 15th position with 0.165. PT Bank Maybank Indonesia Tbk is ranked 16th with 0.159, while PT Bank Mayapada Internasional Tbk recorded a value of 0.000, indicating that the bank did not show profitability efficiency during the period analyzed.

Overall, BCA, Bank Mega, and BRI remain leaders in profitability efficiency, followed by CIMB Niaga and Bank Mandiri which also show high competitiveness. In contrast, Bank Mayapada Internasional recorded the lowest performance because it did not have the profitability efficiency seen over the past four years. Some banks, such as Danamon and Permata, had experienced significant spikes but struggled to maintain consistency. Islamic banking is also starting to show good competitiveness, with Bank Syariah Indonesia in the top six. To increase competitiveness in the future, banks with fluctuating values need to focus on improving profitability efficiency and more stable in order to be able to survive in the competition of the banking industry.

Based on bank profitability efficiency data from 2021 to 2024, there are several patterns that can be analyzed. In 2021, profitability efficiency tends to be low, with the highest value in the second quarter (0.214) before declining in the third quarter (0.175) and increasing slightly in the fourth quarter (0.196). This reflects the challenge of maintaining profitability throughout the year.

Entering 2022, there was a significant improvement, especially in the third quarter (0.507) and fourth quarter (0.459). This increase shows the bank's ability to take advantage of market opportunities and manage operational costs more efficiently. 2023 showed a relatively stable pattern in the second (0.18) and third (0.507) quarters, but decreased slightly in the fourth quarter (0.449). This consistency reflects a fairly effective operational strategy despite the challenges at the end of the year. In 2024, a significant jump is seen in the second quarter (0.45) compared to previous years, although efficiency in the third (0.503) and fourth (0.503) is likely to be stagnant.

A sharp increase in the second quarter could be an indication of a strategy improvement or a substantial increase in operating income. However, the stagnation at the end of the year indicates the need for further evaluation of the sustainability of the profitability strategy. To increase profitability efficiency in a sustainable manner, banks are advised to focus on

optimizing cost structures, diversifying revenue sources, and implementing innovations in financial services. In addition, periodic monitoring of profitability indicators on a quarterly basis can help identify potential improvements early.

Hypothesis Testing

The following are the tests conducted to determine the best estimation model:

1. Chow Test

The Chow test was used to determine whether the panel data regression model used was more in line with the Common Effect Model or Fixed Effect Model method. The test results are as follows:

Table 6. Chow Test Results

Effects Test	Statistic	d.f.	Prob
Cross-section F	86.468412	(16.252)	0.0000
Cross-section Chi-square	508713835	16	0.0000

Source : Output Eviews 12, processed secondary data 2025.

Based on the results of the chow test, it shows that the chi-square probability value is 0.0000 which is less than 0.05 so it can be concluded that the best model chosen is the *fixed effect model*.

2. Hausman Test

This test aims to choose between *a fixed effect model* or *a random effect model*. Here are the results of the Hausman test:

Table 7. Hausman Test Results

Correlated Random Effects – Hausman Test
Equation: Untitled
Test Cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob
Cross-section random	68.220292	3	0.0000

Source: Eviews Data Processing Results Version 12, 2025.

Based on the above output, the probability value is 0.0000 which is below the number 0.05. Therefore, *the fixed effect* model is the best model chosen for panel data regression. Because in the thirst test, *the fixed effect model* is selected as the best model, so the lm test does not need to be done.

Panel Data Regression Analysis

Based on the results of the panel data regression model selection that has been carried out, *the Fixed Effect Model* (FEM) was chosen as the model used in the panel data regression analysis in this study. The results of the regression of panel data in this study are as follows:

Table 8. Regression Results *Fixed Effect Model*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.390916	0.179409	2.178909	0.0303
X1	-0.035319	0.002499	-14.13295	0.0000
X2	0.079757	0.009040	8.822685	0.0000
X3	0.027837	0.002686	10.36375	0.0000

Source : Output Eviews 12, processed secondary data 2025.

Based on the results of the *fixed effect regression model* in the table above, the regression model equation can be obtained as follows:

Return on Assets= 0.390916 – 0.035319X1 + 0.079757X2 + 0.027837X3 + e

Coefficient of Determination

The results of the determination coefficient test are as follows:

Table 9. Determination Coefficient Test Results

R-squared	0.926
Adjusted R-squared	0.920

Source : Output Eviews 12, processed secondary data 2025.

The *r-squared* value for this study model of 0.926 indicates that the contribution of BOPO, CAR and LDR variables to *Return on Assets* is 92.61%, while the remaining 7.4% is explained by other variables outside the variables used in this study.

Test F

The results of the simultaneous test in this study are as follows:

Table 10. Simultaneous Test Results

F-Statistic	166.1298
Prob (F-statistic)	0.000000

Source : Output Eviews 12, processed secondary data 2025.

The results of the simultaneous test showed a statistical probability value of 0.000000 which is smaller than the significance value of 0.05 so that the variables BOPO, CAR and LDR simultaneously affect operational efficiency.

T test

The following are the results of the partial test in this study:

Table 11. Partial Test Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.390916	0.179409	2.178909	0.0303
X1	-0.035319	0.002499	-14.13295	0.0000
X2	0.079757	0.009040	8.822685	0.0000
X3	0.027837	0.002686	10.36375	0.0000

Source : Output Eviews 12, processed secondary data 2025.

Based on the results of the partial test, it shows that the variables BOPO, CAR and LDR partially affect operational efficiency.

Hypothesis Test

1. The Effect of Operating Costs on Operating Income on *Return on Assets*
   The results of the partial test with a probability value of 0.000, which is smaller than the significance level of 0.05, with a coefficient of -0.035319. Therefore, the first hypothesis is acceptable.
2. The Effect of *Capital Adequacy Ratio* on *Return on Assets*
   The results of the partial test on *the Capital Adequacy Ratio* variable showed a probability value of 0.000, which is smaller than the significance level of 0.05, with a coefficient of 0.079757. Thus, the second hypothesis is accepted.
3. The Effect of *Loan to Deposit Ratio* on Operational Efficiency
   The results of the partial test on the *Loan to Deposit Ratio* variable showed a probability value of 0.000, which is smaller than the significance level of 0.05, with a coefficient of 0.027837. Therefore, the third hypothesis is acceptable.

Overview of Operational Efficiency and Profitability Efficiency in Banks Included in KBMI 3 and 4

Based on the data in the table, the total efficiency measured through the Mean Total reflects the efficiency level of each bank. The higher the Total Mean value, the better the operational efficiency in generating profitability. Based on the ranking results, PT Bank Central Asia Tbk (BCA) occupies the first position with the highest total average value (0.545), showing superior performance compared to other banks. BCA's dominance can be attributed to its solid business strategy, rapid technology adoption, and good customer service, which makes it the largest private bank in Indonesia. In second place, PT Bank Rakyat Indonesia (Persero) Tbk (BRI) with a value of 0.491 also showed strong competitiveness, especially because of its focus on the MSME segment which has become a mainstay in supporting financial performance. PT Bank Mega Tbk is in third place with a value of 0.439, indicating that this bank has quite good competitiveness despite competing with other large banks.

Meanwhile, PT Bank Mandiri (Persero) Tbk is ranked fourth with a value of 0.424, which still reflects its strong position as one of the largest banks in Indonesia. On the other hand, PT Bank Negara Indonesia (Persero) Tbk (BNI) and PT Bank Tabungan Negara (Persero) Tbk (BTN) are ranked seventh and ninth, respectively. This shows the differences in strategies and challenges faced by each bank in maintaining their competitiveness. PT Bank Syariah Indonesia (BSI), as the largest Islamic bank, ranks sixth with a value of 0.370, which indicates the great potential of the Islamic banking sector in Indonesia.

On the other hand, lower-ranked banks, such as PT Bank Maybank Indonesia Tbk (ranked 16th) and PT Bank Mayapada Internasional Tbk (ranked 17th with a value of 0.000), showed challenges in maintaining competitiveness and business growth. Factors such as business scale, business strategy, service innovation, and financial condition can be major factors affecting their rankings.

Overall, these results reflect stiff competition in Indonesia's banking sector, where large banks with a wide customer base and strong business strategies tend to rank higher. Lower-performing banks need to improve operational efficiency, strengthen digital strategies and expand market share to better compete in this increasingly competitive industry.

The Effect of BOPO, CAR and LDR Ratios on *Return on Assets*

Based on the results of data processing using panel data regression analysis, it was concluded that the BOPO ratio had a significant negative effect on *Return on Assets* BOPO has a significant negative effect on *Return on Assets*. indicates that the higher the operating costs incurred by the company compared to its operating income, the lower the level of profitability generated. In theory, this relationship can be explained through an operational efficiency approach. According to the theory of efficiency, companies that are able to effectively control operational costs will have larger profit margins, thus increasing ROA as an indicator of financial performance (Alber et al., 2019). In contrast, high BOPO reflects inefficiencies in managing operational resources, which erodes net profit and reduces the company's ability to utilize assets to generate profits. In addition, agency theory is also relevant in this context, where inefficient management in managing operations can worsen the company's performance. Therefore, controlling operational costs through efficiency strategies is crucial to increase profitability and improve ROA. This significant negative relationship confirms that companies need to optimize their operating cost structure in order to maximize returns on their assets. The results of this study are in line with the results of research conducted by Adhim (2022) and Tika Sari et al. (2022) who stated that ROA can be influenced by BOPO.

Based on the results of data processing using panel data regression analysis, it is concluded that the CAR ratio has a significant positive effect on *Return on Assets*.

Capital Adequacy Ratio (CAR) which has a positive effect on Return on Assets (ROA) shows that the higher the capital level of a company, especially a bank, the better its financial performance. The higher the CAR, the stronger the bank's capital position in bearing credit, operational, and market risks, which can ultimately improve efficiency in resource management (Ullah et al., 2023). This is in line with efficiency theory, where effective use of capital and optimal resource allocation can increase the bank's productivity without significantly increasing operational costs (Hughes & Mester, 2012). Sufficient capital also allows banks to optimize their business strategies without relying on high-cost external funding sources.

With a healthy capital structure, banks can reduce interest costs and increase the effectiveness of credit disbursement, thereby increasing efficiency in obtaining income. In addition, banks with high CARs tend to have greater trust from customers and investors, which can expand access to low-cost funds and improve liquidity, thereby reducing operational pressures. In theory, this relationship can also be explained through capital *theory* which states that adequate capital provides a greater ability for companies to absorb risks and face uncertainty. Strong capital also allows the company to expand its operational activities, provide larger loans, and increase interest income, which ultimately has a positive impact on profitability

The findings of this study are in line with previous studies by Lotto (2018) which states that CAR has a positive and significant influence on *return on assets* banks in Tanzania. A study conducted by Ayuni & Situmorang (2022) also found that banks with high CAR tend to have a larger ROA because they are able to allocate their capital more effectively in profitable business activities. Another study by Blessky et al. (2023) also revealed that larger capital provides room for banks to take on higher risks while remaining under good control, thereby increasing overall profitability.

Based on the results of the panel data regression analysis, it can be concluded that *Loan to Deposit Ratio* (LDR) has a significant positive influence on *Return on Assets,* It shows that the higher the proportion of third-party funds disbursed as credit, the greater the bank's potential to generate revenue and increase profitability. This significant influence occurs because LDR reflects the bank's effectiveness in allocating funds obtained from deposits into productive credit. The more optimal the LDR, the more efficient the bank will be in managing its funds, thereby increasing revenue from financing activities (Otoo et al., 2023). Banks that are able to distribute credit in a balanced proportion to third-party funds will be more efficient in their operations, as the interest income earned can cover operational costs and increase profitability.

This is in line with efficiency theory, where the bank's ability to optimally manage resources aims to reduce costs while increasing revenue (Hughes & Mester, 2012). A well-managed LDR can reduce risk *idle funds*, namely unemployed funds that are not used optimally. If too many funds are deposited in the form of liquidity without being channeled as credit, then banks will experience inefficiencies in their operations, because they still have to bear the cost of funds without getting optimal returns. Conversely, if the LDR is too high without good credit risk management, banks may face liquidity risks that negatively impact operational stability. Therefore, balance in LDR is a key factor in improving *return on assets bank*.

In theory, this relationship can also be explained through the theory of financial intermediation, which states that banks function as intermediaries between parties who have surplus funds and those who need funds. When the LDR increases, banks make optimal use of the funds raised to distribute credit, which is the main source of interest income. High net interest income contributes directly to the increase in net profit, thus improving ROA as an indicator of asset use efficiency in generating profits

The results of this study are in line with the results of research conducted by Dsouza et al. (2022) who found that banks with higher LDRs tended to have better ROAs, as they were able to utilize third-party funds more productively. Similar results were also found in the study

of Blessky et al. (2023), which revealed that the optimization of credit distribution has a direct correlation with an increase in bank profitability.

CONCLUSION

Based on the results of the analysis and discussion that have been carried out, it can be concluded as follows: 1) Based on the results of the analysis using Network Data Envelopment Analysis (NDEA), it is known that PT Bank Mandiri (Persero) Tbk has the highest level of operational efficiency in the *KBMI* 3 and 4 categories, while PT Bank Permata Tbk shows the lowest operational efficiency. Meanwhile, in terms of profitability efficiency, PT Bank Central Asia Tbk recorded the highest value, while PT Bank Maybank Indonesia Tbk had the lowest level of profitability efficiency. As for total efficiency, PT Bank Central Asia Tbk remains the most efficient, while PT Bank Maybank Indonesia Tbk is in the lowest position. 2) There is an effect of the ratios of *BOPO*, *CAR*, and *LDR* on Return on Assets in banks included in *KBMI* 3 and 4.

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