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Research article

Efficiency of Indonesia's Regional Development Banks: Evidence from a Non-Parametric Data Envelopment Analysis Method

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Abstract: This study aims to determine the level of performance efficiency of Regional Development Banks in Indonesia. This study uses Data Envelopment Analysis with a non-parametric Banker-Charnes-Cooper model approach to investigate variable return to scale, variable projections, and panel data regression. Input variables include third-party funds, non-interest expenses, interest expenses, and employee costs, while output variables include loans, interest income, and operating income apart from interest with control variables namely net interest margin, operating costs to operating income, loan-to-deposit ratio, and capital adequacy ratio. The findings show that net interest margin, operational costs on operational income, loan-to-deposit ratio, and capital adequacy ratio have a positive and significant effect on the efficiency of Regional Development Banks in Indonesia. However, we found that on average Regional Development Banks in Indonesia were still not efficient in carrying out their operational activities, although some showed quite good performance in the IRS, CRS, and DRS situations during the observation period which had implications for the performance of Regional Development Banks which was not yet optimal.

Keywords: DEA, efficiency, regional development banks, panel data regression

JEL Classification: B26, C58, G21

Abstrak: Studi ini bertujuan untuk mengetahui tingkat efisiensi kinerja Bank Pembangunan Daerah di Indonesia. Studi ini menggunakan Data Envelopment Analysis dengan pendekatan Non Parametrik model Banker-Charnes-Cooper untuk mengetahui variable return to scale, proyeksi variabel, dan regresi data panel. Variabel input meliputi dana pihak ketiga, beban non bunga, beban bunga, dan biaya pegawai, sementara variabel output meliputi pinjaman, pendapatan bunga, pendapatan operasional selain bunga dengan variabel kontrol yaitu margin bunga bersih, biaya operasional pada pendapatan operasional, rasio pinjaman terhadap simpanan, rasio kecukupan modal. hasil temuan menunjukkan bahwa net interest margin, biaya operasional pada pendapatan operasional, loan to deposit ratio, dan capital adequacy ratio berpengaruh positif dan signifikan terhadap efisiensi Bank Pembangunan Daerah di Indonesia. Meskipun demikian kami menemukan bahwa rata-rata Bank Pembangunan Daerah di Indonesia masih belum efisien dalam menjalankan kegiatan operasionalnya, meskipun sebagian menunjukkan kinerja yang cukup baik berada pada situasi IRS dan CRS, dan DRS selama periode pengamatan yang berimpikasi terhadap kinerja Bank Pembangunan Daerah belum optimal.

Kata Kunci: DEA, efisiensi, bank pembangunan daerah, regresi data panel

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1. INTRODUCTION

As the foundation of the financial system, banks play a crucial role in supporting it. According to Nguyen and Pham (2021), the role in question is that of an intermediary for the transfer of funds from surplus units to deficit units. That is, the bank gives credit to those who lack money after first collecting money from parties who have extra money as public deposits (Third Party Funds) (Diallo, 2018). Banks act as financial intermediaries, aiming to boost government, individual, and business production capacity, resulting in wealth effects through bank-approved credit for households, businesses, and the government (Silva et al., 2017). Credit is provided to entrepreneurs to boost production capacity, while households are credited for investments or consumption, allowing the government to increase fiscal space for public welfare (Partovi & Matousek, 2019). Banks facilitate money transfers between surplus and deficit parties, facilitate international transactions, and provide banking services and investment facilities (Izzeldin et al., 2021). Bank services, including transfers, simplify the process of sending money and provide both short and long-term investment products. They are essential for both domestic and international transactions, as distance factors and monetary policies can complicate international transactions. The existence of a bank facilitates easier settlement (Shafron, 2019).

Researchers focus on banking analysis due to the increasing number of banks, indicating the industry's development and community funding needs, as noted by Kamarudin et al. (2019). Meanwhile, the study by Singh & Bansal (2017) states that the more banks, the potentially more competitive, because these banks are always trying to compete for more market share. The bank pays attention to the level of banking efficiency and soundness because a wider range of bank markets indicates being able to compete in the banking business (Haralayya & Aithal, 2021). The second issue is that in recent years, it can be said that the banking industry has been quite affected by the shock of the COVID-19 pandemic, which can cause instability in the financial system (Lawrence et al., 2021). The COVID-19 pandemic can trigger public panic in the banking system, also known as bank panic. Under these conditions, people massively withdraw their funds from banks on a large scale (Xiazi & Shabir, 2022).

The Indonesian banking industry faces issues with various types of banks, including the Regional Development Bank (BPD), which must address the increasing aggressiveness of commercial banks (State-owned enterprises, private banks, and foreign banks) in their intermediary function in the regions (Abidin et al., 2021). According to Saragih (2017), Intense competition drives BPDs to maintain stable financial performance to become regional leaders. Expanding outside their territory is challenging, especially for banks with small assets and limited ability, making it difficult to expand beyond their territory. Therefore, to strengthen its function as an intermediary institution, BPD needs to improve efficiency performance (Sintha, 2020). Another problem was revealed by Herdhayinta & Supriyono (2019), namely BPD's high net interest margin (NIM) is considered inefficient, potentially hindering capital circulation for micro, small, and medium sectors in the area. This could lead to a lack of willingness to borrow funds from BPD, disrupting its role as an intermediary institution in the region (Sangadji, 2018).

The Financial Services Authority (OJK) noted that the NIM of state-owned banks from 2017 to 2021 averaged 5.32%. BPDs NIM from 2017 to 2021 averaged 6.03%, while NIM for National Private Banks from 2017 to 2021 averaged 4.43%, where BPDs NIM was recorded to be very high. NIM that is too high is often associated with inefficiency in the banking system, this inefficiency occurs because banks charge higher lending rates to customers. Therefore, BPD needs to evaluate the bank in dealing with risks that might occur in interest rates so that stability will be achieved in the Net Interest Margin (Wulandari & Ryandono, 2020). The average bank performance based on credit growth from 2017 to 2021, State-Owned Banks achieved a credit growth of 8.40%, Regional Development Banks achieved a credit growth of 6.20%, and national private banks achieved a credit growth of 8.40%. This shows that the results of BPD NIM which are too high will affect the growth of loans extended. If credit growth is too low, it is feared that it will cause the risk of an increase in the ratio of non-performing loans. Credit risk, which is proxied through a comparison of general reserves for non-performing loans with higher gross loans, increases Net Interest Margin, so the

implication is that bank policies are needed to implement steps, especially in increasing security and efficiency in the interbank competition system (Arif, 2019).

The COVID-19 pandemic that rocked Indonesia has had an impact on all aspects of life including the economic sector, this is a challenge for all business sectors in various regions. The outbreak of the COVID-19 pandemic in Indonesia has had many impacts on all sectors of life, both from an economic, social, political, and even cultural perspective. The same is true of the economic sector where this economic sector is considered the heart of a country's economy, especially the banking sector (Adeabah & Andoh, 2020). When the COVID-19 pandemic occurred, the banking sector experienced considerable challenges. Situations like this have a very depressing effect on the banking sector industry (Ningsih & Mahfudz, 2020). The ongoing COVID-19 pandemic is a challenge for all business sectors in various regions. The severe impact of this pandemic has also encouraged the financial sector, especially the BPDs, to play an active role in revitalizing the regional economy (Putri et al., 2023).

BPD experienced an increase in non-interest Operating Expenses during 2018-2021. The highest increases occurred in 2020 and 2021, namely IDR.652.690 billion and IDR.716.871 billion. This shows that the COVID-19 pandemic that rocked Indonesia had an impact on BPD's non-operational expenses. This condition is a challenge for BPD in Indonesia (Adeabah & Andoh, 2020). Situations like this have a very worrying effect on the banking sector industry (Ningsih & Mahfudz, 2020). The impact of the increase in non-interest operating expenses is that if the bank's expenses are greater than its income, the bank will suffer losses and will close its business unit divisions, so this increase requires bank management to work hard in managing efficient non-interest operating expenses (Rusdiansyah & Hayat, 2022).

Bank efficiency is one of the important indicators to analyze the performance of a bank. Efficiency can be seen from 2 sides, namely in cost efficiency and profits. Bank efficiency is not only an important indicator in banking but also an important tool to further increase the effectiveness of monetary policy (Adusei, 2016). A sound and sustainable banking system is the backbone of the financial sector in a credit-based economy (Antil et al., 2020). Therefore, banks measure the ability to transform inputs into financial products and services (Zhuang et al., 2019). A bank must take rational action and efficiency is a factor that must be considered (Hutama & Prasetyo, 2016). Bank efficiency is important to know the port structure or operational costs of the bank so that it can explore the existence of resources more effectively and efficiently when carrying out the role of being an intermediary institution. If a bank is efficient, then there is hope for increased profitability, this will make the amount of funds disbursed greater (Rumiasih & Enayatullah, 2018).

Efficiency measurements must consider any cost adjustments related to changes in variable inputs (Tsionas & Mamatzakis, 2017). Under conditions of a certain level of competition, banks as financial intermediaries are required to be able to operate efficiently. On the other hand, from a macroeconomic perspective, competition can also affect financial intermediation costs (Rumiasih & Enayatullah, 2018). Not all banks can optimize their resources to achieve a certain level of efficiency (Ganefi, Ermawati, 2020). Indonesia bank as the central bank assesses bank efficiency using five factors: capital, asset quality, profitability, management, liquidity, and sensitivity to market risk. This assessment is very important for evaluating the health of banks and their role in a country's development prospects (Adeabah & Andoh, 2020).

Several previous studies that we identified, such as the study conducted by Say et al. (2020) find that asset selection policies should be set and adjusted to address specific risks in each region to prevent banks from selecting too many bad assets. Herdhayinta & Supriyono (2019) found that total assets, loan-to-deposit ratio, operational cost-to-operational income ratio, net interest margin, and inflation rate had a positive and significant effect on the profitability of regional development banks. Ganefi et al. (2020) found that the banking industry in Indonesia generally operates in monopolistic competition. Fernandes et al. (2018) found that higher levels of liquidity and credit risk had a negative and significant effect on bank efficiency levels, while capital and profit risks had a positive impact on bank performance. Antil et al (2020) found that the robustness of the efficiency score from the evaluation results of the potential for increasing input and output was determined from the state of inefficiency. Liviawati et al (2019) found that CAR, NPL, LDR, ROA, NIM, total assets,

and market interest rates all influence the efficiency of government banks. Yonnedi & Rahman Panjaitan (2019) using a non-parametric DEA approach found that multi-stage DEA showed significant differences in the number of efficient BPDs. Lutfi & Suyatno (2019) found that the majority of Indonesian BPDs are inefficient, the main source of inefficiency is non-interest income. The study conducted by Nidar et al. (2020) found that operational cost to operational income and loan-to-deposit ratio did not have a significant effect on efficiency. Jelassi & Delhoumi (2021) found that return on equity, expense-to-income ratio, loan-to-deposit ratio, and growth rate were not significant to the technical efficiency of banking in Tunisia. The study conducted by Zhou et al. (2018) found that all banks were inefficient, indicating that all banks evaluated needed to make improvements at a weak stage.

Additionally, a study conducted by Pratiwi & Adriati (2020) also used non-parametric methods in the Data Envelopment Analysis model and found that changes in macro indicators did not affect the efficiency of Islamic banks. The study by Milenkovi (2022) revealed that the input-oriented approach and found that return on equity, expense-to-income ratio, loan-to-deposit ratio, and growth rate were not significant to the technical efficiency of banking in Tunisia. The study by Abidin et al. (2021) divided bank objects into two categories and found that the efficiency of Category 1 banks was higher than Category 2 banks. Kamarudin et al. (2019) found that the income efficiency of domestic Islamic banks was relatively lower than foreign Islamic banks due to differences in the level of cost efficiency and profit.

Broadly speaking there are two approaches to using bank efficiency measurements, namely using parametric estimation techniques and non-parametric estimation (Grmanová & Ivanová, 2018). This research uses a non-parametric Data Envelopment Analysis (DEA) method for efficiency measurement due to its technical characteristics and lack of a production function framework hypothesis, allowing for group application of efficiency characteristics and relative efficiency values as decision-making unit (DMU) scopes (Othman et al., 2016). The DEA method has two approach models, namely the Charnes-Cooper-Rhodes (CCR) model which is referred to as the constant return to scale (CRS) model. CRS assumes the fact that the output will change in the same proportion as the input is changed which means that if there is an increase in input n times, the output will also increase n times. The second approach model is the Banker-Charnes-Cooper (BCC) model which assumes that the unit is operating or not at an optimal scale. The addition of input and output is not the same meaning if there is an additional input of n times it will not cause the output to increase by n times. The output can increase or decrease from its value (Antil et al., 2020).

This study uses the BCC or variable return to scale (VRS) model, which is the type of border scale used in data envelopment analysis (DEA) which helps to estimate efficiency whether increasing, constant, and decreasing return to scale. The BCC or VRS model is used in this research because the sample of this research is a bank where various financial and competition constraints can cause the company not to operate optimally and the BCC model is more appropriate to be used to analyze the efficiency of service companies. Efficiency is reflected if BPDs can increase output with the same input or if they can maintain the same output with reduced input. The DEA model can be input-oriented or output-oriented, focusing on reducing inputs without reducing output. The input-oriented model aims to minimize inputs without reducing output (Masitoh, 2017). This approach more precisely investigates the ability to maximize existing inputs to obtain high output to measure the expected performance of each company. Additionally, Input-oriented, BPDs are assumed to be quite competitive, all BPDs compete to gain the trust of their customers (Masitoh, 2017). Therefore, the way to gain the trust of bank customers is to maintain liquidity levels by reducing input use. From this explanation, we use input centric, namely reducing the amount of input produced or used to produce a fixed output. This explanation is used as novelty and a research gap with previous studies.

Exploring the level of efficiency of regional development banks is still interesting to debate, even though this study has similarities in the methods used to previous studies conducted by Syaputra & Abidin (2022); Puspasari (2020); Abidin et al. (2021); Zhou et al. (2018); Liviawati et al. (2019); and Fernandes et al. (2018). This study focuses on investigating the level of efficiency, different from the study conducted by Devi & Firmansyah (2020); Nasution et al. (2020); and Ganefi

et al. (2020) compared the efficiency level during the COVID-19 pandemic and before COVID-19. Previous studies that have similar objects, namely Regional Development Banks, have been carried out by Yonnedi & Rahman Panjaitan, (2019), Lutfi & Suyatno, (2019), and Nidar et al. (2020). Our study aims to investigate the performance of Regional Development Banks in Indonesia based on efficiency measurements using the Non-Parametric DEA approach by applying different variables in the research model. We also compare efficiency performance and calculate variable projections in measuring efficiency at Regional Development Banks in Indonesia.

2. RESEARCH METHODS

The type of data used in this study is secondary data. According to Rahayu et al. (2016) secondary data is data obtained by researchers indirectly. Secondary data is to support and complement primary data, such as books, literature, and readings that show a link with research. Researchers use annual data from 2010 to 2021. Data is sourced from the Financial Services Authority via the www.ojk.go.id website. The following is a brief table of data types and sources:

Table 1. Variables, Type & Source Data

Variables	Type of Data	Source Data
Input: Third-party funds (TPF) Non-interest expenses Interest expense	Secondary Data	www.ojk.go.id
Output: Credit Interest income Operational income other than Interest	Secondary Data	www.ojk.go.id
Independent: Net Interest Margin (NIM) Operating Expenses to Operating Income (BOPO) *Loan to Deposit Ratio* (LDR) *Capital Adequacy Ratio* (CAR)	Secondary Data	www.ojk.go.id

Source: Authors

TPF is funds sourced from the public in the form of savings, current accounts, and deposits used for bank operational activities and are most needed by banks. This variable was chosen to determine the total protection from the amount of public funds, both individuals and legal entities, that the bank managed to collect through this product. Non-interest expenses are bank expenses consisting of expenses for allowances for productive assets, expenses for estimated losses on commitments and contingencies, expenses for allowances for other assets, other operational expenses (including salaries and employee benefits expenses, general and administrative expenses, foreign exchange transaction expenses, expenses others), non-operational expenses, and tax expenses. The ratio between total non-interest expenses and total assets is used to see whether non-interest expenses have an effect on the bank's net interest margin. Interest expense is a non-operational expense that is included in the income statement. It represents the interest owed on any bond, loan, convertible debt, or line of credit. It is basically calculated as the interest rate multiplied by the principal amount owed. Interest expense on the income statement is the interest earned during the period calculated by the financial statements, and not the amount of interest paid during that period.

A loan (credit) is borrowing money (goods or services) to another party with repayment in installments after a certain period of time with a certain amount of compensation (interest). The term used for those who take credit is called a debtor and those who give credit are called creditors, in other words, the debtor is the recipient of funds while the creditor is the giver of funds. Interest Income is income generated from banks or financial institutions, where this income is obtained from storage services called interest. In another sense, interest income is the income earned by individuals or companies from the funds they deposit in the bank. Operating income other than interest is income obtained from the company's main (main) business activities. an increase in the

number of assets caused by sales of company products, whether goods or services or income generated from activities carried out by the company by selling goods and services to consumers during one period.

Net Interest Margin according to Bank Indonesia is net interest income compared to the average total productive assets, a financial ratio used in banking that measures the difference between the interest income generated by banks and the amount of interest paid to their lenders (for example, depositors) relative to the amount of their interest-bearing assets. Operating Expenses to Operating Income according to Bank Indonesia is the ratio between operating costs to income operation. Operating costs are costs incurred by the bank in order to carry out its main business activities such as costs interest, marketing costs, labor costs, and other operating costs. Loan to deposit ratio (LDR) which is often used in assessing bank liquidity by comparing total deposits and total bank loans in the same period. Capital adequacy ratio which functions to accommodate the risk of losses that may be faced by the bank. The higher the CAR, the better the bank's ability to bear the risk of any risky credit/productive assets.

In total, there are 27 Regional Development Banks in Indonesia. The data used in this study were 23 BPDs for the 2010-2021 period. This means that the amount of data used is 276 data (23 BPD x 12 years). Banks that do not have complete financial statements during the observation period are not included in the research object. The sampling technique was carried out using a purposive sampling method, namely a sampling technique with certain considerations or criteria. The following is a list of Regional Development Banks registered with OJK, including:

Table 2. The research sample of the Regional Development Banks

No.	Regional Development Banks
1	BPD Bali
2	BPD Bengkulu
3	BPD DKI
4	BPD Jambi
5	BPD West Java & Banten
6	BPD Central Java
7	BPD East Java
8	BPD West Kalimantan
9	BPD South Kalimantan
10	BPD Central Kalimantan
11	BPD North Kalimantan
12	BPD Lampung
13	BPD Maluku & North Maluku
14	BPD East Nusa Tenggara
15	BPD Papua
16	BPD Riau & Riau Islands
17	BPD South Sulawesi & West Sulawesi
18	BPD Central Sulawesi
19	BPD Southeast Sulawesi
20	BPD North Sulawesi & Gorontalo
21	BPD South Sumatra & Bangka Belitung
22	BPD North Sumatra
23	BPD Yogyakarta

Source: www.ojk.go.id

The analysis technique used in this study is Data Envelopment Analysis (DEA) with the Non-Parametric BCC model approach. The BCC model explains that the ratio between the addition of input and output is not the same (for example: If there is an additional input of 1, the output will not increase by 1%, it can be smaller or greater than 1. The BCC model is also known as the variable return to scale (VRS). The VRS model is used because the sample for this research is BPD banks

because these banks experience various financial and competition constraints that can cause companies not to operate optimally. Therefore, the BCC or VRS models are more appropriate to use to analyze bank efficiency (Abidin et al., 2021).

After processing the data using DEA and the BCC model, it can be seen whether the BPD bank has an efficient or inefficient score. Coelli (2005) explains that less than 1 is said to be inefficient, while equal to 1 is said to be efficient. The next step is to look at variable return to scale, if a company adds 1 input, it turns out that the result has decreased from 1 output result, it is said (Decreasing Return to Scale), if a company adds 1 input, it turns out that the result is more than 1 output result, then it is said (Increasing Return to Scale), if a company adds 1 input it turns out that the result is also 1 output result then it is said (Constant Return to Scale). Then look at the projection variable, namely, to find out the initial variable data with data projection and whether the data has changed or not, besides that to find out the total potential improvement results where to find out by analyzing each variable (Wang et al., 2017).

The results of this analysis will produce a number where the number is the total potential for improvement, how big the number on the variable that is not yet efficient to make improvements, to calculate the projection variable. If it produces a value of 0.00 then the total variable = total projection, which means that the variable has no change, but if the result is ≥ 0.00 then the variable has a change, which means that the variable must be corrected to achieve a level of efficiency (Cheng et al., 2020).

$$Max\ \theta\ \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{ij}} \qquad s.t\ \ \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_j x_{ij}} \leq 1 \tag{1}$$

$$u_r \geq 0;\ r = 1, 2, \dots, s;\ v_i \geq 0;\ i = 1, 2, \dots, m;\ j = 1, 2, \dots, n;\ y_{rj} \geq 0;\ j = 1, \dots, n$$

where, x_{ij} is enters the value 1 in units j; v_i is the weighting of input to i; y_{rj} is output value to r; u_r is weighting of input to i.

The panel data regression was performed to find out whether NIM, LDR, BOPO, and CAR had an effect on the efficiency of conventional BPDs in Indonesia. The panel data regression model is a combination of time series data and cross-section data. Gujarati (2011) stated that there are several models in panel data regression as follows: pooled least square, namely the technique used in this method only combines time series data and cross-section. By combining these data without looking at differences between time and individuals, it can be used using the OLS method to estimate the panel data model. Then the fixed effect, this model assumes that there are intercept differences in the equation. The fixed effect model technique estimates panel data using a dummy variable to capture intercept differences. In many applications, the whole point of using panel data is to allow C_i to be arbitrarily correlated with X_{it}. Fixed effects analysis achieves this goal explicitly. Then the last one is the random effect, which is a technique for estimating panel data by adding error terms that may arise. The panel data regression model in this study is as follows:

$$EFF_{it} = \alpha_0 + \beta_1 NIM_{it} + \beta_2 BOPO_{it} + \beta_3 LDR_{it} + \beta_4 CAR_{it} + \varepsilon_{it} \tag{2}$$

$$EFF_{it} = \alpha_0 + \beta_1 NIM_{it-1} + \beta_2 BOPO_{it-1} + \beta_3 LDR_{it-1} + \beta_4 CAR_{it-1} + \varepsilon_{it} \tag{3}$$

Equation 1 shows the panel data regression model in this study. EFF shows the efficiency score; NIM shows the net interest margin; $BOPO$ shows operating costs in operating income; LDR shows the loan-to-deposit ratio; and CAR shows the capital adequacy ratio. The dependent and independent variables have ratio units. The parameter α shows constant in the equation, β_1, ..., β_4 shows independent variable coefficient; ε shows errorterm, and subscript it shows the data used is panel data.

Then the model selection is carried out to find out the most appropriate model for testing, according to (Baltagi, 2006) Model selection in panel data regression is as follows LM test or

Lagrange Multiplier test to find out whether the random effect or pooled least square model is the most appropriate used. Then a Hausman Test was performed to compare the fixed effect and random effect model with the aim of determining which model should be used. Furthermore, the Classical Assumption Test aims to ensure that the research results are valid with the data used theoretically unbiased, consistent, and efficient estimation of the regression coefficient (Gujarati, 2011). There is a definite linear relationship between the regressors. The heteroscedasticity test is one of the problems commonly encountered in cross-sectional data. Then the autocorrelation test is a common problem in regression analysis involving time series data.

Finally, the healing of classical assumptions is carried out, and treating data infected with classical assumption problems is carried out with Generalized Least Square. Assumptions on the conditional variance matrix of u_i can be carried out using a generalized least squares procedure. GLS is usually a technique used to estimate inappropriateness because it is required to know a linear regression model when there is a certain degree of correlation between the residuals in the regression model (Wooldridge, 2002).

3. RESULTS AND DISCUSSION

3.1. Descriptive statistics

Descriptive statistics provide information about the data used in the study which contains the mean value, maximum value, minimum value, and standard deviation of each variable. The research variables consist of input variables, namely third-party funds, non-interest expenses, interest expenses, and employee costs, and output variables consisting of loans, interest income, and non-interest operating income. Descriptive statistical results can be seen in Table 3 as follows.

Table 3. Descriptive statistic

Variables	Max	Min	Mean	Std.Dev
Input				
Third-party funds	8,878,972.22	2407,722.17	4885,999.25	1,855,767.73
Non-interest expenses	1,428,815.17	393,135.00	747,257.88	305,643.54
Interest expense	1,231,546.48	452,117.17	860,287.16	310,496.09
Employee costs	596,098.91	204,569.96	392,619.58	138,424.51
Output				
Credit	765,787.35	44,703.65	359,255.61	305,665.75
Interest income	2,649,088.61	1,017,873.13	2,000,860.51	601,843.98
Operational income other than Interest	312,417.22	74,864.26	194,637.47	86,036.83
Independent Variable				
NIM	9.341	5.978	7.584	1.022
BOPO	79.730	67.670	75.315	3.946
LDR	95.019	76.630	87.215	5.744
CAR	157.246	19.975	52.266	56.404

Source: Authors Calculations

Table 3 reports the input variable, namely the TPF variable, the maximum value is 8,878,972.22, the minimum value is 2,407,722.17, and the mean value is 4,885,999.25 with a standard deviation of 1,855,767.73. For non-interest expense variables, the maximum value is 1,428,815.17, the minimum value is 393135, and the mean value is 747,257.88 with a standard deviation of 305,643.54. For the interest expense variable, the maximum value is 1,231,546.48, the minimum value is 452,117.17, and the mean value is 747,257.88 with a standard deviation of 305,643.54. For the employee load variable, the maximum value is 596,098.91, the minimum value is 44,703.65, and the mean value is 392,619.58 with a standard deviation of 138,424.51. In the output variable, namely the loan variable, the maximum value is 765,787.35, the minimum value is 204,569.96, and the mean value is 359,255.61 with a standard deviation of 305,665.75. For the interest income variable, the maximum value is 2,649,088.61, the minimum value is 1,017,873.13 and the mean value is 2,000,860.51 with a standard deviation of 601,843.98. For operating income variables other than interest the maximum value is 312,417.22, the minimum value is 74,864.17, and the meanvalue is 194,637.50 with a standard deviation of 85,637.78.

The independent variables, namely the NIM variable, have a maximum value of 9.341, the minimum value of 5.977, and the mean value of 7.583 with a standard deviation of 1,022. For the BOPO variable, the maximum value is 79,730, the minimum value is 67,670, and the mean value is 75,315 with a standard deviation of 3,946. For the LDR variable, the maximum value is 95,019, the minimum value is 76,630, and the mean value is 87.215 with a standard deviation of 5,744. For the CAR variable, the maximum value is 157,246, the minimum value is 19,975, and the mean value is 52,266 with a standard deviation of 56,404.

3.2. Results of Efficiency Estimation

In looking for the results of the analysis, in the first stage, the researchers used DEA analysis to get the results of BPD in what year was efficient in allocating part of the input to produce some output. A bank can achieve an efficiency level if it reaches 1.00 if the bank has been able to make efficiency in the use of its inputs and/or has been able to utilize all of its capabilities and resources to produce its output, then on the other hand, a bank with an efficiency score below 1.00 must immediately make efficiency in the use of inputs and must maximize all potential capabilities possessed to produce output. Figure 1 shows the efficiency performance of Conventional BPDs in Indonesia using the DEA method during the 2010-2021 period with an mean efficiency of ≤1.00 or still below the maximum value of 1.

The lowest efficiency score in the 2013 period was 0.56, while the highest efficiency score for the 2020 and 2021 periods was 0.72. This means that BPD in Indonesia has not yet achieved a maximum efficiency score. Table 3 shows that the mean efficiency score is close to 1, for BPD East Nusa Tenggara, which is 0.9, while the mean efficiency score is close to 0, namely BPD West Kalimantan. It is interesting to analyze the 2019-2021 pandemic period.

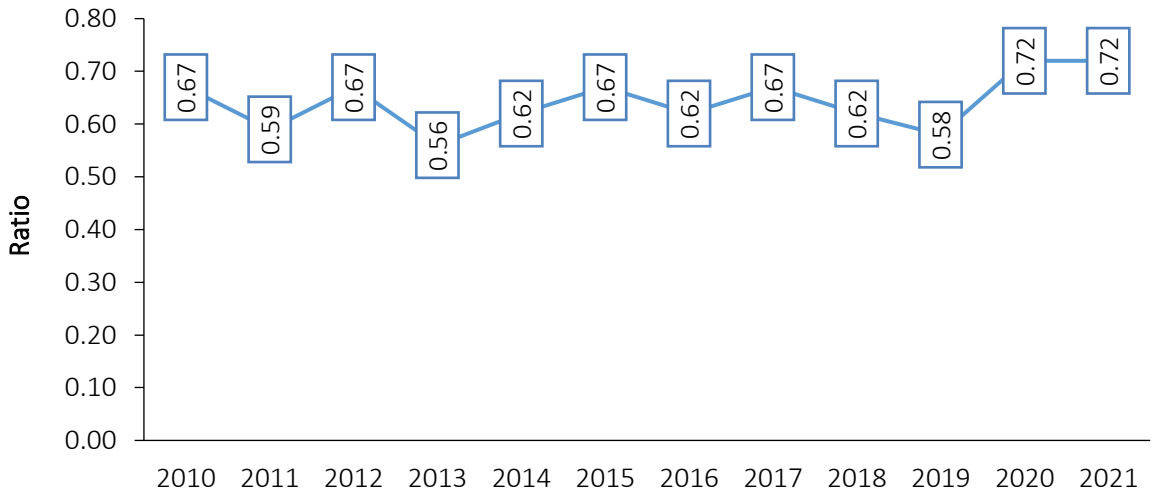

Figure 1. The mean of efficiency score for Regional Development Bank 2010-2021
Source: Authors Calculations

The 2019 period shows that there are three BPDs that have an efficiency score of 1, namely BPDs in West Java and Banten, Maluku and North Maluku, and East Nusa Tenggara. The 2020 period shows that there are seven BPDs that have an efficiency score of 1, namely BPDs in West Java & Banten, Central Java, East Java, North Kalimantan, East Nusa Tenggara, and Papua, as well as North Sulawesi and Gorontalo. The 2021 period shows that there are five BPDs that have an efficiency score of 1, namely DKI, Jambi, Central Kalimantan, South Kalimantan, South Sulawesi, and West Sulawesi. This means that even during a health crisis, banking still reaches an efficient level, so that BPDs that achieve score of 1 have a strong and healthy banking financial condition. The Conventional BPDs in Indonesia are still not efficient in carrying out operational activities. Especially when in 2019 conventional BPDs in Indonesia were still facing an economic crisis due to the COVID-19 virus pandemic. Therefore, it is very necessary to get the attention of all stakeholders to immediately develop strategies and policies to improve BPD performance throughout Indonesia.

Table 4. Efficiency Score of Regional Development Bank 2010-2021

Regional Development Bank	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average
Bali	1.000	1.000	0.384	0.361	0.102	0.432	0.468	0.453	0.344	0.740	0.740	0.598	0.552
Bengkulu	1.000	1.000	1.000	1.000	1.000	0.531	0.438	0.505	0.357	0.395	0.590	0.767	0.715
DKI	0.470	0.506	0.385	0.485	0.525	0.748	0.567	0.528	0.562	0.595	0.665	1.000	0.586
Jambi	0.732	0.667	0.618	0.530	0.492	0.522	0.497	0.447	0.443	0.499	0.522	1.000	0.581
West Java & Banten	0.740	0.430	1.000	0.485	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.688	0.862
Central Java	0.408	0.458	0.515	0.518	0.606	0.684	0.656	0.708	0.723	0.771	1.000	0.689	0.645
East Java	0.575	0.572	0.599	0.617	0.655	0.683	0.692	0.662	0.629	0.661	1.000	0.469	0.651
West Kalimantan	0.412	0.351	0.448	0.414	0.372	0.351	0.333	1.000	0.364	0.361	0.561	0.784	0.479
South Kalimantan	0.531	0.387	0.352	0.359	1.000	0.518	0.362	0.358	0.327	0.333	1.000	0.523	0.504
Central Kalimantan	0.663	0.581	0.688	0.527	0.567	0.574	0.607	0.822	0.753	0.558	0.510	1.000	0.654
East & North Kalimantan	0.506	0.420	0.434	0.547	0.742	1.000	0.750	0.646	0.605	0.552	0.629	1.000	0.653
Lampung	0.662	0.547	0.558	0.514	0.504	0.493	0.490	0.411	0.400	0.366	0.570	0.547	0.505
Maluku & North Maluku	1.000	0.536	1.000	0.517	1.000	0.944	1.000	0.772	0.813	1.000	0.485	0.554	0.802
East Nusa Tenggara	0.484	1.000	0.959	1.000	0.933	1.000	1.000	1.000	0.991	1.000	1.000	0.461	0.902
Papua	0.644	0.449	1.000	0.680	0.848	1.000	0.828	0.817	0.907	0.541	1.000	0.775	0.791
Riau & Riau Island	1.000	0.345	0.332	0.399	0.435	0.576	0.538	0.491	0.461	0.441	0.633	0.695	0.529
South & West Sulawesi	0.491	0.615	0.697	0.522	0.510	0.617	0.468	0.609	0.560	0.632	0.583	1.000	0.609
Central Sulawesi	1.000	0.993	0.923	1.000	0.607	0.710	0.716	1.000	0.467	0.423	0.563	0.937	0.778
Southeast Sulawesi	1.000	1.000	1.000	0.686	0.817	0.840	0.847	1.000	1.000	0.703	0.636	0.493	0.835
North Sulawesi, Gorontalo	0.527	0.412	0.443	0.412	0.325	0.487	0.534	0.559	0.628	0.352	1.000	0.505	0.515
South Sumatra & Bangka Belitung	0.561	0.503	0.546	0.405	0.363	0.403	0.380	0.560	0.559	0.514	0.721	0.663	0.515
North Sumatra	0.613	0.488	0.613	0.538	0.561	1.000	0.720	0.652	1.000	0.633	0.721	0.918	0.705
Yogyakarta	0.476	0.434	1.000	0.415	0.356	0.393	0.412	0.423	0.458	0.464	0.536	0.627	0.499
Average	0.674	0.595	0.674	0.562	0.623	0.674	0.622	0.671	0.624	0.588	0.725	0.726	0.646

Source: Authors Calculations

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Table 5. Variable Return to Scale 2010-2021

Regional Development Banks (BPDs)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Bali	CRS	CRS	IRS	IRS	IRS	DRS	DRS	DRS	IRS	DRS	DRS	DRS
Bengkulu	CRS	IRS	CRS	IRS	CRS	IRS	IRS	IRS	IRS	IRS	IRS	DRS
DKI	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS
Jambi	IRS	IRS	IRS	IRS	IRS	IRS	IRS	IRS	DRS	DRS	IRS	CRS
West Java & Banten	DRS	DRS	DRS	DRS	CRS	DRS	DRS	DRS	DRS	DRS	CRS	DRS
Central Java	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS
East Java	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	CRS	DRS
West Kalimantan	IRS	IRS	IRS	IRS	IRS	IRS	DRS	DRS	DRS	DRS	DRS	DRS
South Kalimantan	IRS	IRS	IRS	IRS	CRS	DRS	IRS	DRS	DRS	DRS	CRS	DRS
Central Kalimantan	IRS	IRS	IRS	IRS	IRS	IRS	IRS	DRS	DRS	DRS	IRS	CRS
East & North Kalimantan	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	CRS
Lampung	IRS	IRS	IRS	IRS	IRS	IRS	IRS	IRS	IRS	IRS	IRS	IRS
Maluku & North Maluku	IRS	IRS	CRS	IRS	CRS	DRS	IRS	IRS	IRS	CRS	IRS	IRS
East Nusa Tenggara	IRS	CRS	DRS	DRS	DRS	DRS	CRS	CRS	DRS	DRS	CRS	IRS
Papua	IRS	IRS	CRS	DRS	DRS	CRS	DRS	DRS	DRS	DRS	CRS	DRS
Riau & Riau Island	CRS	IRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS
South & West Sulawesi	IRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	CRS
Central Sulawesi	IRS	IRS	IRS	CRS	IRS	DRS	DRS	CRS	IRS	IRS	IRS	DRS
Southeast Sulawesi	CRS	IRS	IRS	IRS	DRS	DRS	DRS	CRS	DRS	DRS	IRS	IRS
North Sulawesi, Gorontalo	IRS	IRS	IRS	IRS	IRS	DRS	DRS	DRS	DRS	DRS	CRS	DRS
South Sumatra & Bangka Belitung	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS
North Sumatra	DRS	DRS	DRS	DRS	DRS	CRS	DRS	DRS	CRS	DRS	DRS	DRS
Yogyakarta	IRS	IRS	IRS	IRS	IRS	IRS	IRS	IRS	IRS	IRS	IRS	IRS

Note: CRS is constant return to scale; IRS is increasing return to scale; and DRS is decreasing return to scale

Source: Authors Calculations

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Then do the calculations with Variable Return to Scale (VRS). To find out the magnitude of the rate of change in output along with changes in input proportionally. Does it produce an Increasing return to scale (IRS), namely a situation where the output increases more than the increase in the input portion, decreasing return to scale (DRS), namely a situation where the output decreases more than the increase in the input portion, constant returns to scale (CRS) is a situation where the fixed output from an increasing portion of input. Based on Table 5, it is known that at 23 conventional BPDs in Indonesia, from 2020 to 2021, all of them met, that is, they have existed at the DRS, IRS, and CRS levels. However, there are BPDs that show good performance, namely producing IRS and CRS only, including BPDs in Lampung, Maluku and North Maluku, Yogyakarta. In addition, there were BPDs that only experienced DRS or decreased situations during the observation period, including BPDs in DKI, Central Java, North Sumatera, and South Sumatra & Bangka Belitung only experienced DRS during the observation period.

Table 6. Variables projection Regional Development Bank 2010-2021

Regional Development Banks	TPF	Non-Interest Expenses	Interest Expenses	Employee Costs	Mean
Bali	0,46	0,45	0,45	0,64	0,50
Bengkulu	0,28	0,34	0,28	0,27	0,29
DKI	0,41	0,41	0,41	0,40	0,41
Jambi	0,42	0,45	0,43	0,41	0,43
West Java & Banten	0,14	0,14	0,14	0,19	0,15
Central Java	0,36	0,36	0,36	0,35	0,36
East Java	0,35	0,35	0,35	0,35	0,35
West Kalimantan	0,52	0,52	0,52	0,54	0,53
South Kalimantan	0,50	0,52	0,52	0,44	0,50
Central Kalimantan	0,35	0,35	0,35	0,44	0,37
East & North Kalimantan	0,35	0,36	0,35	1,21	0,57
Lampung	0,50	0,58	0,50	5,72	1,83
Maluku & North Maluku	0,21	0,22	0,21	0,42	0,27
East Nusa Tenggara	0,12	0,10	0,18	0,11	0,13
Papua	0,21	0,23	0,31	1,20	0,49
Riau & Riau Island	0,47	0,52	0,47	0,45	0,48
South & West Sulawesi	0,40	0,39	0,39	0,39	0,39
Central Sulawesi	0,22	0,25	0,23	2,18	0,72
Southeast Sulawesi	0,16	0,16	0,16	0,22	0,18
North Sulawesi, Gorontalo	0,49	0,51	0,49	0,48	0,49
South Sumatra & Bangka Belitung	0,49	0,49	0,49	0,50	0,49
North Sumatra	0,31	0,30	0,30	0,30	0,30
Yogyakarta	0,50	0,50	0,53	0,83	0,59
Mean	**0.36**	**0.37**	**0.37**	**0.79**	**0.47**

Source: Authors Calculations

Table 6 reports that the 23 conventional BPDs taken in the BPD research produced a figure of 0.00, so the total variable = total projection, which means that these variables have no change or are categorized as efficient so there is no need to make improvements, but in 23 conventional BPD all produce number ≥ 0.00, then all of the BPD have changes, which means that there are variables that must be corrected to achieve a level of efficiency. From the results of the variable projection, it is necessary to pay attention to potential improvement where variables have the potential for improvement so that banks that have a relatively low efficiency value or less than one can increase their relative efficiency value. For each input variable that has a large potential improvement value, it indicates that this variable still needs to be increased, namely minimizing the input to that percentage.

3.3. Results of Panel Regression

At the results stage, all independent variables were tested which were thought to influence the level of technical efficiency by using a panel data regression model which was a combination of cross-section data and time series data, where the same cross-section unit was measured at different times.

Table 7. Result of panel regression estimation

Dependent variable = EFF					
Variables	**PLS**	**FEM**	**REM**	**F-GLS**	**F-GLS with lag**
NIM	0.383*	0.200*	0.301*	0.208***	no
	(0.235)	(0.262)	(0.241)	(0.284)	
BOPO	0.375*	-0.009*	0.138*	0.611***	no
	(0.047)	(0.590)	(0.514)	(0.411)	
LDR	0.605*	0.391*	0.521*	0.373***	no
	(0.361)	(0.431)	(0.383)	(0.409)	
CAR	0.762*	0.841*	0.746*	0.878***	no
	(0.199)	(0.021)	(0.002)	(0.261)	
NIM (-1)	no	no	no	no	0.200***
					(0.300)
BOPO (-1)	no	no	no	no	0.617***
					(0.441)
LDR (-1)	no	no	no	no	0.370***
					(0.432)
CAR (-1)	no	no	no	no	0.734***
					(0.329)
Hausman test		0.0673	-	-	-
LM test	-	-	0.0014	-	-
Diagnostic test					
VIF					13.47
Wald test					0.000
Wooldridge test					0.153

Note: *,**,*** significant on 10%, 5%, and 1%
Source: Authors Calculations

In the PLS model, it is known that NIM, BOPO, LDR, and CAR have a positive effect with coefficient values of 0,383, 0,375, 0,605, and 0,762 respectively. Based on these results a 10% rate was generated. In the FEM model, it is known that NIM, BOPO, LDR, and CAR have a positive effect with a coefficient value of 0.200, 0.391, 0.841 respectively, but BOPO has a negative effect with a coefficient value of -0.009, based on these results a 10% level is produced. In the REM model, it is known that NIM, BOPO, LDR, and CAR have a positive effect with coefficient values of 0,301, 0,138, 0,521, and 0,746 respectively, based on these results a 10% level is produced. Furthermore, to find out the best model, the first to use the LM test is used to select the best model to be used as an estimate for random effect model (REM) or Pooled Least Square (PLS) panel data. If the F-Static probability value ≤ 5% percent significance level, then the Random Effect Model (REM) will be selected. Based on Table 6, the probability value of the F-statistic is 0.0014, so the conclusion drawn is to choose the best model, namely the Random Effect Model (REM). Then the results of the Hausman Test are carried out to choose the best method between the Fixed Effect Model (FEM) and the Random Effect Model (REM). The value that must be considered from the Husman Test is the probability value of the F-Static. If the F-Static probability value ⩽ 10% percent significance level, then the Fixed Effect Model (FEM) will be selected. From Table 7 the F-Stat probability value is 0.0673 so it can be concluded that what is taken is to choose the best model, namely the Fixed Effect Model (FEM). Based on the LM test and Hausman test it can be concluded that the best model chosen is the Fixed Effect Model (FEM).

Then a classic assumption test is carried out, the classic assumption test is a prerequisite test that is carried out before carrying out further analysis on the data that has been collected. The

classical assumption test is given in order to produce a regression model that meets the BLUE criteria (Best Linear Unbiased Estimator). The type of classic assumption test in statistics, but what is commonly used is the Multicollinearity Test, the Heteroscedasticity Test, and then the Autocorrelation Test. The VIF score is 13.47, meaning that the VIF value is more than 10, so there is a multicollinearity problem. The multicollinearity problem does not violate the classical assumptions described by Gauss Markov, so even though there is multicollinearity the parameters are still BLUE (Best Linear Unbiassed Estimator). Furthermore, the Wald test probability is 0.000, meaning there is heteroscedasticity, because the Wald test probability is less than 1 percent, so treatment needs to be carried out. The probability of the Woolridge test to detect autocorrelation is 0.1531, meaning it does not contain an autocorrelation problem, because it has a probability of more than 10 percent. Reducing heteroscedasticity and autocorrelation problems using the GLS (Generalized Least Square) approach. Therefore, the results analyzed are FGLS, because they are free from heteroscedasticity and autocorrelation problems.

3.4. Discussion

Efficiency is a reflection of the financial performance of banks, where a bank is said to have high performance if it can increase its efficiency by using appropriate variables to provide maximum results. Eyceyurt et al. (2017), efficiency is a performance parameter that is quite popular and is an important measure of bank operational conditions and is one of the key indicators of a bank's success (Puspasari, 2020). Efficiency is a parameter of banking performance that theoretically underlies all company performance. The more efficient a bank is, it is hoped that it will be more profitable. If profits increase, it will be able to increase added value for the bank and can be used as additional capital to support increased lending or financing. For customers, efficiency in the banking system will have an impact on lower interest rates or margins charged so that more and more people get credit or financing facilities (Ardiansyah et al., 2021).

Efficiency in economics is defined as the maximum potential ratio between output and input from product development processes, which shows the optimal distribution of available resources that allows for achieving maximum potential (Jurkonyte & Cvilikas, 2016) Regarding the banking sector (Isrova in Alber et al., 2019) states that efficiency supports the success of implemented macroeconomic policies that result in sustainable development, economic growth, and prosperity for society, this is the same as opinion. Mckinley & Banaian, (2005) defines efficiency in terms of minimizing costs and maximizing profits. (Diallo, 2018) states that efficiency makes banks more resilient to positive shocks and significantly affects growth. Bank efficiency loosened credit constraints and increased growth rates for financially dependent industries during the crisis. In this study, technical efficiency analysis was carried out using the Data Envelopment Analysis (DEA) approach. In DEA, efficiency results have a value of zero to one where a value of 1 or 100 percent is the most efficient value. A conventional BPD that has a score of 1 is declared efficient, meaning that the BPD can optimize all of its resources. Conversely, if the BPD has a score of zero to less than one, the BPD is declared inefficient in optimizing its resources and has not been able to optimally carry out its role as an intermediary institution (Abidin et al., 2021).

This study produces efficiency values for a period using a non-parametric Data Envelopment Analysis (DEA) approach, to determine or ascertain the efficiency level or stage of regional development banks. The results of this study explain that the efficiency mean of conventional regional development banks has fluctuated from year to year, where the 23 BPDs on mean have not reached the efficiency level, while the highest efficiency score, namely BPD East Nusa Tenggara only produces a value of 0.90 but is not yet said to be efficient because it is not reached 1.00. Factors that can cause inefficiency in banks are first, inefficiency in the use of BPD inputs which can be seen from the amount of employee expenses that must be incurred which is greater than what is needed. The amount of employee burden can be caused by the large number of employees used. The problem with BPD is that the increase in the number of employees is not matched by the skills possessed, therefore it will cause the bank to experience a decrease in productivity. The solution that can be used is the existence of internal bank regulations in using a contract system for its employees. Furthermore, by cooperating with educational institutions or universities, especially in

terms of providing quality and competent human resources, in addition to reducing employees, such as early retirement and others.

BPD Bali from 2010 to 2021 is still experiencing DRS in 2015 to 2017 and from 2019 to 2021 the BPD Bali report explains that DRS occurs due to a decrease in the ability to pay existing debtors so the Bank must optimize existing resources to save credit. Especially when the COVID-19 pandemic occurred, Bali's economic growth also experienced a decline, especially in sectors directly related to tourism, such as culinary, trade, transportation, and services, causing a decline in market demand for credit, narrowing potential debtors that were feasible to be financed.

Consumers and the general public are important drivers of the Indonesian economy, as is their considerable contribution to business development and investment in the area. In contrast to BPD Bengkulu, BPD DKI experienced DRS during 12 years of observation because BPD DKI had experienced the company's gross NPL dropping to 4.08%. This improvement was significant and Bank DKI's NPL rose to a level of 5.73%. Not only from gross NPL but from a net NPL perspective, this bank owned by the Provincial Government of DKI Jakarta also recorded an improvement from 2.86% to 2.58% on an annual basis. The rise in NPL is not an improvement, it's a failure for the bank to maintain its loan quality.

BPD Jambi only experienced DRS in 2018 and 2019 besides that they never experienced DRS again because indeed the development of the Jambi BPD was quite good even though the Jambi bank was not a digital bank, but the Jambi BPD wanted everything at Jambi Bank to be completely digital. Bank Jambi also has a creative team, which is useful in developing Bank Jambi so that BPD Jambi itself runs very well. Switching to BPDs in West Java and Banten which still frequently experienced DRS during the observation period except in 2014 and 2020 experiencing CRS this happened because based on the bank's financial publication reports on the Indonesia bank website, Bank BJB's profit fell due to a decrease in net interest income of 8, 6% to IDR 4.228 trillion. On the other hand, banks recorded an increase in credit asset impairment costs due to a surge in the number of non-performing loans.

In Central Java BPD experienced DRS during the observation period. According to (Sutanto, 2018) Bank Central Java is the BPD which has the lowest efficiency level of 78.6 percent. The burden of interest rates is caused by the inefficiency of most BPDs. Likewise, the BPD in East Java often experiences DRS. Based on the Bank Jatim website, explains that indeed Bank Jatim shows a good mean performance in asset growth, TPF, credit, and interest income. However, the profit has decreased due to the relatively high increase in expenses. Then the BPD East Kalimantan also often experienced DRS in the last five years of observation, based on a regional fiscal study of the East Kalimantan TPID the decrease was caused by a decrease in air transport prices due to a decrease in demand after Christmas and New Year holidays. Price declines also occurred for several horticultural commodities due to price corrections for horticultural commodities as the harvest season entered and was driven by lower rice prices supported by adequate stocks.

BPD in East Kalimantan, even though during the observation period some had experienced DRS, the BPD in East Kalimantan experienced more frequent CRS or IRS. According to Asbanda, the BPD North Kalimantan can optimize revenue, as an effort to maintain profitability at a reasonable level, where one way is to maintain and improve the performance of its assets. Potential Bank assets to support business income. The BPD Central Kalimantan also often experiences CRS and IRS. This can be seen from the BPD of Central Kalimantan website, namely the performance of BPD Central Kalimantan, which recorded growth in net profit, lending, and TPF which experienced growth. For its brilliant performance even during the pandemic, a series of awards were given to BPD in Central Kalimantan. Starting from The Best TOP BUMD Award 2021, The Best Bank In Credit Assets Quality, The Strongest Performance Bank, Titanium Performance Trophy.

Meanwhile, the BPD of East Kalimantan and North Kalimantan experienced DRS more often, according to the Bank Indonesia Representative for East Kalimantan, which noted that East Kalimantan's economic growth was still contracting -0.5% (yoy). East Kalimantan growth was depressed to -0.9%, much lower than the national economic growth. Meanwhile, East Kalimantan inflation rate was the lowest inflation rate in the last five years. BPD Lampung only experienced IRS and CRS during the observation period. This happened because, from a fundraising perspective,

Lampung BPD earned IDR 10.13 trillion, an increase of 26.23 percent yoy. The performance of TPF was driven by deposits which rose 55.3% yoy to IDR 5.77 trillion. The growth in TPF, which was far above credit, made BPD Lampung's liquidity loosen. Likewise, with BPD Maluku and North Maluku which achieved good variable returns to scale during the observation period, this can be seen from the financial performance indicators of BPD Maluku and North Maluku showing growth. BPD Maluku and Nort Maluku assets were still able to grow double digits at 10.23%. Meanwhile, the three main financial indicators, namely credit, TPF, and core capital are still growing well even amid the COVID-19 pandemic.

As for the BPD of East Nusa Tenggara, it has experienced fluctuations between DRS, IRS, and CRS. This can be seen from the fact that BPD of East Nusa Tenggara continues to show brilliant performance in the banking industry in Indonesia. The Company recorded various important achievements in both business and operational aspects. In July 2011, the Company issued bonds amounting to IDR 500 billion with a fixed interest rate which will be used for long-term funding in the framework of the company's expansion, however, it turned out that BPD of East Nusa Tenggara was under threat of being downgraded from a Regional Development Bank to a Rural Credit Bank. (BPR) this is one of the causes of BPD East Nusa Tenggara experiencing a decrease. On the other hand, the BPD Papua only experienced fluctuations, according to the OJK. The condition of Bank Papua is supported by a strong bank CAR, whose position in December 2018 was 23.70 percent from our minimum requirement of 8 percent. This means that Bank Papua's capital is very strong. However, the OJK explained that BPD Papua had experienced a decline in the non-performing loan (NPL) ratio when compared to the position in January 2017. As of the end of January 2018, NPL conditions were at the level of 2.86% or decreased from 3.09% in the same last year. While on a net basis, the NPL ratio as of January was maintained at 1.23%, down from 1.35% last year.

BPD Riau and Riau Islands still often experience DRS, according to Asbanda from the asset side, the performance of BPD Riau and Riau Islands is relatively stagnant. The BPD of North Sulawesi and West Sulawesi also experienced fluctuations but more often experienced DRS, this was because during the period 2012 to 2021, the LDR ratio value of the BPD West Sulawesi was above the mean LDR limit that banks should have but the high LDR ratio value can be covered by a low level of credit risk is indicated by a low NPL value and a high amount of capital is indicated by a high CAR value (Anwar & Pasryb, 2022). In addition, BPD West Sulawesi had planned to convert the regional development banks of North Sulawesi and West Sulawesi to the Sharia system, so they reaped the pros and cons, the shareholders were not yet unanimous in making the conversion.

In contrast to the BPD Central Sulawesi, during the observation period, it often experienced CRS and IRS, this was because Bank Sulteng also collected TPF of IDR.8.16 trillion, an increase of 48.67% (yoy) from the previous IDR.5.49 trillion. This was supported by an increase in the number of low-cost funds (CASA) consisting of demand deposits and savings. In detail, current accounts grew by 51,72% (yoy), while savings skyrocketed by 18,13% (yoy). The same thing also happened in Southeast Sulawesi where during the observation period they experienced CRS and IRS according to the OJK. BPD North Sulawesi and West Sulawesi is no less competitive with national banks. In terms of service facilities, this regional government-owned bank in South Sulawesi Province has started providing digital services. Various transactions can be done anywhere using mobile banking facilities, Automated Teller Machines (ATM or CRM) cards using debit cards, and various other transaction conveniences.

As for the BPD of North Sulawesi and Gorontalo, they experienced fluctuations. BPD North Sulawesi and Gorontalo were observed to have achieved growth in TPF, supported by an increase in the number of current accounts collected. The number of savings and time deposits also increased. In addition, the amount of credit disbursed by Bank SulutGo is higher. Along with the increase in lending, banks were also able to reduce the non-performing loan (NPL) ratio. However, amid the positive performance of the several financial aspects above, Bank SulutGo's net profit eroded in 2021. Bank SulutGo earned a net profit of IDR 162.05 billion, down 10.93% compared to 2020 which reached IDR 181.94 billion. When viewed from the financial statements, this was due to the swelling bank operating expenses. The operational expenses referred to in this case are the total labor expenses, promotion expenses, and other expenses.

BPD of North Sumatra and South Sumatra-Bangka Belitung are inversely proportional where during the observation period they experienced DRS during the observation period. This condition occurred because the BPD's net profit performance decreased. The BPD of North Sumatera was also the same during the observation period, which also often experienced DRS, namely the profits of the BPD of North Sumatera which had fallen, to increase the capital of the North Sumatera Provincial Government later it would be up to 50 percent, currently, the shares of the North Sumatera Provincial Government were only 41%. As for BPD Yogyakarta, it experienced CRS and IRS during the observation period. This happened because the main criteria were divided into seven financial ratios and four growth ratios. The indicators referred to include capital ratios, asset quality, profitability, liquidity, efficiency, capital growth, funds, credit, and profits so that Bank BPD DIY won the Trophy Platinum Award.

Based on the results of the analysis, it is known that of the 23 BPDs, there are still BPDs that experience continuously decreasing returns to scale during the observation period. This occurs because doubling inputs for production results in a decreasing doubling of production output. In a decreased return to scale, the output produced is increasing but the additional output is getting smaller. so as not to be continuously in the DRS condition, it is necessary to reduce the input until it reaches the Constant Return to Scale (CRS) point. By paying attention to potential improvement, namely variables that have the potential for improvement the bank experiences improvement.

The research results show that DEA calculations generally experience a decrease. The tendency during a crisis is that banks make efficiencies so that costs incurred decrease. This is due to the financial intermediary function not running normally, resulting in decreased bank revenue. The biggest source of inefficiency lies in the workforce. The limitations of the study are not detailed in describing the technical inefficiency sources, not presenting potential input-output improvements, and best practice references for inefficient banks. In the condition of decreasing return to scale, the higher the size of the bank, the lower the level of efficiency, or the efficiency level of small banks is lower than that of large banks. Based on this explanation, BPDs that experience DRS need to make improvements.

Furthermore, calculations are carried out by looking at the projection variable to find out the initial variable data with projection data whether the data has changed or not, besides to find out the total potential improvement results where to find out by analyzing each variable where the results are to find out how much the number is generated to improve the level efficiency. Variable Projection is an analysis result that will produce a number where the number is the total potential for improvement and how big the number is on the variable that is not yet efficient to make improvements.

Ratio analysis is used to measure the interest profit received by a bank from its business activities. One of the ratios used is the Net Interest Margin (NIM). Net Interest Margin (NIM) is the ratio between the bank's interest income minus the bank's interest costs divided by the mean earning assets. Net interest income is obtained from interest income minus interest expenses. The greater this ratio, the more interest income will increase on productive assets managed by the bank, so that the possibility of a bank in a troubled condition is smaller (Warno & Farida, 2017). The estimation results show that NIM has a significant positive effect on efficiency, this means that increasing NIM in conventional BPDs in Indonesia can increase BPD efficiency. The results of this estimate are in line with (Herdhayinta & Supriyono, 2019) where interest income is obtained from interest received from loans given minus interest costs from the source of funds collected. The greater this ratio, the higher the interest income on productive assets managed by the bank, so the possibility of the bank being in a troubled condition is getting smaller. This increase in net interest income will increase funds at banks as well as increase lending and increase the level of efficiency of conventional BPDs.

The estimation results show that BOPO has a significant positive effect on efficiency, this means that increasing BOPO in conventional BPDs in Indonesia can increase BPD efficiency. The results of this estimate are in line with (Endri et al., 2022) the more efficient a bank is, the better its performance. Increased bank performance will increase public trust in banks. Increasing public trust can increase the amount of TPF collected by a bank, besides that people are also encouraged to use

bank services and products such as loans or credit. It is hoped that the high TPF and community contributions to bank products will increase efficiency.

The Loan Deposit Ratio (LDR) is an assessment of the soundness of a bank from the aspect of liquidity. LDR is the ability of a bank to provide funds to its debtors with capital owned by the bank and funds that can be collected by the public (Sudarmawanti & Pramono, 2017). The results of statistical testing of the LDR variable show that the LDR variable has a positive and significant effect on banking efficiency, which means that the higher the LDR of a bank, the higher the efficiency of the bank. Thus these results are in accordance with the third hypothesis in this study which states that LDR has a positive effect on banking efficiency. This is because the higher the credit distribution, the greater the profit opportunities the bank will receive so that the bank can increase its business scale and efficiency (Muljawan in Wendha & Alteza, 2020).

The estimation results show that LDR has a significant positive effect on efficiency, this means that increasing the LDR in conventional BPDs in Indonesia can increase the efficiency of BPDs. The results of this estimate are in line with (Nidar et al., 2020) Bank liquidity must be managed properly so that it can always meet customer needs when needed that an increased LDR ratio means that the large amount of funds channeled in credit, the bank will earn profit from interest credit which will ultimately increase the level of banking efficiency as long as the bank can properly manage the management of credit given to the public. However, if the TPF collected by the bank is not turned into credit, then these funds will become a deposit of money which will result in a loss of income-earning opportunities but will still add to the burden on the bank in the obligation to provide sacrifices in the form of interest charges to customers (Istinfarani & Azmi, 2020).

Capital adequacy ratio (CAR) is an indicator of a bank's ability to cover or compensate for a decrease in its assets as a result of bank losses caused by risky productive assets. The amount of CAR required by Bank Indonesia for banks operating in Indonesia is a minimum of 8%. The size of the CAR owned by a bank can be influenced by the performance of other financial aspects, namely the liquidity aspect, asset quality aspects, profitability, and financing aspects (Ismaulina et al., 2020). A bank with a higher CAR shows that the bank is getting healthier. CAR is an alternative source of funding for a bank to obtain income from disbursed loans. CAR is a source with relatively low costs so banks with large CARs are able to reduce their operational costs. Banks with higher CAR will tend to put pressure on external funding sources, so they will be relatively safer (Haryanto, 2018).

From the explanation above, the estimation results show that CAR has a significant positive effect on efficiency, this means that increasing CAR in conventional BPDs in Indonesia can increase BPD efficiency. CAR reflects the ability of a bank to face the possibility of unexpected loss. Therefore the level of CAR owned by a bank can shape market perceptions of the level of security of the bank concerned. This can further affect the market acceptance of the bank, which is reflected in the borrowing rate that must be paid (Pambuko, 2016). The results of this estimation are in line with research (Nidar et al., 2020) in his research which states that CAR has a positive effect on the level of banking efficiency, also says that CAR is used as a benchmark for banks in sufficient capital in measuring, monitoring, and preventing existing risks because there is still an influence with the amount of capital owned by the bank. Then the hypothesis that is formulated is: CAR has a significant positive effect on the efficiency level of banking performance. Based on the results of panel data regression, it can be interpreted that NIM, BOPO, LDR, and CAR have a positive effect on the efficiency of conventional BPD in Indonesia. In connection with the variables that affect the level of efficiency, indeed, banks should pay more attention to internal factors that affect the level of efficiency, this is because internal factors are determining factors in the use of inputs related to bank operations.

4. CONCLUSIONS

The average of conventional Regional Development Banks in Indonesia are still not consistently efficient in carrying out their operational activities, whereas the 23 BPDs on mean have not reached the level of efficiency. Based on the research results from the Variable Return to Scale, it is known that 23 conventional BPDs in Indonesia from 2010 to 2021 all meet the DRS, IRS, and CRS levels. Then, based on the research results from the Variable Projection, it is known that in 23 conventional

BPDs, all of them produce numbers ⩾0.00, so all these BPDs have changes, which means that there are variables that must be corrected in order to achieve a level of efficiency. Based on the estimation results using the FEM-GLS, it shows that the variables NIM, BOPO, LDR, and CAR have a positive and significant effect on efficiency. Based on the return to scale variable, it is known that there are still BPDs that only experience decreasing returns to scale. In the condition of decreasing return to scale, when the size is higher, the level of efficiency will be lower, and/or small banks will have a lower level of efficiency when compared to large banks. From this explanation, BPDs that experience DRS need to make improvements.

For Banking, this research can be a consideration for Regional Development Banks that need attention for bank management, namely, to identify resources that have not been utilized optimally and to increase the utilization of these resources to obtain maximum results. Regional Development Banks are expected to increase their efficiency values to obtain better performance. By optimizing the use of input variables, namely by expanding financing to the community and on the precautionary principle in the implementation process. Without reducing the input value to produce the same output. Regional Development Banks in meeting their needs do not waste to increase the amount of operational expenses that must be incurred.

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