



Efficiency Analysis of Regional Development Banks in Indonesia Using the Data Envelopment Analysis (DEA) Approach

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ABSTRACT

This study analyzes the efficiency of Regional Development Banks (BPD) in Indonesia – Bank Aceh, Bank NTB, Bank Bengkulu, and Bank Nagari – using the Data Envelopment Analysis (DEA) approach. It also examines financial ratio variables affecting efficiency. Secondary data were collected from Bank Indonesia, BPS, and BPD publication reports. The methods used include DEA and panel data regression. The results show that the average efficiency under constant returns to scale (CRSTE) is 0.20, variable returns to scale (VRSTE) is 0.21, and scale efficiency is 0.94. Efficiency is significantly influenced by SIZE, ROA, NPL, CAR, LDR, BOPO, and NIM.

INTRODUCTION

Regional Development Banks (BPD) constitute an essential component of Indonesia's banking structure, particularly in supporting economic growth at the regional level. These banks function as financial intermediaries that channel funds to stimulate local economic activities (Abidin et al., 2021). In practice, BPDs play a strategic role in facilitating development, especially in regions classified as low- and middle-income. Through relatively affordable financing schemes, they support a wide range of sectors, including infrastructure development, public services, private business expansion, agriculture, environmental governance, and the management of natural resources (Putra et al., 2021).

However, the performance of BPDs has not yet reached its full potential. Their profitability indicators have not entirely represented their overall operational performance as part of the national banking industry. As financial institutions that are expected to contribute significantly to regional advancement, BPDs are required to operate efficiently and competitively (Olilingo & Putra, 2020). The banking industry itself is highly vulnerable to macroeconomic fluctuations, which may trigger financial instability. From a regulatory standpoint, banks that operate inefficiently face greater exposure to risk and are more susceptible to financial distress or even failure. Moreover, banking efficiency is closely linked to broader economic productivity. An economy will struggle to function effectively without a sound and efficient banking system.

In this context, evaluating the technical efficiency of BPDs—both those operating under conventional systems and those that have converted to sharia principles—becomes increasingly relevant. Efficiency can be assessed by comparing performance before and after conversion, thereby identifying whether banks demonstrate better technical efficiency following their transformation into Islamic banking institutions. Empirical studies that specifically compare the efficiency levels of BPDs before and after conversion remain relatively scarce. Therefore, further investigation is necessary to provide a clearer understanding of efficiency performance in both conditions. The findings may also serve as a strategic reference for other regional banks considering conversion as a means to enhance competitiveness and expand the market share of Islamic banking in Indonesia. For this reason, this research focuses on analyzing the efficiency of Islamic Regional Development Banks using the Data Envelopment Analysis (DEA) approach.

This study is designed to measure the technical efficiency level of Regional Development Banks in Indonesia. Additionally, it aims to determine whether several financial indicators—namely Total Assets (as a proxy for size), Return on Assets (ROA), Non-Performing Loans (NPL), Capital Adequacy Ratio (CAR), Loan to Deposit Ratio (LDR), Operating Expenses to Operating Income (BOPO), and Net Interest Margin (NIM)—significantly influence the technical efficiency of BPDs in Indonesia.

LITERATURE REVIEW

Banking Efficiency

The assessment of banking efficiency generally focuses on technical efficiency as a core indicator. In evaluating bank performance, several analytical perspectives may be applied, such as the production and intermediation approaches using nonparametric techniques like Data Envelopment Analysis (DEA), as well as cost and profit efficiency approaches. Each of these perspectives offers a different lens for understanding how effectively a bank operates (Korneyev et al., 2022; Mai et al., 2023; Sohn & Ju, 2023). Technical efficiency reflects a bank's ability to utilize its resources in the most productive manner. In simple terms, it shows whether a bank can reduce the quantity of inputs used to generate a certain level of output or, conversely, increase output without adding more inputs. This concept is commonly divided into two elements: pure technical efficiency and scale efficiency. Pure technical efficiency relates to managerial capability in managing and allocating available resources. When this component is high, it indicates that management has effectively optimized operational processes. Scale efficiency, on the other hand, concerns whether the bank operates at an optimal size. It examines whether the institution has fully benefited from economies of scale. If scale efficiency is low, it suggests that adjustments in operational size are still needed. Improvements in scale efficiency will ultimately enhance overall technical efficiency. In practice, efficiency measurement in banking typically relies on two principal viewpoints: the production approach and the intermediation approach. Under the production perspective, banks are treated as entities that produce services—particularly deposit and loan services—by employing inputs such as labor and capital. Meanwhile, the intermediation perspective views banks primarily as intermediaries that collect funds from depositors and transform them into loans or other earning assets. Because these approaches conceptualize banking activities differently, they also differ in how inputs and outputs are defined (Abidin et al., 2021; Čiković et al., 2022; Mai et al., 2023; Patra et al., 2023; Zuo et al., 2023).

Measuring Bank Efficiency

Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) was introduced by Charnes, Cooper, and Rhodes in 1978 as a nonparametric method to evaluate the relative efficiency of Decision Making Units (DMUs), including banks. The main objective of DEA is to compare each unit with a set of similar units in order to determine which ones operate efficiently. The method constructs an efficiency frontier formed by the best-performing units and measures how far other units deviate from that frontier (Yudistira, 2004). DEA commonly applies two models: Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS). The CRS model assumes that all DMUs function at an optimal scale, meaning that proportional increases in inputs will lead to proportional increases in outputs. In contrast, the VRS model relaxes this assumption by acknowledging that not all units operate at optimal scale. Under VRS, changes in input do not necessarily result in equal proportional changes in output, allowing for increasing or decreasing returns to scale.

Stochastic Frontier Analysis (SFA)

Stochastic Frontier Analysis (SFA) represents a parametric alternative for measuring efficiency. Developed independently by Aigner, Lovell, and Schmidt, as well as by Meeusen and Van den Broeck in 1977, SFA has been widely applied in banking efficiency studies, particularly in developed economies and transitional countries. A key strength of SFA lies in its ability to distinguish inefficiency from random statistical disturbances. By separating these two components, the method reduces the risk that inefficiency estimates are distorted by external shocks or measurement errors. Nevertheless, SFA requires the specification of a particular functional form for the production or cost function, which can be restrictive. If the chosen functional form is incorrect, it may blur the distinction between inefficiency and model misspecification. Although SFA relies on strong assumptions regarding the error structure, it offers advantages over nonparametric methods in handling random noise. In contrast, nonparametric approaches such as DEA do not explicitly account for statistical error. In many SFA-based banking studies, input prices are incorporated into the estimation of the efficiency frontier. However, this practice may create complications, especially when the analysis is grounded in cost-minimization or profit-maximization frameworks that assume perfectly competitive input markets. In reality, proxies for input prices often contain measurement inaccuracies, which may influence the estimation results.

METHODOLOGY

This research adopts a quantitative causal (associative) approach aimed at examining the relationships among several variables using secondary data derived from Regional Development Banks (BPD). To analyze the data, two main analytical techniques are employed. First, Data Envelopment Analysis (DEA) is utilized as a non-parametric linear programming method to evaluate the relative efficiency of each Decision Making Unit (DMU) by comparing it to an efficiency frontier constructed from the best-performing units. This approach assesses how effectively multiple inputs are transformed into desired outputs (Goyal et al., 2019; Mahmoudi et al., 2019; Wanke et al., 2020; Yilmaz & Güneş, 2015). Second, panel data regression analysis is applied to identify the factors influencing bank efficiency. The estimated model is expressed as:

$$\begin{aligned} \text{EBPD}_{it} = & \alpha_0 + \beta_1 \text{SIZE}_{it} + \beta_2 \text{ROA}_{it} + \beta_3 \text{NPL}_{it} + \beta_4 \text{CAR}_{it} + \beta_5 \text{LDR}_{it} + \beta_6 \text{BOPO}_{it} \\ & + \beta_7 \text{NIM}_{it} + \varepsilon_{it} \end{aligned}$$

where ; $i = 1, 2, \dots, N$; $t = 1, 2, \dots, T$

In this model, EBPD_{it} denotes the efficiency level of Regional Development Banks, while the explanatory variables include Total Assets (Size), Return on Assets (ROA), Non-Performing Loans (NPL), Capital Adequacy Ratio (CAR), Loans to Deposit Ratio (LDR), Operating Costs to Operating Income (BOPO), and Net Interest Margin (NIM).

RESEARCH RESULT AND DISCUSSION

Technical Efficiency Level of Regional Development Banks (BPD) in Indonesia

The findings indicate that the overall technical efficiency of Regional Development Banks (BPD) in Indonesia remains relatively low when evaluated using the DEA approach. The average efficiency score under the Constant Return to Scale (CRSTE) assumption is 0.20, while the average score under the Variable Return to Scale (VRSTE) assumption is slightly higher at 0.21. Meanwhile, the average scale efficiency reaches 0.94, suggesting that most BPDs are operating close to an optimal scale, although their ability to utilize inputs efficiently is still limited.

When examining the highest observed efficiency levels, the maximum average CRSTE value reaches 0.39 and the VRSTE value reaches 0.40. In terms of scale efficiency, the highest average value recorded is 0.98 (98%). These results imply that although some BPDs are approaching optimal scale conditions, improvements in managerial performance and resource allocation are still required to enhance pure technical efficiency. In other words, inefficiency is more likely driven by internal operational factors rather than scale constraints. These findings are consistent with previous empirical studies. Research conducted by Vistarani Dwi et al. (2018) shows that the average technical efficiency of BPD expansion banks exceeded 90 percent, indicating a tendency toward improved performance. Similarly, Zaenal Abidin and Endri Endri (2019) found that BPDs experienced increasing operational efficiency over time, although the efficiency level had not yet reached the ideal benchmark of 100 percent. This suggests that while progress has been made, there remains untapped potential in optimizing input utilization to generate maximum output.

Further analysis based on asset classification reveals that BPDs with larger total assets tend to demonstrate higher efficiency levels compared to medium- and small-sized BPDs. Larger banks generally benefit from better economies of scale, stronger capital structures, and more advanced management systems. This observation aligns with the findings of Fadhlullah and Ahmad Husein (2015), who reported that none of the Sharia BPDs achieved full efficiency (100 percent). Among them, BPD West Kalimantan Syariah recorded the highest efficiency score at 90.42 percent, while BPD Syariah West Sumatra was identified as the least efficient. Moreover, the average efficiency of 15 Sharia BPDs during the 2008–2012 period showed a steady upward trend, increasing from 33.57 percent in 2008 to 71.81 percent in 2012. Overall, the evidence indicates that although BPDs have shown gradual improvement in efficiency, their technical performance is still below optimal levels. Strengthening managerial capability, improving operational effectiveness, and enhancing resource allocation strategies are necessary to achieve higher efficiency scores.

Financial Ratio Variables Influencing the Efficiency of Regional Development Banks (BPD) in Indonesia

The panel data regression results demonstrate that several financial performance indicators significantly influence the efficiency of Regional Development Banks in Indonesia. These variables include SIZE (Total Assets),

Return on Assets (ROA), Non-Performing Loans (NPL), Capital Adequacy Ratio (CAR), Loans to Deposit Ratio (LDR), Operating Costs to Operating Income (BOPO), and Net Interest Margin (NIM).

Total Assets (SIZE) reflect the scale of bank operations and the bank's capacity to expand its intermediation function. Banks with larger asset bases generally possess stronger financial flexibility and greater opportunities to optimize input-output combinations, which positively contribute to efficiency. ROA, as a profitability indicator, reflects management's ability to generate earnings from total assets. Higher profitability is typically associated with more efficient operational performance. Conversely, a higher level of Non-Performing Loans (NPL) tends to reduce efficiency, as problem loans increase risk exposure and require additional provisioning costs. Similarly, an inappropriate Loans to Deposit Ratio (LDR) may signal inefficiencies in liquidity management. The Capital Adequacy Ratio (CAR) also plays a crucial role, as adequate capital strengthens the bank's resilience and supports operational stability.

The BOPO ratio, which measures operational cost efficiency, has a direct relationship with overall bank efficiency. A higher BOPO indicates greater operational expenses relative to income, thereby reducing efficiency levels. Meanwhile, Net Interest Margin (NIM) reflects the bank's ability to generate interest income from productive assets. A higher NIM generally contributes positively to efficiency, as it indicates effective asset management and intermediation performance. Taken together, these findings confirm that both structural factors (such as asset size and capital strength) and performance-related indicators (profitability, cost management, credit quality, and liquidity management) jointly determine the technical efficiency of Regional Development Banks in Indonesia.

CONCLUSIONS AND RECOMMENDATIONS

The results indicate that the technical efficiency of Regional Development Banks (BPD) in Indonesia is still relatively low. The average CRSTE value is 0.20 and the VRSTE value is 0.21, while the average scale efficiency reaches 0.94, suggesting that most BPDs operate near optimal scale but have not maximized their input utilization. The highest CRSTE and VRSTE values are 0.39 and 0.40, with scale efficiency reaching 0.98. These findings are consistent with Vistarani Dwi et al. (2018) and Zaenal Abidin and Endri Endri (2019), which show improving but not yet fully efficient performance. Similarly, Fadhlullah and Ahmad Husein (2015) found that no Sharia BPD achieved full efficiency. Larger-asset BPDs tend to be more efficient than smaller ones.

Furthermore, financial ratios significantly influence BPD efficiency, including SIZE, ROA, NPL, CAR, LDR, BOPO, and NIM. Asset size and profitability tend to improve efficiency, while high NPL and BOPO reduce it. Overall, both structural and performance factors determine the technical efficiency of BPDs in Indonesia.

ADVANCED RESEARCH

Future research can expand this study by comparing the efficiency of Regional Development Banks (BPD) with other banking groups to obtain broader benchmarking results. Further studies may also apply alternative methods such as SFA or dynamic panel models (e.g., GMM) to produce more robust findings. In addition, incorporating macroeconomic variables, governance factors, and digital banking indicators could provide a more comprehensive understanding of the determinants of BPD efficiency.

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