

THE EFFECT OF LIQUIDITY, INCOME DIVERSIFICATION, OPERATIONAL EFFICIENCY, CREDIT RISK, AND LEVERAGE ON THE STABILITY OF REGIONAL DEVELOPMENT BANKS (BPD) IN INDONESIA: PERIOD 2021–2025

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Abstract

Regional Development Banks (BPD) play a strategic role as intermediary institutions supporting regional economic development and maintaining the stability of the regional financial system. Therefore, the ability of BPDs to maintain financial stability is a crucial aspect to ensure the sustainability of their intermediation function and increase their contribution to the regional economy. This study aims to analyze the effect of internal bank factors, including liquidity, revenue diversification, operational efficiency, credit risk, and leverage, on the stability of Regional Development Banks in Indonesia. This study uses a quantitative approach with secondary data obtained from the annual financial reports of 24 Regional Development Banks for the period 2021–2025. Data analysis was conducted using panel data regression with a Random Effects Model (REM) approach. The results show that revenue diversification and operational efficiency have a positive and significant effect on BPD stability, while credit risk has a negative and significant effect on BPD stability. Meanwhile, liquidity and leverage do not significantly affect BPD stability. These findings indicate that BPDs' ability to expand revenue sources, improve operational efficiency, and control credit risk is a more decisive factor in maintaining stability than liquidity management and funding structure. This study provides empirical evidence regarding the determinants of BPD stability in Indonesia and enriches the literature on regional banking stability. In addition, the research results are expected to be used as consideration for BPD management and regulators in formulating policies that support strengthening the resilience and sustainability of the regional banking industry.

Keywords: Bank Stability, Credit Risk, Income Diversification, Leverage, Operational Efficiency, Liquidity, Z-Score

INTRODUCTION

Banking stability is a crucial prerequisite for maintaining the financial system stability and supporting economic growth. Stable banks are able to effectively perform their intermediary function, withstand shocks and manage risks effectively, and maintain public trust in the banking system. In the Indonesian context, Regional Development Banks (BPDs) play a strategic role as agents of regional development by mobilizing and channeling funds, extending credit to productive sectors, and managing local government finances. Therefore, the BPDs' ability to maintain financial stability is crucial to supporting regional economic development and strengthening the resilience of the national financial system.

Strengthening the stability of regional development banks (BPD) is has become a key regulatory concern. The Financial Services Authority (OJK), through its Roadmap for Strengthening Regional Development Banks (2024–2027), emphasizes the importance of transforming BPDs to become more competitive, efficient, and resilient in facing the dynamics of the banking industry. However, the level of stability among BPDs in Indonesia still shows significant variation. This is reflected in the differences in Z-scores across BPDs over the 2021–2025 period, indicating differences in each bank's ability to manage risk and maintain financial performance. This variation

demonstrates that bank stability is influenced not only by external factors but also by the bank-specific characteristics and internal management practices.

Financial intermediation theory, as proposed by Diamond (1984), suggests that, banks function as intermediaries between those with excess funds and those in need. In carrying out this function, banks face various risks that can impact their operational stability. Meanwhile, risk management theory emphasizes that a bank's ability to identify, measure, and manage risk is a key factor in maintaining financial stability. Furthermore, the portfolio diversification theory proposed by Markowitz (1952) states that diversification can reduce risk and increase stability by diversifying income sources. Based on these three theories, liquidity, revenue diversification, operational efficiency, credit risk, and leverage are internal factors that have the potential to affect bank stability.

Prior studies have examined the determinants of banking stability. Some studies found that liquidity has a positive effect on bank stability, while others found an insignificant effect. Similarly, the effects of credit risk and leverage on bank stability have inconsistent findings. The inconsistent findings indicate that the relationship across internal bank factors and bank stability requires further empirical.

In addition to the inconsistent findings reported in previous studies, the literature on banking stability is dominated by studies focusing on conventional commercial banks and Islamic banks, while research specifically examining Regional Development Banks (BPD) in Indonesia is relatively limited. BPDs, however, have distinct characteristics because they are not only oriented toward profitability but also entrusted with regional development functions. To address this empirical gap, this study develops a more comprehensive model by simultaneously analyzing the effects of liquidity, revenue diversification, operational efficiency, credit risk, and leverage on BPD stability in Indonesia using data from 2021–2025.

LITERATURE REVIEW

A. Bank Stability

Bank stability refers to the condition in which a bank can continuously perform its intermediation function without experiencing significant financial disturbances. It reflects the bank's capacity to manage risk, maintain liquidity, and sustain financial performance over the long term (Wulandari & Hwihnus, 2025). In the banking literature, stability is frequently proxied by the Z-score, calculated as: $Z\text{-score} = (ROA + EAR) / \sigma ROA$, where ROA is return on assets, EAR is the equity-to-assets ratio, and σROA is the standard deviation of ROA. A higher Z-score implies greater stability (Adem, 2022; Kurnia et al., 2024).

B. Liquidity

Liquidity denotes a bank's ability to meet short-term obligations, including deposit withdrawals and other operational liabilities (Utama, 2023). In intermediation theory, adequate liquidity allows banks to channel third-party funds productively into credit without disrupting financial stability. Liquidity is commonly measured by the Loan-to-Deposit Ratio (LDR): $LDR = \text{Total Credit} / \text{Total Third-Party Funds} \times 100\%$. An optimal LDR supports income generation through credit expansion, which strengthens profitability and, in turn, stability. However, evidence on this relationship remains mixed (Hartono, 2024; Fitriya et al., 2025).

C. Income Diversification

Income diversification is a strategy by which banks broaden their revenue base beyond interest income to include non-interest sources such as fee-based income, commissions, digital banking services, and treasury activities (Kusumadewi et al., 2024). Based on modern portfolio theory, spreading income sources reduces revenue volatility and enhances resilience to economic shocks. Diversification is measured using the Herfindahl–Hirschman Index: $HHI = 1 - [(INT/TOT)^2 + (NON/TOT)^2]$, where INT is interest income, NON is non-interest income, and TOT is total income. Values range from 0 to 0.5, with higher values indicating greater diversification (Adem, 2022).

D. Operational Efficiency

Operational efficiency reflects a bank's capacity to optimise operational costs relative to its operating income. It is measured using the Operating Expense-to-Operating Income Ratio (BOPO): $BOPO = \text{Total Operating Expenses} / \text{Total Operating Income} \times 100\%$. Because BOPO has an inverse relationship with efficiency a lower ratio signals higher efficiency improvements in BOPO are expected to raise profitability and strengthen bank stability. Irawan et al. (2025) and Hartono (2024) confirm that BOPO has a significant negative effect on bank stability, implying that operational efficiency exerts a positive effect.

E. Credit Risk

Credit risk represents the potential loss arising from borrowers' failure to fulfil their obligations (Aji & Manda, 2021). It is measured through the Non-Performing Loan (NPL) ratio: $NPL = \text{Total Non-Performing Loans} / \text{Total Loans} \times$

100%. Higher NPL reduces interest income, increases loan-loss provisions, and ultimately lowers profitability and stability. Under risk management theory, effective credit quality management is essential for preserving bank soundness (Nguyen et al., 2020; Damayanti & Mawardi, 2022).

F. Leverage

Leverage indicates the extent to which a bank's operations are financed by liabilities relative to equity. It is measured by the Debt-to-Equity Ratio (DER): $DER = \text{Total Liabilities} / \text{Total Equity} \times 100\%$. Trade-off theory posits that excessive leverage amplifies financial risk and reduces stability, while moderate leverage can enhance intermediation capacity and profitability. However, in the banking industry the DER is structurally elevated because customer deposits are classified as liabilities, meaning a high DER does not necessarily signal financial distress (Alabbas, 2025; Sinaga et al., 2024).

G. Hypotheses

Based on the theoretical foundations and prior empirical evidence, the following hypotheses are proposed:

H1: Liquidity has a positive effect on BPD stability.

H2: Income diversification has a positive effect on BPD stability.

H3: Operational efficiency has a positive effect on BPD stability.

H4: Credit risk has a negative effect on BPD stability.

H5: Leverage has a negative effect on BPD stability.

METHOD

This study employs a quantitative research design with a causal approach, analysing panel data from 24 conventional BPDs over the period 2021–2025. The sample was selected using purposive sampling based on four criteria: (1) operating under conventional banking principles during the study period; (2) officially registered with OJK and publishing complete audited annual financial reports for each year from 2021 to 2025; (3) providing complete data for all study variables; and (4) not having undergone merger, acquisition, or licence revocation during the observation period. Three BPDs that had fully converted to Islamic banking were excluded, yielding a final sample of 24 BPDs and 120 initial observations.

One BPD (BPD Banten) was identified as an outlier due to negative Z-scores in 2021 and 2022, an average BOPO of 118.63%, and an NPL reaching 14.09%, resulting in highly skewed distributions (skewness > 3.8, kurtosis > 22). Following its exclusion, the final dataset comprised 115 observations. All data were sourced from each BPD's official website, OJK publications, and Indonesian Banking Statistics.

The panel regression model estimated is: $Z\text{-Score}_{it} = \alpha + \beta_1 LDR_{it} + \beta_2 HHI_{it} + \beta_3 BOPO_{it} + \beta_4 NPL_{it} + \beta_5 DER_{it} + \varepsilon_{it}$

The appropriate model specification was selected through three sequential tests: The Chow test favored the Fixed Effect Model, whereas the Hausman and Lagrange Multiplier tests supported the Random Effect Model. Therefore, the Random Effect Model was selected for further analysis. Classical assumption tests—normality and multicollinearity—were conducted. The results of the normality test indicate that the data are not normally distributed. According to the Central Limit Theorem (CLT), a large sample size allows the sampling distribution to approximate a normal distribution, so the regression model can still be used for further analysis. The highest inter-variable correlation was 0.337 (BOPO and NPL), well below the threshold of 0.8, therefore, there is no multicollinearity was detected. All analyses were performed using Eviews 13.

Table 1. Operational Definition of Variables

Variable	Operational Definition	Measurement Formula	Scale
Bank Stability	Ability of a bank to sustain healthy financial performance and avoid insolvency risk.	$Z\text{-score} = (\text{ROA} + \text{EAR}) / \sigma\text{ROA}$	Ratio
Liquidity	Capacity to meet short-term obligations and support continuous intermediation.	$\text{LDR} = \text{Total Credit} / \text{Total Third-Party Funds} \times 100\%$	Ratio
Income Diversification	Strategy to broaden income sources beyond interest income.	$\text{HHI} = 1 - [(\text{INT}/\text{TOT})^2 + (\text{NON}/\text{TOT})^2]$	Ratio
Operational Efficiency	Ability to manage operating costs effectively to maximise operating income.	$\text{BOPO} = \text{Total Operating Expenses} / \text{Total Operating Income} \times 100\%$	Ratio
Credit Risk	Potential loss from borrower default on contractual obligations.	$\text{NPL} = \text{Total Non-Performing Loans} / \text{Total Loans} \times 100\%$	Ratio
Leverage (DER)	Degree to which bank operations are funded by liabilities versus equity.	$\text{DER} = \text{Total Liabilities} / \text{Total Equity} \times 100\%$	Ratio

RESULTS AND DISCUSSION

A. Descriptive Statistics

Table 2 presents the descriptive statistics for all variables following outlier elimination ($n = 115$).

Table 2. Descriptive Statistics of Research Variables

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Obs.
Z-score	12.5573	9.1700	61.1100	1.3200	11.8869	115
LDR (%)	85.7398	84.6900	116.2400	49.4300	10.2670	115
HHI	0.1503	0.1400	0.3000	0.0000	0.0606	115
BOPO (%)	76.9553	77.2700	93.9400	60.3800	7.2767	115
NPL (%)	2.4009	2.4900	4.5400	0.6400	0.8633	115
DER (%)	660.58	645.01	1129.09	357.36	164.81	115

Source: BPD Financial Reports, processed with EViews 13

The mean Z-score of 12.56 reflects moderate-to-good stability across the sample BPDs. The highest Z-score of 61.11 was recorded by BPD DIY in 2023, while the lowest of 1.32 was posted by Bank Jakarta in 2025, indicating wide variation in financial resilience. The mean LDR of 85.74% falls within OJK's healthy range. The average HHI of 0.1503 suggests that BPDs remain predominantly reliant on interest income, leaving significant room for diversification. A mean BOPO of 76.96% is classified as 'highly healthy' by OJK, although values approaching 94% highlight pockets of inefficiency. The mean NPL of 2.40% is below the 5% regulatory threshold, indicating generally sound credit quality. The high average DER of 660.58% is consistent with the nature of banking, where customer deposits constitute the bulk of funding.

B. Model Selection

The Chow test yielded a Cross-section F-statistic of 1,017.39 ($p < 0.01$), rejecting the Common Effect Model (CEM) in favour of the Fixed Effect Model (FEM). The Hausman test produced a Chi-Square statistic of 5.79 ($p = 0.328$), failing to reject the null hypothesis and indicating that the Random Effect Model (REM) is more efficient. The Lagrange Multiplier test returned a Breusch-Pagan statistic with $p < 0.01$ for the cross-section dimension, confirming the superiority of REM over CEM. Accordingly, REM was adopted as the estimation model.

C. Hypothesis Testing Results

Table 3 presents the panel regression results under the Random Effect Model.

Table 3. Results of Panel Regression (Random Effect Model)

Variable	Coefficient	Std. Error	t-Statistic	Probability
Constant	24.0106	3.2504	7.3869	0.0000
LDR (X1)	0.0040	0.0115	0.3480	0.7285
HHI (X2)	10.0573	3.7844	2.6575	0.0091
BOPO (X3)	−0.1623	0.0213	−7.6115	0.0000
NPL (X4)	−0.3489	0.1515	−2.3031	0.0232
DER (X5)	0.0000	0.0013	0.0220	0.9825
R-squared	0.4414		Adj. R ²	0.4158
F-statistic	17.2290		Prob(F)	0.0000

The F-statistic of 17.229 ($p < 0.001$) confirms the joint significance of all independent variables. The R-squared of 0.4414 indicates that the model explains 44.14% of the variation in BPD stability; the remaining 55.86% may be attributed to macro-economic factors, governance quality, or other bank-specific variables outside the model's scope.

a) Effect of Liquidity on BPD Stability (H1)

The research results show that liquidity does not significantly influence the stability of Regional Development Banks (BPD) in Indonesia, thereby failing to support H1. This finding indicates that the liquidity position of BPDs is not yet a primary factor determining bank stability. Although financial intermediation theory explains that adequate liquidity is necessary for banks to perform their intermediation role effectively, high liquidity does not always improve stability if it is not accompanied by efficient asset allocation and effective credit management. During the study period, the average Loan to Deposit Ratio (LDR) of BPDs was 85.75%, still within the range recommended by Bank Indonesia, which is 78%–92%. This means that most BPDs experienced maintained relatively adequate liquidity positions. This condition results in relatively small variations in liquidity between banks, thereby limiting its ability to explain variations in BPDs stability.

Furthermore, high liquidity does not always reflect a bank's ability to generate profits and manage risks effectively. Banks with high liquidity tend to hold more liquid assets, which provide lower returns than income-generating loans. Conversely, banks that extend credit more aggressively also face increased credit and liquidity risks. This situation indicates a trade-off between liquidity and profitability, implying that increased liquidity does not automatically increase the Z-score, an indicator of bank stability. In other words, liquidity primarily serves as a buffer against short-term risks, while bank stability is more determined by the ability to generate sustainable profits and manage risks.

The relatively stable third-party funding base of Regional Development Banks (BPDs), particularly deposits from local governments, may help explain why liquidity is not a dominant determinant of stability. The availability of relatively stable funding sources could have mitigated most BPDs were less exposed to liquidity pressures during the study period.

b) Effect of Income Diversification on BPD Stability (H2)

The HHI coefficient is positive and significant ($\beta = 10.057$, $p = 0.009$), supporting H2. This result confirms that BPDs with more diversified income structures exhibit higher financial stability. When banks generate income from both interest and non-interest sources, their dependence on any single revenue stream decreases, thereby dampening income volatility. For BPDs which are traditionally reliant on interest income from lending developing non-interest revenue channels such as digital banking, QRIS-based UMKM services, government treasury

management, and fee-based products constitutes a critical strategic imperative. These findings align with Adem (2022) and Kusumadewi et al. (2024), both of which document a positive and significant link between income diversification and bank stability in emerging-market contexts.

c) Effect of Operational Efficiency on BPD Stability (H3)

The results of the study indicate that the Operating Cost to Operating Income (BOPO) ratio has a negative and significant effect on the Z-Score ($\beta = -0.1623$, $p < 0.001$). This finding essentially supports the research hypothesis that operational efficiency has a positive effect on bank stability. This is because operational efficiency in this study is proxied by BOPO, which has an inverse relationship with the level of efficiency. A higher BOPO ratio indicates a lower level of operational efficiency because the costs incurred are relatively greater than the operating income earned. Conversely, a lower BOPO ratio reflects a higher level of operational efficiency. Therefore, the negative effect of BOPO on stability can be interpreted as a positive effect of operational efficiency on BPD stability. Banks that are able to control operational costs effectively will have better profitability, thereby increasing the bank's ability to absorb risks and strengthening financial resilience. This condition ultimately increases the Z-score value and reduces the risk of financial distress. This finding is in line with risk management theory which emphasizes the importance of efficient resource management to maintain operational sustainability and bank stability.

d) Effect of Credit Risk on BPD Stability (H4)

The NPL coefficient is negative and significant ($\beta = -0.3489$, $p = 0.023$), supporting H4. Rising non-performing loans reduce interest income, trigger higher loan-loss provisions (CKPN), and increase earnings volatility each of which directly depresses the Z-score's ROA and σ ROA components. BPDs with lower NPL ratios consistently demonstrate stronger profitability and capital adequacy, translating into higher Z-scores. Effective credit risk management encompassing rigorous credit analysis, continuous portfolio monitoring, proactive restructuring, and robust risk governance is therefore essential for sustaining BPD stability. These findings are consistent with Nguyen et al. (2020) and Damayanti and Mawardi (2022), who confirm the negative and significant relationship between NPL and bank stability.

e) Effect of Leverage on BPD Stability (H5)

The DER coefficient is positive but statistically insignificant ($\beta = 0.0000$, $p = 0.983$), leading to the rejection of H5. In the banking industry, a structurally high DER is inevitable because customer deposits the core funding source are recorded as liabilities, naturally elevating the ratio relative to non-financial firms. As long as BPDs maintain adequate capital (KPM) as required by OJK and manage their assets productively, a high DER does not necessarily represent a heightened stability risk. External funding channelled effectively into quality credit portfolios can support income growth and strengthen intermediation capacity without undermining stability. These results are in line with Sinaga et al. (2024) and the broader banking literature, which cautions against direct comparisons of DER between banks and non-financial entities. Future research should consider alternative leverage proxies more aligned with banking regulation, such as the Capital Adequacy Ratio (CAR) or the regulatory leverage ratio.

CONCLUSION

This study analysed the influence of liquidity, income diversification, operational efficiency, credit risk, and leverage on the stability of 24 conventional Regional Development Banks (BPDs) in Indonesia over the period 2021–2025, using a Random Effect panel regression model with 115 observations.

The main findings are as follows. First, liquidity (LDR) has a positive but statistically insignificant effect on BPD stability, reflecting the structural reliance of BPDs on seasonal government funds and the absence of meaningful differentiation in liquidity management across the sample. Second, income diversification (HHI) has a positive and significant effect, confirming that broader revenue bases beyond interest income substantially reduce earnings volatility and enhance resilience. Third, operational

efficiency (BOPO) has a positive and significant effect (reflected through an inverse BOPO–stability relationship), demonstrating that cost control is a key pillar of financial stability. Fourth, credit risk (NPL) has a negative and significant effect, underscoring that deteriorating loan quality erodes profitability and capital adequacy, thereby destabilising banks. Fifth, leverage (DER) has a positive but insignificant effect, attributable to the peculiar nature of bank balance sheets where deposits constitute liabilities; what matters is not the raw DER but rather the adequacy of capital to absorb risk.

These findings carry important practical implications. BPDs should prioritise the development of non-interest income streams, pursue systematic cost efficiency through digitalisation, and strengthen credit risk governance. Regulators, particularly OJK and Bank Indonesia, should reinforce supervisory frameworks that promote income diversification and operational modernisation in line with the BPD Strengthening Roadmap 2024–2027. Future research is encouraged to incorporate macro-economic variables (e.g., GDP growth, inflation, interest rates), bank governance indicators, and more sector-appropriate leverage measures such as CAR, in order to provide a more comprehensive explanation of BPD stability dynamics.

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