

The Effect of Credit Risk, Liquidity Risk, and Operational Efficiency on The Profitability of PT Bank Mandiri (Persero) Tbk

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Abstract

This study aims to analyze the impact of credit risk (NPL), liquidity risk (LDR), and operational efficiency (BOPO) on banking profitability, as proxied by Return on Assets (ROA) and Return on Equity (ROE), at PT Bank Mandiri (Persero) Tbk. The study uses quarterly secondary data for the period 2016Q1–2025Q4 (n=40) sourced from the company's quarterly financial reports. The analysis technique used is Ordinary Least Squares (OLS) with Newey-West Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors to address violations of the autocorrelation assumption detected through the Breusch-Godfrey test. The results of the study indicate that: (1) NPL has a significant positive effect on ROA ($\beta=0.132$; $p=0.015$) and a significant negative effect on ROE ($\beta=-1.310$; $p=0.001$); (2) LDR has a significant positive effect on ROA ($\beta=0.033$; $p<0.001$) but is not significant for ROE; (3) BOPO has a significant negative effect on both ROA and ROE at the 1% significance level. The model explains 94.1% of the variation in ROA and 92.2% of the variation in ROE. These findings imply that operational efficiency is the most dominant determinant of Bank Mandiri's profitability, while the unique relationship between NPL and ROA reflects the effects of the risk premium and credit restructuring policies during the pandemic era.

Keywords: Bank Mandiri ;Credit Risk; NPL; LDR; BOPO; ROA; ROE; Newey-West HAC

INTRODUCTION

The banking sector occupies a central position in Indonesia's financial system architecture due to its role as an intermediary that channels funds from surplus parties to deficit parties. Banking stability and profitability are crucial indicators of national macroeconomic resilience, particularly in the post-COVID-19 era and amid global dynamics marked by geopolitical uncertainty, volatile benchmark interest rates, and the acceleration of digital transformation. As the largest state-owned systemic bank, PT Bank Mandiri (Persero) Tbk serves as a barometer of the national banking sector's health and a key pillar of the National Economic Recovery program.

(Ariefianto et al. 2024) found that the dynamic relationship between credit risk, profitability, and capital adequacy in the Indonesian banking sector requires an equilibrium period of 2.11–3.73 months, meaning that delays in managerial responses can trigger a domino effect on micro- and macro-level banking stability.

Bank profitability is influenced by a combination of internal factors that can be controlled by management, including credit risk, liquidity risk, and operational efficiency. Credit risk, as proxied by Non-Performing Loans (NPLs), reflects the quality of a bank's earning assets. High NPLs result in increased provisions for impairment losses (CKPN), a decline in interest income, and a weakening of the capital structure (Pepur and Tripović 2017; Kalkan 2025). Liquidity risk, measured by the Loan to Deposit Ratio (LDR), reflects the balance between intermediation functions and liquidity availability. Meanwhile, operational efficiency, proxied by the Operational Expense to Operating Income Ratio (BOPO), is a key determinant of banking profitability as it

reflects a bank's ability to manage costs productively (Buchory et al. 2016; Sherlita and Utami 2019).

The inconsistency of findings in the Indonesian banking literature is a pressing research issue that needs to be addressed. Sherlita and Utami (2019) and Rohman et al. (2022) reported that NPLs have a significant negative effect on ROA, whereas Rifqah and Hassan (2019) found that the impact of NPLs on profitability varies across banks. Yudaruddin et al. (2024) add that the development of FinTech moderates this relationship. Jalali et al. (2023) used the FMOLS approach in E7 countries and found that the LDR has a significant effect on NPLs, but the direction of the LDR's effect on ROA-ROE remains inconclusive. It is this contradiction that forms the research gap of this study, particularly in the context of state-owned systemic banks facing dual pressures, among them commercial and socio political.

Previous studies specifically examining these three determinants simultaneously in relation to Bank Mandiri's profitability remain very limited and generally rely on annual data with short time horizons. Furthermore, most studies have not accounted for time-series characteristics such as autocorrelation commonly found in quarterly financial ratio data. This study contributes to filling this gap by using: (a) high-resolution quarterly data spanning 40 quarters (2016Q1–2025Q4) covering the pre-pandemic, pandemic, and recovery periods; and (b) the application of Newey - West HAC standard errors to produce valid estimates when the assumptions of homoscedasticity and or non autocorrelation are violated.

Based on the background and research gaps outlined above, this study aims to analyze the impact of credit risk proxied by Non Performing Loans (NPLs) liquidity risk proxied by the Loan to Deposit Ratio (LDR) and operational efficiency, proxied by the Operating Expense to Operating Income Ratio (BOPO), on the profitability of PT Bank Mandiri (Persero) Tbk, measured using Return on Assets (ROA) and Return on Equity (ROE), during the period 2016 Q1 until 2025 Q4. Specifically, this study examines the effect of each independent variable on profitability as well as their simultaneous effects. The results of this study are expected to provide an empirical contribution to the development of banking risk management literature and serve as a basis for bank management to improve profitability performance through more optimal risk management and operational efficiency.

LITERATURE REVIEW

This section presents the theoretical framework and prior empirical evidence underlying the relationship between bank-specific risk, operational efficiency, and profitability. This review is structured around the core concepts of this study credit risk, liquidity risk, operational efficiency, and profitability and concludes with the formulation of the research hypotheses.

Theories of Banking Profitability and Risk Management

As financial intermediaries, commercial banks generate profits by converting deposits into productive assets; thus, their profitability reflects how effectively management balances the returns and risks inherent in this process. Within the framework of banking risk management, the quality of profit-generating assets, adequate liquidity, and discipline in cost control collectively determine the sustainability of a bank's profits. The Pecking Order theory further explains that companies, including banks, prioritize internally generated funds over external financing, so that retained earnings strengthen the capital buffer needed to absorb risk. For state-owned systemic banks such as PT Bank Mandiri (Persero) Tbk, this mechanism operates under a dual mandate of commercial performance and national economic stability.

Credit risk and profitability

Credit risk, which is often represented by the ratio of non-performing loans (NPLs), reflects the probability that borrowers will default on their obligations. A higher NPL ratio increases impairment provisions, reduces interest income and weakens the capital structure (Pepur and Tripović 2017; Kalkan 2025). Most Indonesian studies report a negative correlation between NPLs and profitability. For example, Sherlita and Utami (2019) and Rohman et al. (2022), found that NPLs significantly reduced return on assets. However, the evidence is not uniform. For example, Rifqah and Hassan (2019) report that the impact of credit risk on profitability can vary between banks. Conversely, Othman and Gabbori (2024) document a risk premium channel through which banks facing higher credit risk can offset the adverse effect on asset returns by charging higher lending rates. This divergence highlights the need for a careful, multivariate analysis of the relationship between NPLs and profitability.

Liquidity Risk and Profitability

The loan-to-deposit ratio (LDR) is a measure of liquidity risk that reflects the balance between a bank's intermediation function and its liquidity availability. A higher LDR indicates more aggressive lending relative to third-party funds, which can improve asset utilization but also increase funding pressure. Jalali et al. (2023) applied an FMOLS approach to the E7 economies and found that the LDR significantly influences non-performing loans; however, the direction of its effect on profitability remains inconclusive. Similarly, Oanh et al. (2023) and Chabachib et al. (2019) show that bank liquidity supports operating performance, though its effect on equity returns may be moderated by capital structure.

Operational Efficiency and Profitability

Operational efficiency is measured by the ratio of operating expenses to operating income (BOPO). This ratio indicates management's ability to control costs productively. A lower BOPO ratio indicates greater efficiency and is consistently associated with higher profitability. Sherlita and Utami (2019), as well as Buchory (2016), identify operational efficiency as a primary determinant of banking profitability in Indonesia. Comparable findings have been reported for emerging markets by Gazi et al. (2024) and Pan et al. (2023). Since 2020, the accelerated digital transformation of large Indonesian banks has further strengthened this relationship by lowering cost-to-income ratios.

Profitability Measures and Hypothesis Development

Bank profitability is most often measured by return on assets (ROA) and return on equity (ROE). ROA measures how efficiently total assets generate pre-tax earnings, while ROE measures the return on shareholders' equity and is therefore sensitive to financial leverage. Since these two indicators have different denominators, a single risk factor may affect them by different amounts or in opposite directions. Based on the theoretical arguments and empirical evidence presented, this study proposes the following hypotheses:

- H1 : Credit risk (NPL) significantly affects the profitability (ROA and ROE) of PT Bank Mandiri (Persero) Tbk.
- H2 : Liquidity risk (LDR) significantly affects the profitability (ROA and ROE) of PT Bank Mandiri (Persero) Tbk.
- H3 : Operational efficiency (BOPO) significantly affects the profitability (ROA and ROE) of PT Bank Mandiri (Persero) Tbk.
- H4 : NPL, LDR, and BOPO have a significant joint effect on the ROA and ROE of PT Bank Mandiri (Persero) Tbk.

METHODS

This study uses a quantitative, explanatory design to investigate the causal relationships among the variables. The quantitative secondary data are quarterly financial ratios drawn from PT Bank Mandiri (Persero) Tbk's quarterly financial reports, which are officially published on the Financial Services Authority (OJK)'s website and the company's investor relations website. The population comprises all of Bank Mandiri's financial-ratio data since the bank went public. The sample was determined using a purposive sampling technique based on the criterion of the most recent and consistently available observation period 2016 Q1 until 2025 Q4 (n = 40 observations). The operational definitions and measurements of the variables are presented in Table I.

Table I The operational definitions and measurements

Variable	Concept	Measurement	Scale Unit
NPL (X1)	Credit Risk (Non-Performing Loan Gross)	$\frac{\text{Total Non Performing Loans}}{\text{Total Loans}} \times 100\%$	Ratio (%)
LDR (X2)	Liquidity Risk (Loan to Deposit Ratio)	$\frac{\text{Total Non Performing Loans}}{\text{Total Third Party Funds}} \times 100\%$	Ratio (%)
BOPO (X3)	Operational Efficiency	$\frac{\text{Operating Expenses}}{\text{Operating Income}} \times 100\%$	Ratio (%)
ROA (Y1)	Return on Assets (Profitability)	$\frac{\text{Pre tax Profit}}{\text{Total Assets}} \times 100\%$	Ratio (%)
ROE (Y2)	Return on Equity (Profitability)	$\frac{\text{Net Profit}}{\text{Total Equity}} \times 100\%$	Ratio (%)

Source: Adapted from Sherlita and Utami (2019), Buchory (2019), and SEOJK No. 14/SEOJK.03/2017.

Econometric Model

The econometric model is a multiple linear regression specified as two equations that are estimated separately:

$$ROA_t = \beta_0 + \beta_1 NPL_t + \beta_2 LDR_t + \beta_3 BOPO_t + \varepsilon_t \dots (1)$$

$$ROE_t = \beta_0 + \beta_1 NPL_t + \beta_2 LDR_t + \beta_3 BOPO_t + \varepsilon_t \dots (2)$$

where β_0 is the constant; β_1 , β_2 , and β_3 are the partial coefficients of NPL, LDR, and BOPO; and ε_t is the error term in period t.

Parameters are estimated using Ordinary Least Squares (OLS). Prior to interpreting the coefficients, a series of classical assumption tests is conducted, namely the Jarque-Bera normality test, the multicollinearity test based on the Variance Inflation Factor (VIF), the Breusch-Pagan-Godfrey heteroskedasticity test, and the Durbin-Watson and Breusch-Godfrey LM autocorrelation tests. When the assumptions of homoskedasticity and/or no autocorrelation are violated, OLS estimates remain consistent but the resulting standard errors become inefficient. To correct for this, the study applies Newey-West Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors, introduced by Newey and West (1987), with the number of lags following the automatic rule $L = [4 \cdot (n/100)^{(2/9)}] \approx 3$ for $n = 40$.

Hypothesis testing is carried out in two stages. The partial test (t-test) examines the individual significance of each coefficient, rejecting H_0 when the p-value is below 0.05. The simultaneous test (F-test) examines the joint significance of all independent variables. Goodness of fit is evaluated through the coefficient of determination (R^2) and the adjusted R^2 .

RESULTS AND DISCUSSION

Content of Results and Discussion

Descriptive Statistics

Table 2 presents descriptive statistics for all research variables. During the observation period, Bank Mandiri's average gross non-performing loan (NPL) ratio was 2.50%, ranging from 0.96% to 3.96%. This reflects a downward trend in credit risk. The average loan-to-deposit ratio (LDR) of 88.73% lies within Bank Indonesia's ideal LDR corridor of 78-92%. The average BOPO ratio of 65.48% is lower than the national banking industry average of around 78%, indicating a relatively high level of efficiency. An ROA of 2.95% and an ROE of 18.34% reflect consistently high profitability.

Table 2 Descriptive Statistics

Variable	N	Mean	Median	Min	Max	Std. Dev.
NPL (%)	40	2.4975	2.7350	0.9600	3.9600	1.0193
LDR (%)	40	88.7268	88.7650	77.6100	98.0400	4.9643
BOPO (%)	40	65.4802	66.5300	51.8800	80.9400	8.3434
ROA (%)	40	2.9530	3.0200	1.6400	4.0300	0.5798
ROE (%)	40	18.3358	16.6550	9.3600	27.3100	4.8379

Source: Data processing output, 2026.

Classical Assumption Tests

Classical assumption tests were conducted to ensure the validity of the OLS estimates; a summary is presented in Table 4. The Jarque-Bera test indicates that the residuals of both models are normally distributed ($p > 0.05$). The multicollinearity test shows VIF values for all variables below 10 (the highest being 3.31 for NPL), so there is no serious multicollinearity. The Breusch-Pagan-Godfrey test also fails to reject H_0 (homoskedastic residuals). However, the Breusch-Godfrey LM autocorrelation test (lag = 2) rejects H_0 for both models ($p = 0.0083$ for ROA and $p = 0.0027$ for ROE), indicating serial autocorrelation in the residuals. This violation of the no-autocorrelation assumption motivates the use of the Newey-West HAC correction, as recommended by the time-series econometrics literature (Newey and West 1987).

Table 4. Summary of Classical Assumption Test Results

Type of Test	Criterion	ROA Model	ROE Model
Jarque-Bera (Normality)	$p > 0.05 = \text{normal}$	JB=1.3545; $p=0.5080$ (Normal)	JB=1.6009; $p=0.4491$ (Normal)
VIF (Multicollinearity)	$VIF < 10 = \text{free}$	Max VIF=3.31 (Free)	Max VIF=3.31 (Free)
Breusch-Pagan (Heteroskedasticity)	$p > 0.05 = \text{homoskedastic}$	BP=1.7916; $p=0.6168$ (Homosked.)	BP=7.3656; $p=0.0611$ (Homosked.)
Durbin-Watson (Autocorrelation)	DW ≈ 2.00 (ideally 1.5-2.5)	DW=0.9882 (Autocorr. indicated)	DW=0.7281 (Autocorr. indicated)
Breusch-Godfrey LM (lag=2)	$p > 0.05 = \text{no autocorr.}$	BG=9.5881; $p=0.0083$ (Autocorr.)	BG=11.8127; $p=0.0027$ (Autocorr.)

Source: Data processing output, 2026. Because the Breusch-Godfrey test detects serial autocorrelation in both models, the standard OLS estimates are corrected using Newey-West HAC.

ROA Model Estimation Results

The OLS estimation results with the Newey-West HAC correction for the ROA model are presented in Table 5. All independent variables significantly affect ROA. NPL has a significant positive effect on ROA ($\beta = 0.132$; $p = 0.015$), LDR has a significant positive effect ($\beta = 0.033$; $p < 0.001$), and BOPO has a significant negative effect ($\beta = -0.076$; $p < 0.001$). The R^2 value of 0.9411 indicates that 94.11% of the variation in Bank Mandiri's ROA is explained by the three independent variables, with the remaining 5.89% explained by factors outside the model. The F-statistic of 191.57, with a p-value approaching zero, confirms that the model is jointly significant.

Table 5. OLS Estimation Results with Newey-West HAC - ROA Model

Variable	Coefficient	NW Std. Error	t-stat	p-value	Sig.
Constant	4.6925	0.6044	7.7639	0.0000	***
NPL	0.1317	0.0514	2.5618	0.0147	**
LDR	0.0331	0.0054	6.0707	0.0000	***
BOPO	-0.0764	0.0074	-10.3416	0.0000	***

$R^2 = 0.9411$; Adj. $R^2 = 0.9361$; F-stat = 191.57 ($p < 0.001$); $n = 40$; Newey-West lag = 3.

Note: *** significant at $\alpha = 1\%$; ** significant at $\alpha = 5\%$; * significant at $\alpha = 10\%$. Source: Data processing output, 2026.

The estimated regression equation is:

$$ROA_t = 4.6925 + 0.1317 \cdot NPL_t + 0.0331 \cdot LDR_t - 0.0764 \cdot BOPO_t + \varepsilon_t$$

ROE Model Estimation Results

The OLS estimation results with the Newey-West HAC correction for the ROE model are presented in Table 6. NPL has a significant negative effect on ROE ($\beta = -1.310$; $p = 0.001$), BOPO

has a significant negative effect ($\beta = -0.421$; $p < 0.001$), while LDR is not significant ($\beta = -0.052$; $p = 0.436$). The R^2 value of 0.9222 indicates that 92.22% of the variation in Bank Mandiri's ROE is explained by the model. The F-statistic of 142.23, with a p-value < 0.001 , confirms that the model is jointly significant.

Table 6. OLS Estimation Results with Newey-West HAC - ROE Model

Variable	Coefficient	NW Std. Error	t-stat	p-value	Sig.
Constant	53.7418	5.0895	10.5593	0.0000	***
NPL	-1.3102	0.3559	-3.6817	0.0008	***
LDR	-0.0518	0.0656	-0.7886	0.4355	ns
BOPO	-0.4206	0.0685	-6.1362	0.0000	***

$R^2 = 0.9222$; Adj. $R^2 = 0.9157$; F-stat = 142.23 ($p < 0.001$); $n = 40$; Newey-West lag = 3.

Note: *** significant at $\alpha = 1\%$; ns = not significant. Source: Data processing output, 2026.

The estimated regression equation is:

$$ROE_t = 53.7418 - 1.3102 \cdot NPL_t - 0.0518 \cdot LDR_t - 0.4206 \cdot BOPO_t + \varepsilon_t$$

Bivariate Visualisation

The bivariate relationships between NPL and each profitability indicator are visualised in Figures 1-3. The scatter patterns are consistent with the multivariate analysis: NPL has a negative slope against both ROA and ROE, whereas its relationship with NIM is positive, confirming the presence of a risk-premium effect on the interest margin.

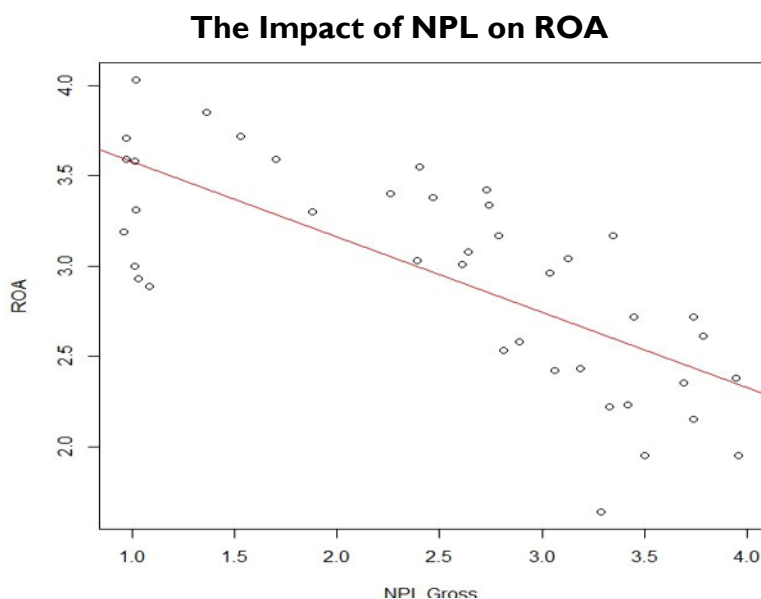


Figure 1. Scatter of NPL against ROA at PT Bank Mandiri, 2016Q1-2025Q4

The Impact of NPL on ROE

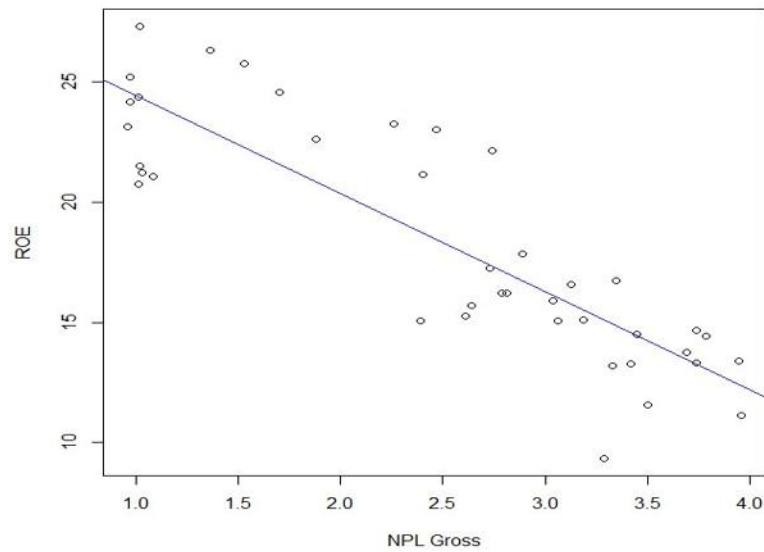


Figure 2. Scatter of NPL against ROE at PT Bank Mandiri, 2016Q1-2025Q4

The Impact of NPL on NIM

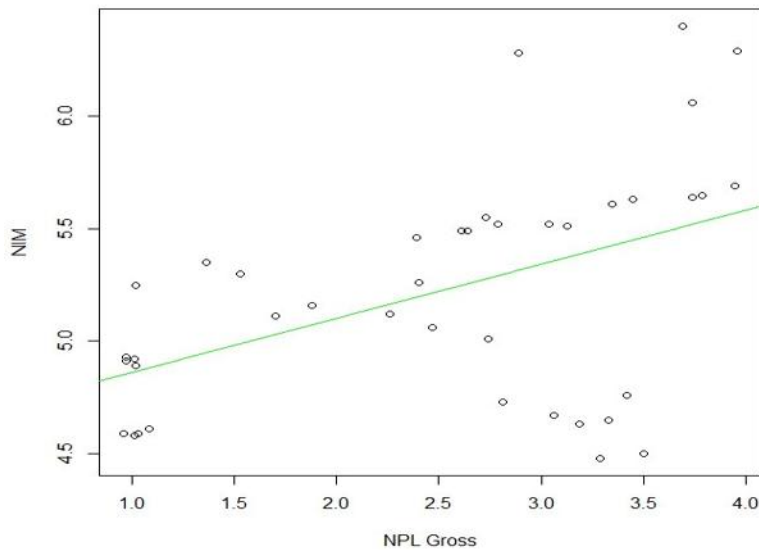


Figure 3. Scatter of NPL against NIM at PT Bank Mandiri, 2016Q1-2025Q4

Discussion

The Effect of NPL on ROA: A Meaningful Positive Anomaly

The finding that NPL significantly positively affects ROA ($\beta = 0.132$) seems counterintuitive, yet it aligns with the results of several prior studies concerning large Indonesian banks. It aligns with the risk premium phenomenon described by Pepur and Tripovic (2017) and Othman and Gabbori (2024). Banks with higher NPLs tend to charge higher lending rates to compensate for risk. Once operating costs are controlled for through BOPO, the marginal interest income from the riskier portfolio increases earnings relative to total assets. This effect may be reinforced by the credit restructuring policy implemented during the pandemic (POJK No. 11/POJK.03/2020), which delayed recognizing NPLs as bad debt and preserved asset quality administratively (Wahyuni et al., 2021). This result highlights the importance of interpreting the NPL coefficient within a multivariate framework because its sign differs from the bivariate correlation (-0.732). This is because the effect of NPL on ROA is partial after controlling for LDR and BOPO.

The Effect of NPL on ROE : Confirming the Classical Hypothesis

Conversely, NPL has a significant negative effect on ROE, with a large coefficient ($\beta = -1.310$): each one-percentage-point increase in NPL lowers ROE by 1.31 percentage points. This finding is consistent with Sherlita and Utami (2019), Rohman et al. (2022), Kalkan (2025), and Sutanto et al. (2024), all of whom report a negative relationship between credit risk and equity profitability. The theoretical explanation for the difference in the direction of the NPL effect on ROA and ROE lies in their denominators: because ROE uses equity as the divisor, when NPLs rise and equity must absorb losses through impairment provisions, financial leverage magnifies the decline in ROE. Ariefianto et al. (2024) emphasise that optimal capital management must actively absorb credit-risk shocks so as not to erode equity returns.

The Effect of LDR on Profitability

The LDR has a significant positive effect on ROA ($\beta = 0.033$), but it is not significant for ROE. This suggests that improving the intermediation function (lending relative to third-party funds) positively impacts asset utilization, though it is not robust enough to influence equity returns. This finding aligns with the work of Chabachib et al. (2019) and Oanh et al. (2023), who discovered that bank liquidity aids in maintaining operating performance, though its impact on ROE may be moderated by capital structure. For Bank Mandiri, the high average LDR (88.73%) puts the bank at the upper limit of Bank Indonesia's safe zone. Further increases would result in diminishing returns on equity profitability.

BOPO as the Dominant Determinant

BOPO is the strongest and most consistent predictor of Bank Mandiri's profitability. A one-point increase in BOPO lowers ROA and ROE by 0.076 and 0.421 percentage points, respectively, both of which are significant at the 1% level. These findings align with those of Sherlita and Utami (2019), Buchory (2019), Gazi et al. (2024), and Pan et al. (2023), who identified operational efficiency as the primary factor influencing banking profitability in emerging markets. Since pursuing an aggressive digital transformation in 2020, Bank Mandiri has seen its BOPO fall from 80.03% in Q4 of 2020 to 51.88% in Q4 of 2023, which correlates with the surge in ROA and ROE during the recovery period.

Simultaneous Effect and Explanatory Power

When considered simultaneously, the F-test for both models yields a p-value of less than 0.001. Therefore, H_0 is rejected, and it can be concluded that NPL, LDR, and BOPO have a significant joint effect on ROA and ROE. The high coefficients of determination ($R^2 > 0.92$) confirm that these three internal variables dominate the determinants of Bank Mandiri's profitability in the short-to-medium term, outweighing the influence of macroeconomic factors.

CONCLUSION

Based on the analysis and discussion, the following conclusions can be drawn. First, credit risk (NPL) significantly affects Bank Mandiri's profitability in opposite directions across indicators: it is positive for ROA ($\beta = 0.132$) and negative for ROE ($\beta = -1.310$). This difference reflects a risk premium effect that is partly offset at the asset level, yet unable to counteract the pressure caused by leverage at the equity level.

Second, liquidity risk (LDR) significantly affects ROA positively ($\beta = 0.033$), but not ROE. More aggressive lending contributes to asset profitability, yet it is insufficient to drive equity returns at an LDR level that is already at the upper bound of the safe zone.

Third, operational efficiency (BOPO) is the most dominant determinant with significant negative effects on ROA ($\beta = -0.076$) and ROE ($\beta = -0.421$) at $\alpha = 1\%$.

Fourth, NPL, LDR, and BOPO significantly affect ROA ($F = 191.57$; $R^2 = 0.941$) and ROE ($F = 142.23$; $R^2 = 0.922$) when considered simultaneously. The model explains more than 92% of the variation in Bank Mandiri's profitability.

SUGGESTIONS AND ACKNOWLEDGMENTS

Based on the above conclusions, several recommendations are offered. Bank Mandiri's management should prioritize digitalization-based operational efficiency initiatives since BOPO is the strongest profitability lever. They should also strengthen advanced creditworthiness assessments by integrating big data and predictive analytics to detect credit quality deterioration earlier, as Jalali et al. (2023) recommended. For regulators (OJK and Bank Indonesia), the findings can serve as a quantitative basis for calibrating Risk-Based Bank Rating (RBBR) parameters, particularly the weighting of BOPO and non-performing loans (NPL), as well as for evaluating the long-term effect of the post-pandemic credit restructuring policy on the quality of banking assets. BOPO and NPL can serve as primary signals in the fundamental analysis of Bank Mandiri shares for investors. Future research should (a) extend coverage to all KBMI 4 banks using a panel data approach, (b) add macroeconomic control variables, such as inflation, the BI rate, and the exchange rate, (c) employ dynamic models, such as panel ARDL or VECM, to capture short- and long-run adjustments, and (d) incorporate a structural break dummy variable for the pandemic.

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