

THE EFFECT OF CREDIT RISK, LIQUIDITY, CAPITAL ADEQUACY, AND FIRM SIZE ON RETURN ON EQUITY: EVIDENCE FROM INDONESIAN BANKS

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ABSTRAK

Abstrak: *Return on equity* (ROE) mengukur imbal hasil yang diperoleh pemegang saham bank dan dipengaruhi oleh kinerja operasional maupun struktur modal. Sebagian besar penelitian tentang profitabilitas bank di Indonesia menggunakan *return on assets* (ROA), sehingga faktor penentu imbal hasil pemegang saham pada masa pemulihan pascapandemi belum banyak diketahui. Penelitian ini bertujuan menganalisis pengaruh risiko kredit, likuiditas, kecukupan modal, dan ukuran bank terhadap ROE bank di Indonesia. Penelitian ini merupakan penelitian kuantitatif dengan pendekatan data panel. Data berupa panel seimbang 43 bank dengan 172 observasi bank-tahun periode 2022–2025 dari LSEG/Refinitiv Datastream. ROE diregresikan pada rasio kredit bermasalah (NPL), rasio kredit terhadap simpanan (LDR), rasio kecukupan modal (CAR), dan ukuran bank. Uji Chow, Hausman, dan Breusch–Pagan Lagrange multiplier memilih model *random effect*, yang koefisiennya diuji dengan *White heteroskedasticity-robust standard error* dan diperiksa ulang dengan *bank-clustered robust standard error*. Ukuran bank berhubungan positif dengan ROE, sedangkan NPL berhubungan negatif. Kecukupan modal berhubungan positif namun lemah, dan likuiditas tidak berpengaruh signifikan.

Kata Kunci: *Return on Equity*; Risiko Kredit; Kecukupan Modal; Ukuran Bank; Data Panel.

Abstract: *Return on equity (ROE)* measures the return that a bank earns for its shareholders and depends on both operating performance and capital structure. Most studies of bank profitability in Indonesia use return on assets (ROA), so the drivers of shareholder return in the post-pandemic recovery period are not well understood. This study aims to examine the effect of credit risk, liquidity, capital adequacy, and firm size on the ROE of Indonesian banks. It is a quantitative study with a panel data approach, using a balanced panel of 43 banks and 172 bank-year observations over 2022–2025 from LSEG/Refinitiv Datastream. ROE is regressed on the non-performing loan ratio (NPL), the loan-to-deposit ratio (LDR), the capital adequacy ratio (CAR), and bank size. The Chow, Hausman, and Breusch–Pagan Lagrange-multiplier tests select the random-effect model, whose coefficients are tested with White heteroskedasticity-robust standard errors and re-examined with bank-clustered standard errors. Bank size is positively related to ROE, while NPL is negatively related to it. Capital adequacy is positively but weakly related to ROE, and liquidity is not significant.

Keywords: *Return on Equity; Credit Risk; Capital Adequacy; Firm Size; Panel Data.*



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A. INTRODUCTION

For the owners of a bank, the measure that matters most is Return on Equity (ROE), the profit earned on the capital they have committed. Unlike Return on Assets (ROA), ROE reflects both how well a bank runs its balance sheet and how much leverage it employs, since ROE equals ROA multiplied by the equity multiplier (Saona, 2016; Kebede, 2025). In Indonesia, where a bank-dominated financial system channels household and corporate funds, what raises or lowers the return to bank shareholders matters to investors, boards, and prudential regulators, partly because bank profitability is tied to financial stability (Lamothe et al., 2024).

A large literature links bank profitability to a small set of bank-specific fundamentals. Athanasoglou et al. (2008) and Dietrich and Wanzenried (2011) identify capital, credit risk, and efficiency as the internal drivers of returns, while Ekinici and Poyraz (2019) and Kalkan (2025) show that credit risk depresses performance. Indonesian studies find the same, with non-performing assets lowering bank earnings (Hersugondo et al., 2021). Most of this work measures profitability through asset returns. For Indonesian banks, studies that take ROE as the outcome, and so capture how capital structure and scale together shape the return to shareholders, remain few, and they rarely cover the recovery years after the pandemic. This study addresses that gap.

Cross-country evidence points the same way. Petria et al. (2015) find that credit and liquidity risk, management efficiency, and business diversification drive profitability across EU banking systems, and Menicucci and Paolucci (2016) add that capital strength and asset quality matter most in the European banking sector. Tan (2016) shows that risk and competition jointly shape bank profitability in China, and Le and Ngo (2020) find, for 23 countries, that more highly capitalised banking systems tend to be less profitable. On the capital side, Bitar et al. (2018) show that higher capital ratios generally improve efficiency and profitability but may weaken them in highly liquid banks, which reflects the dual role of capital in the DuPont decomposition. Louzis et al. (2012) and Ghosh (2015) study the determinants of problem loans themselves. They trace Non Performing Loans (NPL) to a mix of macroeconomic conditions and bank-level management quality, while Rachman et al. (2018) and Prawira and Wiryono (2020) document the bank-specific drivers for Indonesian banks.

ROE can be broken down with the DuPont identity. It rises with operating profitability. Credit risk enters through provisioning and the bad-management channel, where weak screening and monitoring raise NPL and force earnings-reducing provisions (Berger & DeYoung, 1997; Ekinici & Poyraz, 2019). Capital adequacy plays a dual role: stronger capital lowers funding costs and signals resilience (Al-Harbi, 2019), yet by reducing leverage it can also hold back the equity multiplier that raises ROE. Scale matters

because larger banks spread fixed costs, diversify income, and borrow more cheaply (Athanasoglou et al., 2008), while lending intensity, proxied by the Loan to Deposit ratio (LDR), may lift returns but also carries funding and liquidity risk at high levels (Saleh & Abu Afifa, 2020).

Four determinants are examined. Credit risk reduces the earnings available to shareholders through provisions and lost interest, so a negative relation with ROE is expected (Berger & DeYoung, 1997; Kalkan, 2025). Lending intensity can raise returns when loans are productive, but a high LDR puts pressure on funding and liquidity, so the net effect is ambiguous (Saleh & Abu Afifa, 2020). Capital adequacy should support earnings through cheaper funding and greater resilience, even though it reduces leverage; on balance, a positive relation is expected once size is held constant (Al-Harbi, 2019). Larger banks benefit from economies of scale, diversification, and cheaper funding, which should give shareholders higher and more stable returns (Athanasoglou et al., 2008).

The objective of this study is to examine how credit risk, liquidity, capital adequacy, and firm size affect the ROE of Indonesian banks in the post-pandemic period of 2022–2025. Four hypotheses are tested: NPL is negatively associated with ROE (H1); the LDR is associated with ROE, with no sign assumed in advance (H2); capital adequacy is positively associated with ROE (H3); and bank size is positively associated with ROE (H4). Using a balanced panel of 43 banks and random-effect estimation, the study aims to show which balance-sheet fundamentals matter most for the returns received by the shareholders of banks in an emerging, bank-based financial system.

B. RESEARCH METHOD

1. Data and Sample

The study uses a quantitative, explanatory design with secondary bank-level panel data from LSEG/Refinitiv Datastream. Sampling is purposive: a bank enters only if it reports complete, non-zero values on every model variable in each year of 2022–2025, so the panel is balanced, with each bank present in all four years. This produces 43 banks and 172 bank-year observations. A balanced panel is chosen so that the fixed- and random-effect transformations use the same set of banks in every year (Baltagi, 2021).

2. Operational Definitions of Variables

Table 1 defines the variables. The dependent variable is ROE; the explanatory variables are NPL, LDR, CAR, and bank size, measured as the natural logarithm of total assets.

Table 1. Operationalisation of research variables

Variable	Operationalisation	Expected sign
ROE (DV)	Net income as a percentage of shareholders' equity (%)	Dependent variable
NPL	Non-performing loans / gross loans (%)	Negative (H1)
LDR	Total loans / total deposits (%)	+/- (H2)
CAR	Capital / risk-weighted assets (%)	Positive (H3)
SIZE	Natural logarithm of total assets	Positive (H4)

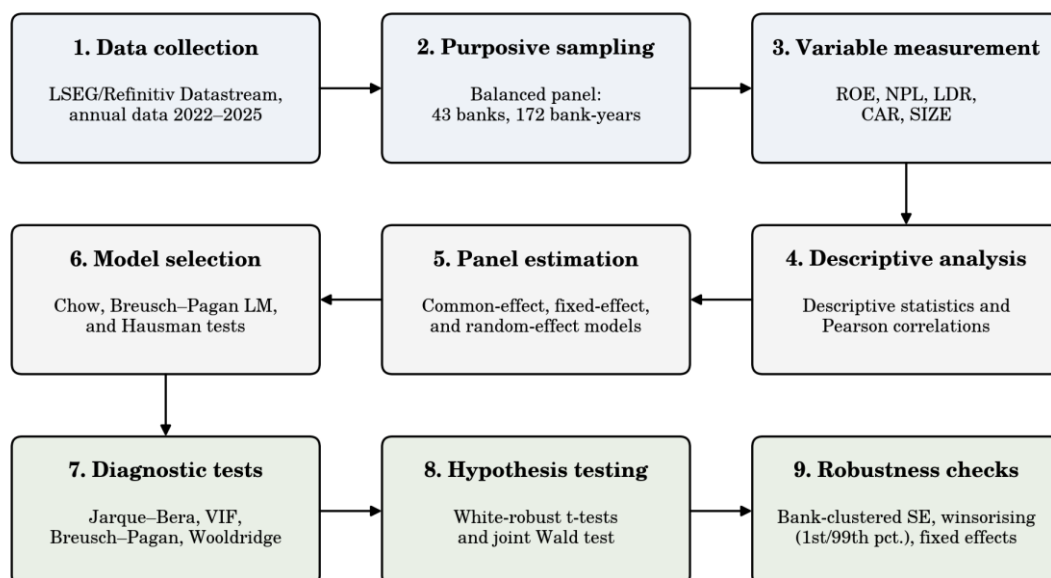
The estimating equation is:

$$ROE_{it} = \alpha + \beta_1 NPL_{it} + \beta_2 LDR_{it} + \beta_3 CAR_{it} + \beta_4 SIZE_{it} + u_i + \varepsilon_{it} \quad (1)$$

3. Data Analysis Techniques

The equation is fitted under the common-effect (pooled OLS), fixed-effect (within), and random-effect (Swamy–Arora GLS) frameworks (Baltagi, 2021). The estimator is chosen with the Chow poolability test, the Breusch–Pagan Lagrange-multiplier test, and the Hausman test. Residual diagnostics for the chosen model cover normality (Jarque–Bera), multicollinearity (variance-inflation factors), heteroskedasticity (Breusch–Pagan), and serial correlation (the Wooldridge test).

The baseline coefficients and the four hypotheses are evaluated with White heteroskedasticity-robust standard errors, using t-tests for the individual coefficients and a joint Wald test for the model as a whole. The robustness checks use three alternatives: bank-clustered standard errors, a re-estimation with all variables winsorised at the 1st and 99th percentiles, and the fixed-effect estimator. All computations use R with the *plm*, *lmtest*, *sandwich*, and *car* packages. Figure 1 summarises the research procedure.

**Figure 1.** Research Procedure

C. RESULTS AND DISCUSSION

1. Descriptive Statistics and Correlations

Table 2 reports the descriptive statistics. The mean ROE is 4.57% with a standard deviation of 10.23, and the values range from -57.22% to 22.45% . The skewness of -2.613 shows a left tail, created by a small number of bank-years with heavy losses. The mean NPL is 3.02%. LDR and CAR have high means (109.26% and 39.45%) and very wide ranges, reaching 572.73% and 283.38% at the maximum. The mean SIZE, measured as the natural logarithm of total assets, is 24.75.

Table 2. Descriptive Statistics

Variable	N	Mean	SD	Min	Median	Max	Skew.	Kurt.
ROE	172	4.571	10.232	-57.220	4.765	22.450	-2.613	15.415
NPL	172	3.019	2.097	0.010	2.660	13.210	1.438	6.315
LDR	172	109.258	67.700	21.310	95.085	572.730	4.578	27.732
CAR	172	39.446	30.720	10.100	29.395	283.380	3.902	26.384
SIZE	172	24.749	1.652	21.921	24.225	28.670	0.586	2.446

Table 3 reports the Pearson correlations. ROE is negatively correlated with NPL (-0.344) and positively correlated with SIZE (0.443), while its correlations with LDR (-0.062) and CAR (-0.073) are small. The simple correlation between ROE and CAR is negative, yet CAR has a positive coefficient in the regressions. The reason is that CAR is negatively correlated with SIZE (-0.559), so the positive link between capital and ROE appears only once bank size is controlled for. The highest correlation among the independent variables is between LDR and CAR (0.718), but the variance-inflation factors in Table 6 show that it does not cause multicollinearity.

Table 3. Pearson correlation matrix among the variables

	ROE	NPL	LDR	CAR	SIZE
ROE	1.000	-0.344	-0.062	-0.073	0.443
NPL	-0.344	1.000	0.112	0.046	-0.084
LDR	-0.062	0.112	1.000	0.718	-0.306
CAR	-0.073	0.046	0.718	1.000	-0.559
SIZE	0.443	-0.084	-0.306	-0.559	1.000

2. Estimation and Model Selection

Table 4 reports the estimates of the three panel models. The common-effect and random-effect models give similar results: NPL has a negative coefficient, CAR and SIZE have positive coefficients, and the LDR coefficient is close to zero. The fixed-effect model gives a different picture. None of its slope coefficients is statistically significant, and the SIZE coefficient becomes negative (-1.658). This is expected in a four-year panel, because the fixed-effect estimator uses only changes within each bank, and variables such as bank size change little from one year to the next.

Table 4. Panel regression estimates for ROE (CEM, FEM, REM)

Variable	CEM	FEM	REM
Constant	-81.329 (12.468)	–	-71.372 (17.861)
NPL	-1.470 (0.311)	-0.505 (0.411)	-0.921 (0.337)
LDR	-0.013 (0.014)	-0.018 (0.017)	-0.014 (0.014)
CAR	0.106 (0.035)	0.024 (0.042)	0.068 (0.035)
SIZE	3.536 (0.479)	-1.658 (4.009)	3.132 (0.697)
R-squared	0.339	0.019	0.153
Overall test	F = 21.38	F = 0.60	$\chi^2 = 30.07$
p-value	< 0.001	0.663	< 0.001
Observations	172	172	172

The specification tests in Table 5 point to the random-effect model. The Chow test rejects the common-effect model in favour of bank-specific effects ($F(42,125) = 4.96$, $p < 0.001$), and the Breusch–Pagan LM test confirms a significant bank-specific variance component ($\chi^2(1) = 51.94$, $p < 0.001$). The Hausman test does not reject the random-effect model at the 5% level ($\chi^2(4) = 9.24$, $p = 0.055$), so the random-effect model is used for hypothesis testing. It is more efficient than the fixed-effect model here and keeps the between-bank variation, which carries most of the information in this short panel.

Table 5. Panel Model-Selection Tests

Test (hypothesis)	Statistic (p-value)	Decision
Chow – F (CEM vs FEM)	4.956 ($p < 0.001$)	FEM over CEM
Hausman – χ^2 (FEM vs REM)	9.237 ($p = 0.055$)	REM over FEM
Breusch–Pagan LM – χ^2 (CEM vs REM)	51.935 ($p < 0.001$)	REM over CEM
Selected model	–	REM (random effects)

Table 6 reports the diagnostic tests for the random-effect model. The largest variance-inflation factor is 2.82, well below 10, so the correlation between LDR and CAR does not create a multicollinearity problem. The Jarque–Bera test rejects normality of the residuals (1312.564, $p < 0.001$). The non-normality comes from the extreme observations visible in Table 2: a few bank-years with large losses (ROE as low as -57.22%) and a few banks whose deposits are small relative to their loans, or whose risk-weighted assets are small relative to their capital, which gives very high LDR (up to 572.73%) and CAR (up to 283.38%) values. These are reported figures, not data errors, so they are kept; removing them would also break the balanced structure of the panel.

Two steps are taken. First, inference uses White heteroskedasticity-robust standard errors, and with 172 observations the coefficient tests rely on the asymptotic normality of the estimator and not on normally distributed residuals. Second, the model is re-estimated with all variables winsorised at the 1st and 99th percentiles (Table 8). All four coefficients keep their signs

after winsorising, so the main results are not driven by the extreme observations. The Breusch–Pagan test indicates heteroskedasticity (17.671, $p = 0.001$), which supports the use of robust standard errors, and the Wooldridge test finds no serial correlation (1.494, $p = 0.135$).

Table 6. Classical Assumption Diagnostics

Test	Statistic	P-value	Conclusion
Multicollinearity (max VIF)	2.820	–	VIF < 10
Normality (Jarque–Bera)	1312.564	0.000	Non-normal (CLT applies)
Heteroskedasticity (Breusch–Pagan)	17.671	0.001	Heteroskedastic (robust SE)
Autocorrelation (Wooldridge)	1.494	0.135	No serial correlation

3. Hypothesis Testing and Robustness

Table 7 reports the random-effect estimates with White heteroskedasticity-robust standard errors. The model is significant (Wald $F(4,167) = 16.50$, $p < 0.001$). SIZE has a positive and significant coefficient (3.132, $p < 0.001$), so H4 is supported: a one-unit increase in the logarithm of total assets is associated with an ROE about 3.1 percentage points higher. NPL has a negative coefficient that is significant at the 10% level (–0.921, $p = 0.087$), which supports H1. A one-percentage-point rise in the NPL ratio is associated with an ROE about 0.9 points lower, a smaller effect than in the common-effect model (–1.470). CAR is positive but significant only at the 10% level (0.068, $p = 0.070$), which gives weak support for H3. LDR is not significant (–0.014, $p = 0.351$), so H2 is not supported.

Table 7. Random-effect estimates for ROE

Variable	Coef.	Robust SE	t (p)	Result
Constant	–71.372	12.130	–5.88 (<0.001)	–
NPL	–0.921	0.535	–1.72 (0.087)	Supported at 10% (H1)
LDR	–0.014	0.015	–0.94 (0.351)	Not supported (H2)
CAR	0.068	0.038	1.82 (0.070)	Weakly supported at 10% (H3)
SIZE	3.132	0.450	6.96 (<0.001)	Supported at 1% (H4)

Table 8 compares the baseline estimates with three alternative specifications: bank-clustered standard errors, winsorised variables, and the fixed-effect estimator. SIZE stays positive and significant at the 1% level in all three random-effect columns. NPL stays negative; it is significant at the 5% level with bank-clustered standard errors and at the 10% level after winsorising. CAR is not significant with clustered standard errors, but after winsorising its coefficient rises to 0.154 and becomes significant at the 5% level, which suggests that the extreme CAR values weaken the baseline estimate. LDR is significant only in the winsorised model, at the 10% level. In the fixed-effect model none of the coefficients is significant. The

relationships thus come from differences between banks, not from year-to-year changes within the same bank.

Table 8. Robustness of the ROE Determinants

Variable	White	Cluster	Winsorised	FE (within)
NPL (H1 −)	−0.921 (10%)	−0.921 (5%)	−1.008 (10%)	−0.505 (n.s.)
LDR (H2)	−0.014 (n.s.)	−0.014 (n.s.)	−0.024 (10%)	−0.018 (n.s.)
CAR (H3 +)	0.068 (10%)	0.068 (n.s.)	0.154 (5%)	0.024 (n.s.)
SIZE (H4 +)	3.132 (1%)	3.132 (1%)	3.770 (1%)	−1.658 (n.s.)

4. Discussion

The results show that shareholder returns in Indonesian banking rise with bank size and fall with credit risk. The positive size effect supports the evidence that banks gain cost efficiency and returns to scale as they grow (Sapci & Miles, 2019). In ROE terms the effect can be larger, because bigger banks in the sample also hold less capital relative to their risk-weighted assets (the correlation between SIZE and CAR is -0.559) and so tend to operate with more leverage. The negative NPL effect agrees with international and Indonesian studies showing that problem loans reduce earnings through provisions (Ekinici & Poyraz, 2019; Hersugondo et al., 2021; Kalkan, 2025), and Ghosh (2017) shows that the effect of problem loans extends to the real economy.

In the random-effect model, the NPL coefficient (-0.921) is smaller than in the pooled model (-1.470). The CAR coefficient is positive but small. Capital lowers funding costs and signals resilience (Al-Harbi, 2019), but more capital also means less leverage, which directly holds ROE down. LDR shows no clear relation with ROE in this sample, although liquidity risk has been found to affect bank profitability in other emerging markets (Saleh & Abu Afifa, 2020). One limitation should be noted. The random-effect model uses both between-bank and within-bank variation, but the fixed-effect results suggest that the associations come from differences between banks, not from changes within a bank over four years. The coefficients are better interpreted as associations that distinguish persistently more profitable banks from less profitable ones than as within-bank causal effects.

D. CONCLUSION AND SUGGESTION

This study examined the determinants of ROE for a balanced panel of 43 Indonesian banks over 2022–2025, regressing ROE on the NPL, the LDR, the CAR, and bank size, with a random-effect model selected by the Chow, Hausman, and Lagrange-multiplier tests. Bank size has the strongest association with shareholder returns, and credit risk is the main negative factor: larger banks earn higher ROE, while a higher share of problem loans lowers it. Capital adequacy is positively but weakly related to ROE, because capital brings benefits but also lowers leverage, and liquidity is not

significant. For bank managers, the results suggest that scale and a clean loan book both support the returns that shareholders receive. For supervisors, they suggest that asset quality should remain a focus of supervision as capital buffers are strengthened. Further work should extend the sample period, dynamic panel estimators that allow profit persistence to be modelled, and incorporate macroeconomic and ownership controls so that the within-bank channel can be identified more clearly.

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