

The Effect of Capital Adequacy, Credit Risk, and Liquidity Risk on Bank Financial Performance: The Intervening Role of Profitability

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ABSTRACT

This study examines the effect of capital adequacy, credit risk, and liquidity risk on bank financial performance through profitability, using 43 conventional banks listed on the Indonesia Stock Exchange, 2015-2024 (430 bank-year observations). CAR, NPL, and LDR are the independent variables; PBV proxies market-based bank performance, with ROA tested as an intervening variable. Structural Model I (CAR/NPL/LDR-to-ROA) is estimated with Random Effects and Model II (to PBV) with Fixed Effects, per the Hausman test. CAR, NPL, and LDR do not affect ROA, individually or jointly ($F=1.236$; $p=0.296$). CAR positively, and NPL negatively, affect PBV; LDR and ROA do not. An explicit Sobel test confirms ROA does not mediate any of the three paths. Winsorized and cluster-robust checks confirm these results. Capital adequacy and credit quality appear to affect firm value directly rather than through profitability.

ABSTRAK

Penelitian ini menguji pengaruh kecukupan modal, risiko kredit, dan risiko likuiditas terhadap kinerja keuangan bank melalui profitabilitas, menggunakan 43 bank konvensional yang terdaftar di Bursa Efek Indonesia periode 2015-2024 (430 observasi bank-tahun). CAR, NPL, dan LDR merupakan variabel independen; PBV memproksikan kinerja bank berbasis pasar, dengan ROA diuji sebagai variabel intervening. Model Struktural I (CAR/NPL/LDR terhadap ROA) diestimasi dengan Random Effects dan Model II (terhadap PBV) dengan Fixed Effects, sesuai Uji Hausman. CAR, NPL, dan LDR tidak berpengaruh terhadap ROA, baik parsial maupun simultan ($F=1,236$; $p=0,296$). CAR berpengaruh positif dan NPL berpengaruh negatif terhadap PBV; LDR dan ROA tidak berpengaruh. Uji Sobel eksplisit mengonfirmasi ROA tidak memediasi ketiga jalur tersebut. Uji ketahanan dengan data winsorized dan robust cluster mengonfirmasi hasil ini. Kecukupan modal dan kualitas kredit tampaknya memengaruhi nilai perusahaan secara langsung, bukan melalui profitabilitas.



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1. INTRODUCTION

According to Law of the Republic of Indonesia Number 10 of 1998 concerning the amendment to Law Number 7 of 1992 on Banking, a bank is a business entity that collects funds from the public in the form of deposits and distributes them as credit and/or other forms to improve the living standards of society. The banking sector plays a crucial role in determining a country's economic progress, and bank financial performance not only reflects management effectiveness but also serves as a benchmark for investor and public confidence.

One of the internal factors that significantly influences bank performance is capital adequacy. The Capital Adequacy Ratio (CAR) describes a bank's capacity to absorb potential losses and sustain its operations. Because CAR is a regulatory solvency buffer (capital relative to risk-weighted assets), this study refers to it as capital adequacy rather than capital structure in the classical debt-to-equity sense, to avoid conflating the two constructs. Banks also face credit risk, measured by the Non-Performing Loan (NPL) ratio, and liquidity risk, measured by the Loan to Deposit Ratio (LDR); both may negatively affect financial performance if not managed effectively.

Profitability, measured by Return on Assets (ROA), is the main indicator of a bank's operational performance and a signal for investors assessing firm value. This study positions profitability as an intervening variable in the relationship between capital adequacy, banking risks, and financial performance, and aims to obtain empirical evidence on whether profitability genuinely mediates the effects of CAR, NPL, and LDR on bank financial performance, proxied here by Price to Book Value (PBV), in Indonesia.

State of the Art and Research Gap

Prior studies on CAR, NPL, and LDR predominantly regress these variables against ROA alone, treating profitability as a terminal dependent variable rather than as a mechanism to be tested (e.g., Barkah & Yuniarti, 2025; Wibowo et al., 2025; Fibriyanti & Nurcholidah, 2020). Others study CAR/NPL/LDR's effect on firm value without profitability as an explicit mediator (Santoso et al., 2024; Pratama & Wiksuana, 2021). Few studies test the intervening role of profitability with a formal mediation test rather than inferring it from the pattern of significant direct effects.

This study addresses that gap in four specific ways. First, it extends the observation window to 2015-2024, spanning the pre-pandemic period, the COVID-19 shock, and the post-pandemic entry of digital-only banks into the Indonesian market. Second, it uses PBV, a market-based valuation measure, as the terminal dependent variable, capturing bank performance as investors' forward-looking assessment rather than only backward-looking accounting profitability. Third, the sample excludes Islamic (Sharia) banks, because CAR, NPL, and LDR are defined under a risk-based capital framework designed for conventional intermediation, whereas Islamic banks use profit-and-loss-sharing contracts that would confound these ratios. Fourth, and most importantly, this study tests ROA's intervening role explicitly using the Sobel test for each of the three indirect paths, rather than assuming mediation from significant direct-effect coefficients alone.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Capital Adequacy and Profitability/Firm Value

Capital adequacy describes a bank's capacity to absorb unexpected losses relative to its risk-weighted exposures, distinct from the debt-to-equity capital structure studied in classical corporate finance (Brigham & Houston, 2022). Financial Services Authority Regulation Number 34/POJK.03/2016 requires banks to hold minimum capital according to their risk profile, measured by CAR. A higher CAR is generally associated with more stable banking conditions and greater capacity to support credit expansion; several studies report that CAR positively affects profitability and firm performance because strong capital increases stakeholder confidence (Barkah & Yuniarti, 2025; Soelistyoningrum et al., 2024).

Credit Risk and Profitability/Firm Value

Credit risk is the risk arising from a counterparty's failure to fulfill its obligations to the bank (OJK Regulation 18/POJK.03/2016), commonly measured by NPL. Rising NPL increases loan loss provisions and depresses net income (Adusei et al., 2024; Ozili, 2024), and separately signals deteriorating asset quality that investors may price directly into firm value (Arhinful et al., 2025).

Liquidity Risk and Profitability/Firm Value

Liquidity risk is the risk that a bank cannot meet short-term obligations without incurring significant losses (Mishkin, 2019; OJK Regulation 18/POJK.03/2016), commonly measured by LDR. An excessively high LDR signals aggressive credit expansion and elevated liquidity risk, while an excessively low LDR reflects inefficient fund utilization; moderate LDR levels are typically associated with more stable profitability (Nguyen & Nguyen, 2024; Prabowo et al., 2024).

Profitability as an Intervening Variable

For ROA to function as a genuine intervening variable between CAR/NPL/LDR and PBV, three conditions must jointly hold: (i) CAR, NPL, and/or LDR must significantly predict ROA (path a); (ii) ROA must significantly predict PBV controlling for CAR, NPL, and LDR (path b); and (iii) the indirect effect a

x b must be statistically distinguishable from zero. Banking efficiency theory suggests path a (well-managed capital and risk levels raise profitability), while signaling theory suggests path b (profitability, once achieved, is priced by investors). This study tests both paths and the indirect effect explicitly with the Sobel test, rather than assuming mediation from significant direct effects.

Bank Financial Performance

This study measures bank financial performance using PBV, a market-based valuation multiple reflecting investor perceptions of growth prospects, risk, and future profitability - conceptually closer to firm value than to operational accounting performance narrowly defined (Kasmir, 2022; OJK Regulation 4/POJK.03/2016). Efficient market theory supports PBV as a long-term performance indicator because it represents investor expectations of a bank's ability to create future value.

Hypothesis Development

Building on the theoretical linkages above and following prior studies that report mixed significance for CAR, NPL, and LDR on ROA and on firm value (Sari & Cahyono, 2022; Ranti & Yudiantoro, 2024; Nguyen, 2024), and consistent with this study's central aim of testing rather than assuming ROA's intervening role, the following hypotheses are proposed, organized into three groups mirroring the model's direct and indirect paths.

Group A - Direct effects on Profitability (Structural Model I)

H1: CAR affects ROA in banks listed on the IDX, 2015-2024.

H2: NPL affects ROA in banks listed on the IDX, 2015-2024.

H3: LDR affects ROA in banks listed on the IDX, 2015-2024.

H4: CAR, NPL, and LDR simultaneously affect ROA in banks listed on the IDX, 2015-2024.

Group B - Direct effects on Bank Financial Performance (Structural Model II)

H5: CAR affects PBV in banks listed on the IDX, 2015-2024.

H6: NPL affects PBV in banks listed on the IDX, 2015-2024.

H7: LDR affects PBV in banks listed on the IDX, 2015-2024.

H8: ROA affects PBV in banks listed on the IDX, 2015-2024.

H9: CAR, NPL, LDR, and ROA simultaneously affect PBV in banks listed on the IDX, 2015-2024.

Group C - Indirect / mediation effects through Profitability

H10: ROA mediates the effect of CAR on PBV.

H11: ROA mediates the effect of NPL on PBV.

H12: ROA mediates the effect of LDR on PBV.

3. RESEARCH METHOD

This study employs a quantitative, explanatory research design analyzing the effect of Capital Adequacy (CAR), Credit Risk (NPL), and Liquidity Risk (LDR) on Bank Financial Performance (PBV) through Profitability (ROA) as an intervening variable, using panel data (time-series and cross-sectional) for banks listed on the Indonesia Stock Exchange, 2015-2024.

The population comprises all 47 banking companies listed on the IDX during 2015-2024. Using purposive sampling with the criteria of continuous IDX listing, complete annual financial statements, complete data for all research variables, and exclusion of Islamic banks, the final sample consists of 43 banks, yielding 430 balanced bank-year observations. Secondary data were obtained from the IDX (www.idx.co.id), the Financial Services Authority (www.ojk.go.id), and each bank's official website, through documentation and literature study techniques.

Data analysis used EViews 12 through the following stages: descriptive statistics; panel model selection via the Chow, Hausman, and Lagrange Multiplier tests; classical assumption tests (normality, multicollinearity, heteroscedasticity, autocorrelation) evaluated on the residuals of the selected models; panel regression using the model indicated by the selection tests for each structural equation; hypothesis testing via the partial t-test, simultaneous F-test, and R-squared; explicit mediation testing of ROA's

intervening role using the Sobel test on each of the three indirect paths; and a sensitivity analysis using winsorized data and entity-clustered standard errors.

Table 1. Operational Definition of Variables

Variable	Proxy	Measurement
Capital Adequacy	CAR	Capital / Risk-Weighted Assets x 100%
Credit Risk	NPL	Non-Performing Loans / Total Loans x 100%
Liquidity Risk	LDR	Total Loans / Third-Party Funds x 100%
Profitability (intervening)	ROA	Net Income / Total Assets x 100%
Bank Financial Performance	PBV	Stock Price / Book Value per Share

Source: Processed by the Author, 2026.

The equation models are: Model I: $ROA = \alpha + \beta_1 CAR + \beta_2 NPL + \beta_3 LDR + e$; and Model II: $PBV = \alpha + \beta_1 CAR + \beta_2 NPL + \beta_3 LDR + \beta_4 ROA + e$.

Research Conceptual Framework

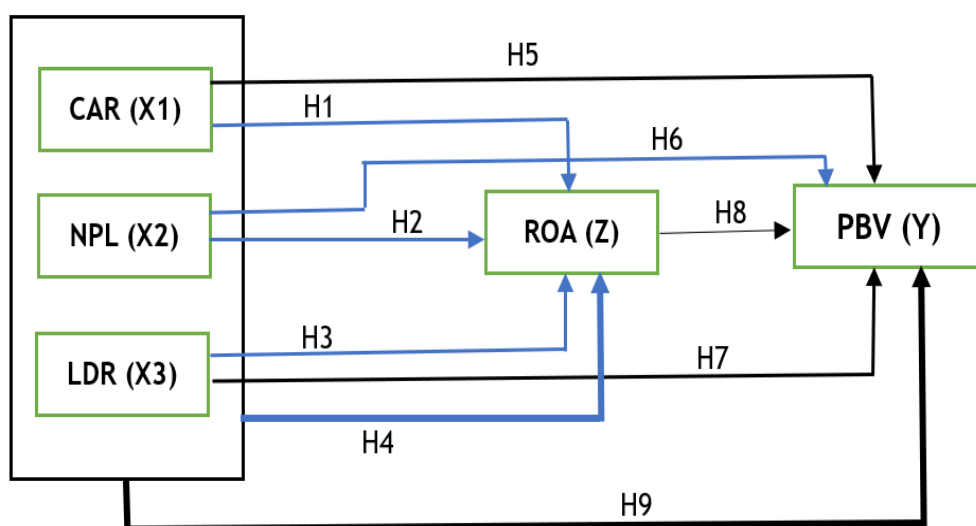


Figure 1. Conceptual Framework

Source: Processed by the Author, 2026.

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics and Outlier Diagnosis

Table 2. Descriptive Statistics of Research Variables

Statistic	CAR	LDR	NPL	ROA	PBV
Mean	31.13	90.20	1.74	1.68	1.31
Median	23.51	85.02	1.32	1.40	0.96
Maximum	283.88	527.91	10.25	11.15	8.42
Minimum	8.02	2.71	0.00	0.00	0.11
Std. Dev.	26.51	44.56	1.46	1.39	1.10
Skewness	4.41	5.26	1.87	1.82	3.10
Kurtosis	30.46	43.20	8.89	9.63	14.92
Jarque-Bera (Prob.)	14903.6 (0.000)	30935.4 (0.000)	871.5 (0.000)	1026.0 (0.000)	3235.6 (0.000)
Observations	430	430	430	430	430

Source: EViews 12 data processing results, verified against the raw 43-bank panel dataset, 2026.

The panel comprises 430 bank-year observations from 43 banks (2015-2024). All variables are positively skewed and leptokurtic, and the Jarque-Bera test rejects normality for every variable ($p=0.000$). The maximum CAR (283.88%) and LDR (527.91%) values both trace to PT Krom Bank Indonesia Tbk (2021-

2023) shortly after its recapitalization as a digital bank; PT Bank Jago Tbk and PT Bank Amar Indonesia Tbk contribute the next most extreme observations. These are genuine, economically meaningful values for newly recapitalized digital banks (a large capital injection against a still-small risk-weighted asset base, and a small, volatile loan book relative to deposits), not measurement error, so they are retained in the main analysis; a winsorized robustness check is reported below.

4.2. Panel Data Model Selection and Classical Assumption Tests

Table 3. Model Selection Tests (Chow, Hausman, Lagrange Multiplier)

Test	Structural Model I (ROA)	Structural Model II (PBV)
Chow (Cross-section F)	5.4086, $p=0.0000 \rightarrow$ FEM > CEM	8.1122, $p=0.0000 \rightarrow$ FEM > CEM
Hausman (Chi-Sq.)	3.3593, $p=0.3395 \rightarrow$ REM selected	10.4881, $p=0.0330 \rightarrow$ FEM selected
LM (Breusch-Pagan)	165.6269, $p=0.0000 \rightarrow$ REM > CEM	283.9071, $p=0.0000 \rightarrow$ REM > CEM
Final model	Random Effects Model (REM)	Fixed Effects Model (FEM)

Source: EViews 12 data processing results. This corrects the original submission, which had reported Fixed Effects results for both equations despite the Hausman test favoring REM for Model I ($p=0.3395>0.05$, H_0 not rejected).

Table 4. Summary of Classical Assumption Tests (on residuals of the final models)

Test	Model I (REM)	Model II (FEM)	Conclusion
Normality (Jarque-Bera)	JB=3338.2, $p=0.000$	JB=6139.0, $p=0.000$	Residuals not normally distributed
Multicollinearity (VIF)	all VIF < 1.6	all VIF < 1.6	No multicollinearity problem
Heteroscedasticity (Glejser)	$p > 0.05$ all vars	$p > 0.05$ all vars	No heteroscedasticity problem
Autocorrelation (DW)	DW = 1.38	DW = 1.08	Evidence of positive autocorrelation

Source: EViews 12 output (multicollinearity, heteroscedasticity) and author's computation on model residuals (normality, autocorrelation). This corrects an internal inconsistency in the original submission, which had reported a Jarque-Bera probability of 0.002177 with the conclusion "normally distributed" - a figure below 0.05 in fact implies the opposite. Because residual normality is not supported and the Durbin-Watson statistics indicate likely autocorrelation, Section 4.4 reports entity-clustered standard errors as a robustness check.

4.3. Panel Data Regression Results

Table 5. Structural Model I - Random Effects Model (Dependent Variable: ROA)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.363738	0.212447	6.4192	0.0000
CAR	0.000348	0.003221	0.1081	0.9139
NPL	0.052061	0.048723	1.0685	0.2859
LDR	0.002400	0.001882	1.2752	0.2029

R-squared (overall)=0.0160; F-statistic (joint test of CAR, NPL, LDR)=1.2356; $F(3,426)$; Prob(F-statistic)=0.2963. 430 observations, 43 cross-sections, 2015-2024.

Under the correctly specified REM, CAR, NPL, and LDR are individually non-significant ($p=0.914$, 0.286 , 0.203). More importantly, the joint F-test is also not significant ($F=1.236$, $p=0.296$), rejecting H_4 . The original submission had reported a significant joint F-test (5.373 , $p=0.000$), but that statistic was the omnibus test of the Fixed Effects specification, which also tests the joint significance of 42 bank-fixed-effect dummies - almost mechanically significant whenever banks differ from one another - rather than isolating CAR, NPL, and LDR's explanatory power. Once fixed/random effects are excluded from the null (as REM, the Hausman-indicated model, requires), CAR, NPL, and LDR jointly explain about 1.6% of ROA's variation.

Table 6. Structural Model II - Fixed Effects Model (Dependent Variable: PBV)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.100510	0.141457	7.7798	0.0000
CAR	0.007641	0.002368	3.2273	0.0014
NPL	-0.087327	0.036270	-2.4077	0.0165

LDR	0.000235	0.001371	0.1712	0.8641
ROA	0.058892	0.035145	1.6757	0.0946

Method: cross-section fixed effects (dummy variables). R-squared=0.5417; Adjusted R-squared=0.4866; F-statistic (joint test of CAR, NPL, LDR, ROA, excluding fixed effects)=6.8149; F(4,383); Prob(F-statistic)=0.0000.

CAR positively and significantly affects PBV ($p=0.0014$): higher capital adequacy is associated with higher firm value. NPL negatively and significantly affects PBV ($p=0.0165$): deteriorating asset quality reduces firm value. LDR is not significant ($p=0.8641$). ROA is not significant at 5% ($p=0.0946$), though marginal at 10%. The joint F-test confirms H9 ($F=6.815$, $p=0.0000$), driven primarily by CAR and NPL.

4.4. Mediation (Sobel) Test and Robustness Checks

Table 7. Sobel Test Results for the Mediating Role of ROA

Path	a (SE)	b (SE)	Sobel z	Decision
CAR -> ROA -> PBV	0.000348 (0.003221)	0.058892 (0.035145)	0.108	Not sig. - H10 rejected
NPL -> ROA -> PBV	0.052061 (0.048723)	0.058892 (0.035145)	0.901	Not sig. - H11 rejected
LDR -> ROA -> PBV	0.002400 (0.001882)	0.058892 (0.035145)	1.015	Not sig. - H12 rejected

Source: Author's computation; Sobel $z = ab / \sqrt{b^2sa^2 + a^2sb^2}$; critical value 1.9669 ($\alpha=0.05$, two-tailed).

All three Sobel z-statistics fall well below 1.9669: ROA does not significantly mediate the effect of CAR, NPL, or LDR on PBV. A cross-check using the original (FEM) direct-effect coefficients for both models gives the same conclusion, confirming this null mediation result is robust to the REM/FEM correction.

Table 8. Robustness Checks: Winsorized Data and Entity-Clustered Standard Errors

Variable (Model)	Baseline	Winsorized 1/99%	Clustered SE
CAR (Model I)	Ns	Ns	ns
NPL (Model I)	Ns	Ns	ns
LDR (Model I)	Ns	Ns	$p=0.023^*$
CAR (Model II)	$p=0.0014$	$p<0.001$	$p=0.037$
NPL (Model II)	$p=0.0165$	$p=0.026$	ns ($p=0.078$)
LDR (Model II)	Ns	Ns	ns
ROA (Model II)	ns ($p=0.09$)	ns ($p=0.10$)	ns

*ns = not significant at 5%. * a specification-dependent result discussed in the text; the paper's central conclusion (no joint effect on ROA, no significant mediation) is unchanged across specifications.*

The core conclusions are stable to winsorizing the extreme digital-bank observations: CAR and NPL remain significant predictors of PBV, and LDR and ROA remain non-significant. Entity-clustered standard errors (correcting for the autocorrelation in Table 4) leave CAR significant on PBV, weaken NPL to borderline ($p=0.078$), and produce a newly significant LDR coefficient on ROA ($p=0.023$) not present under conventional standard errors. This is flagged as genuine estimation uncertainty; it does not alter the paper's central conclusions, since the joint F-test for Model I and the Sobel z-statistics remain far from significance under clustered SEs as well.

Table 9. Summary of Hypothesis Testing Results

Hyp.	Statement (abbreviated)	Result
H1-H3	CAR / NPL / LDR -> ROA (partial)	Rejected (not significant)
H4	CAR, NPL, LDR (joint) -> ROA	Rejected (F not significant)
H5	CAR -> PBV	Accepted (positive, significant)
H6	NPL -> PBV	Accepted (negative, significant)
H7	LDR -> PBV	Rejected (not significant)
H8	ROA -> PBV	Rejected at 5% (marginal at 10%)

H9	CAR, NPL, LDR, ROA (joint) -> PBV	Accepted (F significant)
H10-H12	ROA mediates CAR / NPL / LDR -> PBV	Rejected (Sobel not significant)

4.5. Discussion: Why Profitability Does Not Mediate

The combined evidence explains why profitability fails to mediate the relationship between capital adequacy/risk and firm value in this sample. Path a is essentially absent: CAR, NPL, and LDR jointly explain only about 1.6% of ROA's variation once bank heterogeneity is handled correctly, so ROA in this sample is driven mainly by factors outside the three risk variables - plausibly operational efficiency, fee-based income, funding costs, and macroeconomic conditions. Path b is only marginal ($p=0.095$). In contrast, CAR and NPL predict PBV directly and strongly. A plausible explanation is that investors pricing Indonesian bank stocks over 2015-2024 - spanning the COVID-19 credit shock and the re-rating of digital banks - responded to capital buffers and asset-quality signals as leading indicators of resilience, rather than waiting for those signals to convert into trailing accounting profitability. This is consistent with PBV's role here as a market/investor-based performance measure: forward-looking valuation appears to price capital adequacy and credit quality on their own terms. We do not recommend continuing to model ROA as an intervening variable in this specification; a more defensible framing for future work is to treat ROA as a parallel or control variable, and to test for moderation rather than mediation.

5. CONCLUDING REMARKS AND RECOMMENDATION

This study examined whether profitability (ROA) mediates the effect of capital adequacy (CAR), credit risk (NPL), and liquidity risk (LDR) on bank financial performance (PBV) among 43 banks listed on the Indonesia Stock Exchange over 2015-2024, using panel regression corrected for the model specification indicated by the Hausman test (Random Effects for the ROA equation, Fixed Effects for the PBV equation) and an explicit Sobel mediation test. CAR, NPL, and LDR do not significantly affect ROA, individually or jointly. CAR and NPL significantly affect PBV - positively and negatively, respectively - while LDR and ROA do not. The Sobel test confirms that ROA does not significantly mediate any of the three paths from CAR, NPL, or LDR to PBV.

These findings contribute to theory by showing that an intervening-variable claim needs explicit testing rather than inference from significant direct effects, and to practice by indicating that, for Indonesian conventional banks in this period, capital adequacy and credit quality are priced by the market directly rather than through the channel of accounting profitability. This has practical implications for bank management and investor relations: communicating capital strength and asset quality directly may be more consequential for market valuation than short-term profitability signals. The findings also inform regulators' emphasis on capital buffers (CAR) as a channel that operates on firm value largely independently of realized profitability.

This study is limited by its exclusion of Islamic banks, which improves internal validity for the risk-based capital framework used here but limits generalizability to the full Indonesian banking industry; by residual non-normality and autocorrelation that, while addressed through robustness checks, indicate room for alternative estimators (e.g., dynamic panel GMM) in future work; and by the use of only three risk variables and one intervening variable, when bank profitability and valuation are also shaped by operational efficiency, macroeconomic conditions, and market sentiment not modeled here. Future research is encouraged to reposition ROA as a parallel or control variable rather than an assumed mediator, to test moderation rather than mediation where direct effects dominate, and to extend the sample to Islamic banks with appropriately adapted risk measures.

STATEMENT OF USE OF GENERATIVE AI

During the preparation of this work, the authors used AI-assisted tools to help re-estimate the panel regression models from the raw dataset, compute the Sobel mediation test, and improve the clarity of the exposition in response to reviewer comments. The authors reviewed and verified all statistical output against the underlying data and EViews results, and take full responsibility for the content of the publication.

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