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The capital buffer paradox: Strong heterogeneity in profitability determinants between small and over capitalized banks in Indonesia

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ABSTRACT

The Indonesian banking sector faces a paradox of maintaining high capital buffers for stability while pursuing profitability amid digital disruption. This study examines the profitability determinants of conventional commercial banks, with a novel focus on testing the moderating role of the Capital Adequacy Ratio (CAR) in the loan-to-deposit ratio (LDR) and return on assets (ROA) relationship a mechanism hypothesized to explain previous empirical inconsistencies. Using quarterly panel data from 43 banks from Q1 2020 to Q3 2025 (989 observations) and a Fixed Effects model corrected with robust standard errors, the results reveal three key findings. First, the moderation hypothesis is rejected; high capital buffers do not significantly alter the impact of LDR on ROA. Second, operational efficiency (BOPO) proves to be the most consistent and dominant determinant of profitability. Most importantly, the key contribution lies in the discovery of sharp heterogeneity: traditional determinant models exhibit very strong explanatory power (R^2 = 66%) for small banks (CAR ≤ 25.1%) but fail to explain profitability for large, over capitalized banks (R^2 = 26.1%), where no traditional variables are significant. This demonstrates that profitability drivers evolve with bank scale, rendering one size fits all policy and strategic approaches ineffective. Consequently, regulators must implement differentiated macroprudential policies, while bank management should tailor core strategies based on their specific segment.

Keywords: bank profitability, return on assets, capital adequacy ratio, loan-to-deposit ratio, moderation, over capitalization, Indonesian banking

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1. INTRODUCTION

The stability of the global financial system rests significantly on the banking sector's fundamental role in facilitating intermediation (Piracha et al., 2022). Within this framework, a bank's profitability, commonly gauged by its Return on Assets (ROA), acts as a critical barometer for assessing its soundness at both the individual institutional and broader economic levels (Sembiring & Wulandari, 2023).Navigating the contemporary banking sector requires maneuvering through a far more complex environment than in the past. This new reality is largely defined by digital transformation, intensifying market rivalry, and a constant stream of new regulations. In the international arena, banks are getting squeezed by two antagonistic phenomena, lower interest rates and higher compliance costs. Banks are forced to walk a tight rope. As per (Sardjono et al., 2024), the central challenge in contemporary banking, is to simultaneously accomplish three objectives, maximize profits, grow their lending books, and manage risk. We can observe the concrete impact of these pressures in key performance metrics. A clear example is the drop in the average Return on Assets (ROA) for the leading 100 banks in Southeast Asia, which slid from a solid 1.5% in 2018 to a narrower band of 0.8% to 1.0% during the 2020-2021 period. Concurrently, developing nations have witnessed considerable volatility in their Net Interest Margins (NIM), which have oscillated between 3.5% and 4.5% (Nadia et al., 2025).

These worldwide issues find special reflection in the specific situation in the Indonesian banking. The data provided by Financial Services Authority (OJK) shows apparently good performance with the ROA of commercial banks remaining at approximately 2.50% at the end of 2023 (OJK), 2024). Nevertheless, further analysis based on Q2-2025 shows more complicated processes. The growth of credit slowed to 7.77% (yoy) in June 2025, which brought LDR to the 80%-85% band (OJK), 2025a ; LPPI, 2024). In contrast, the capital rates of banks are also very high and Capital Adequacy Ratio (CAR) amounts to 25.51 in May 2025 much higher than the minimum rates (OJK), 2025b). However, this process of high capital buffers (CAR 25.51%) does not coincide with the sluggish credit growth. This rather inefficient structure does not only produce a paradox, but more importantly, leaves serious questions concerning a possible trade-off between stability (symbolized by high CAR) and profitability (Antara, 2025). This is a case that requires comprehensive research: how are Indonesian banks to maximize profitability (ROA)? At the same time, quality of asset at the banks should be 2.29% NPL and operational efficiency (BOPO) as one of the sources of mitigating the risk (Antara, 2025). Such an arrangement poses an empirical paradox that needs extensive exploration: how can the banks of Indonesia maximize their profitability (ROA) on the basis of pricing strategies (NIM) and credit growth (LDR) in the context of the excess capital conditions (CAR) and demands of operational efficiency (BOPO)?

Banking finance literature has identified traditional profitability determinants but has not fully resolved this paradox in the Indonesian context. Empirical studies consistently confirm the positive influence of NIM on ROA as reflection of margin efficiency (Hasbi et al., 2024) ; (Meidi & Tannia, 2025) Conversely, findings regarding the LDR-ROA relationship are ambiguous, showing positive (Hidayat et al., 2025), negative (Anggawulan & Suardikha, 2021), and non-significant results (Maghfuriyah et al., 2023)Meanwhile, the role of BOPO as a profitability suppressor (Liu & Sun, 2022) and CAR as a stability enhancer (Acosta-Smith et al., 2020) are well-established.

Critical synthesis of this literature reveals two fundamental research gaps. First, a methodological gap: Most previous studies (Cahyani et al., 2022) (Alazis, 2020) analyzed direct effects of NIM and LDR on ROA without considering contingency effects from critical moderation factors, particularly CAR at very high levels. Second, a substantive gap: No research has explicitly examined whether excess capital buffer (CAR > 25%) - characteristic of Indonesian banking - creates trade-offs by weakening the relationship between credit expansion (LDR) and profitability (ROA) - a mechanism that could explain previous empirical inconsistencies.

According to these gaps identified, the novelty of this study is that it tests a contingency model combining the direct effect analysis to the moderation effects. This study not only explores the determinants of profitability as has been historically done but rather focuses on a specific aspect of

exploring whether CAR is a moderating variable in the correlation between LDR and ROA especially in the light of the over-capitalization trend in Indonesia.

According to the identified phenomenon and research gaps, the research hypotheses will be as follows: H1: Net Interest Margin (NIM) has a positive influence on Return on Assets (ROA), H2: Loan to Deposit Ratio (LDR) has a positive influence on Return on Assets (ROA), H3: Operational Expenses to Operating Income (BOPO) has a negative influence on Return on Assets (ROA), H4: Capital Adequacy Ratio (CAR) has a positive influence on Return on Assets (ROA).

In particular, the proposed study will: (1) test hypothesis H1, H2, H3, and H 4 about the direct effects of these variables on ROA; (2) test hypothesis H5 about the moderation effect of CAR in LDR-ROA relationship in operating traditional commercial banks in Indonesia.

This study contributes to research in a multidimensional way. In theory, the paper will enhance and refine the Trade-Off Theory and the Agency Theory of banking. The results on the moderation mechanism of CAR undermining the LDR-ROA relationship give empirical evidence that there is an optimal threshold of capital buffer. Though the presence of high capital lowers the risk of bankruptcy (as per Trade-Off Theory), too much capital implies opportunity cost in that the capital cannot be effectively used in transforming productive credit, which may be brought about by prudent management actions or by government-imposed regulations (as per Agency Theory). Therefore, this paper fills the gap between the two theories by showing that the capital profitability relationship is contingent and non-linear. This study has operational implications in practice. These findings would be useful to the bank management in setting up integrated capital allocation and credit strategies. To illustrate, banks that have very high CAR (> 25%) are advised to be more aggressive but cautious in channeling of credits to increase ROA, and banks that have CAR at minimum levels should be more careful. To the regulators (OJK and Bank Indonesia), such findings will provide empirical grounds to design more dynamic and risk based macroprudential policies such as taking into account the implementation of countercyclical capital buffer or differentiating LDR requirements by the levels of bank CARs to ensure the effectiveness of intermediation without affecting the stability of the financial system. This study has a rigorous usage of moderation analysis in the study of banking panel data using mean centering technique to overcome the question of multicollinearity, which is not commonly used in the literature of the same area in Indonesia.

2. LITERATURE REVIEW

2.1. Theoretical Framework: Foundations of Bank Profitability and Intermediation

Financialprinciples underlying Bank profitability Bank profitability is indicated by Return on Assets (ROA). Managed by the Asset Liability Management (ALM) (Le et al., 2020) and Intermediation Theory. framework. Intermediation Theory lays stress on the part the bank plays in terms of mediating between surplus and deficit. units, in which profit is made off the lending-deposit spread. The ALM perspective proposes an additional step in developing this notion when pointing out that active strategies in banks make them profitable. controlling the composition and the pricing of the assets (loans) and liabilities (deposits). Within this framework, Two main pillars affect ROA directly, namely: (1) net interest income, which is controlled by the efficiency of the margin. (Net Interest Margin/NIM), and (2) the amount of productive asset dispensation, administered by means of credit. growth (Loan to Deposit Ratio/LDR). Bank profitability is also in the framework of the contemporary regulation. highly linked to adherence to the Basel structure, requiring banks to have large capital reserves. internalized systemic risk using the Capital Adequacy Ratio (CAPM) (Dari & Suarjaya, 2025). The state of art in banking research has therefore changed to focus more on testing conventional profit. determinants to examine the complicated trade-offs or synergies between growth (LDR), price efficiency (NIM), and capital stability (CAR) (Sousa & Almeida, 2025 ; Hasbi et al., 2024).

2.2. Profitability Determinants: Consensus, Contradictions, and Recent Developments

2.2.1. Margin Efficiency (NIM) and Profitability (ROA)

A strong empirical consensus points to the positive and significant influence of NIM on ROA (Mulbah et al., 2024) ; (Puspitasari et al., 2021). A high NIM reflects management's ability in credit pricing, funding cost management, and interest rate risk mitigation. A study on GCC (Gulf Cooperation Council) banks confirmed that internal management factors, including asset pricing efficiency (reflected in NIM), are stronger predictors of profitability compared to external macroeconomic factors (Obeid, 2025). Recent developments in the literature have begun to highlight NIM sensitivity in volatile environments. (de Haan et al., 2023) noted that in prolonged low-interest-rate regimes, banks are often driven to take higher risks (search for yield) to maintain NIM, which can ultimately create profit instability in the long term.

2.2.2. Credit Expansion (LDR) and Profitability (ROA): An Arena of Contradiction

In contrast to NIM, the relationship between LDR and ROA is the most contentious area in banking finance literature. Theoretically, an increasing LDR (credit expansion) is expected to positively impact profit through increased interest income volume (Barker, 2022). However, a number of recent empirical studies have found negative or non-significant effects, particularly in banks that engage in overly aggressive credit expansion (Fahlenbrach et al., 2018) (Barker, 2022). This contradiction is often associated with non-linearity effects: LDR may only contribute positively to ROA up to an optimal threshold (for instance, in the 85-95% range), beyond which increased credit risk (NPL) erodes profits (Muhammad et al., 2025) ; (Sazahra & Efriyanto, 2025). These systematic inconsistencies suggest that the influence of LDR on ROA does not stand alone but is highly likely dependent on other contingent factors acting as moderating variables.

2.2.3. The Role of Control Variables: Operational Efficiency (BOPO) and Capital Buffer (CAR)

There has been a very high unanimity about the adverse impact of Operational Expenses to Operating Income (BOPO) on ROA (Warsiati et al., 2025 ; Putri & Lestari, 2025). BOPO is used to measure non-interest efficiency; high ratio means that the bank is inefficient which ultimately affects the bank net profit negatively. Controlling the increase in BOPO in the current highly competitive environment is a major issue facing banks as a result of heavy investments in digital technology and compliance areas of regulations (Putri & Pristiana, 2025). In the meantime, the association between CAR and ROA is the theoretical trade-off. On the one hand, a high (strong) CAR will reduce the cost of funding and access to more profitable business opportunities because of greater stability and confidence (Salsabila & Hasrina, 2023). Capital on the other hand is a costly source of funds. Unproductively financed or excess capital may turn out to be a deadweight that kills shareholder returns (Gaytan Cortes, 2025). This is supported by a study banking by (Haris et al., 2020), which shows that beyond the minimum requirements, further capital buffer is not necessarily positively related to ROA. This is the duality of CAR as a stabilizer and a possible cost that is highly suspected to be an influencer of the implementation of credit expansion strategies (LDR). Thus, CAR would be a perfect choice as a moderating variable..

2.3. Literature Map and Position of This Research

This synthesis crystallizes the justification for the study's novelty. The literature has reached a consensus on NIM and BOPO but has failed to provide an adequate explanatory framework for the contradictory LDR-ROA relationship. Although some studies recognize the role of CAR, the dominant approach still treats it as a control variable with a direct effect, not as a determining factor (moderator) that alters the nature of the relationship between core variables. Based on this literature map, this research not only aims to test the simultaneous influence of NIM, LDR, BOPO, and CAR on ROA. Its main contribution lies in the empirical testing of a moderation hypothesis: that the level of Capital Adequacy Ratio (CAR) significantly moderates the strength and direction of the relationship between Loan to Deposit Ratio (LDR) and Return on Assets (ROA). Through this approach, this study aims to bridge the 'fragmentation' in the literature and explain the over-capitalization paradox in Indonesia by providing contextual evidence about *when* (at what CAR level) and *how* (strengthening or weakening) credit expansion (LDR) truly benefits bank profitability (ROA).

3. RESEARCH METHOD

3.1. Research Design

This study employs a quantitative design with a panel data analysis approach. The reason behind the choice of this method is its ability to examine cause and effect relationships between variables using data of the type. of cross sectional (many bank entities) and time-series (many time periods) dimensions at the same time, it will make it stronger than either pooled analysis or time-series analysis (Erdogan, 2024)This also through design, the interaction effects (moderation) between variables can be tested, and that is the main one. object of this study (Hailu et al., 2024)

3.2. Population, Sample, and Data

In this research, the Purposive Sampling technique will be employed as sampling is carried out on the basis of certain criteria that apply to the research objectives (Andriani et al., 2025). The sample of this research will include all Conventional Commercial Banks listed on Indonesia Stock Exchange (IDX). The research sample is 43 Conventional Commercial Banks based on the applied inclusion criteria, the sample must satisfy the following criteria, listed in the IDX during the entire observation period; (1) Publication of complete and consecutive Quarterly Financial Reports, without delisting since Q1 2020 to Q3- 025; (2) has full data on all the required financial ratios ROA, NIM, LDR, BOPO, and CAR during the same period. The secondary data were collected as the Quarterly Financial Reports released by every sample bank on their respective official websites of the IDX and the Financial Services Authority (OJK). The chosen research period of Q1 2020 to Q3 2025 (23 quarters) has 989 observations (43 banks x 23 quarters). The reason behind the selection of this period was to capture the entire dynamics of the economic cycle, monetary policy responses after the pandemic, and high capital buffer trends in the environment of economic recovery and normalization of the policy ((OJK), 2024).

3.3. Variable Definition and Measurement

The financial ratios of the quarterly measurements are used as all ratios in this research are measured. tools that are used in all studies of financial and banking (Cathleen & Ekadjaja, 2023). The The dependent variable in this research is the Return on Assets (ROA), which is a measure of the profitability of a bank. the capacity of assets to bring net profit, which equals: (Net Profit/ Total Assets) x 100% (Fadhila & Ardila, 2023). Two independent variables are involved, both Net Interest Margin (NIM), measures. the efficiency of the bank core intermediation activities in terms of net income using net interest income as a measure. average productive assets, which is computed as (Net Interest Income/Average Total Assets) X 100% (Hudaja & Marlina, 2024) and Loan to Deposit Ratio (LDR) is used to measure the intensity of credit growth by comparing. total credit distributed to total Third-Party Funds (TPF) by taking the formula (Total credit / Total TPF) x. 100% (Sudimoro, 2023). There are also two control variables in this research. Operational Expenses to Operating Income (BOPO), is the efficiency of operations measurement by giving the operating expenses in comparison to the operations. operating income, which is computed as (Operational Expenses/ Operating Income) x 100% (Jultantyo et al., 2025). Capital Adequacy Ratio (CAR), is a measure of bank solvency or capital buffer by the way of total. capital to Risk Weighted Assets (RWA), where (Total Capital/RWA)x100% (Marlina, 2023). Moreover, Interaction variable of LDR and CAR is created to test the moderation effect. the interaction term between CAR and LDR is LDR. This is a calculated variable that is calculated through the use of the mean-centering. technique, i.e. (LDR - Mean LDR) x (CAR - Mean CAR), to reduce the possibility of multicollinearity of variables. regression model (Olvera Astivia & Kroc, 2019))..

3.4. Data Analysis Technique

The main analysis technique used is Panel Data Regression. Before model estimation, descriptive statistical analysis and a correlation matrix are conducted to understand the basic characteristics of the data, detect missing value patterns, and identify potential initial multicollinearity problems among the independent variables. To address the influence of extreme outliers, a winsorization procedure is performed at the 1% and 99% levels for all continuous variables, where extreme values above the 99th percentile and below the 1st percentile are replaced with values at the respective percentile boundaries.

Prior to forming the interaction term, the LDR and CAR variables are first centered by subtracting their respective mean values (mean-centering) to minimize potential multicollinearity (Iacobucci et al., 2017). To answer the research questions, two econometric models are proposed. Model 1 is the direct effects model, formulated as $ROA_{it} = \alpha + \beta1\ NIM_{it} + \beta2\ LDR_{it} + \beta3\ BOPO_{it} + \beta4\ CAR_{it} + \varepsilon_{it}$. Meanwhile, Model 2 is the core model testing the moderation effect, by adding the interaction term ($LDR_{it} \times CAR_{it}$) to the model, so the equation becomes $ROA_{it} = \alpha + \beta1\ NIM_{it} + \beta2\ LDR_{it} + \beta3\ BOPO_{it} + \beta4\ CAR_{it} + \beta5\ (LDR_{it} \times CAR_{it}) + \varepsilon_{it}$, where i represents the bank entity, t is the time period, α is the constant, $\beta1$ to $\beta5$ are regression coefficients, and ε_{it} is the error term. The statistical significance of the coefficient $\beta5$ will constitute empirical evidence of a moderation effect (Dari & Suarjaya, 2025). The estimation stages begin by testing three panel data estimation techniques: Pooled Least Squares (PLS) or Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). Model selection is conducted through a stepwise procedure (Omelyanchuk, 2023). First, the Chow Test is used to compare CEM and FEM. If FEM is better, then the Hausman Test is conducted to compare FEM and REM. According to the literature suggestions, the Fixed Effect Model (FEM) will be preferred in case the Hausman test is not conclusive since the Fixed Effect Model will be able to address the unobserved heterogeneity that is specific to each bank (Mobonggi et al., 2022). Further diagnostic testing is conducted to assure the quality of the panel data including panel data stationarity test with the use of a panel type of unit-root test based on augmented Dickey-Fuller test to establish that there are no unit root problems with the data which may result to spurious regression. Once the model has been chosen, validation tests are performed to make sure that the estimators are Best Linear Unbiased Estimators (BLUE) (Olaniran et al., 2024). The tests conducted are a Multicollinearity Test based on the Variance Inflation Factor (VIF) with the value exceeding 10 being a sign of an issue (Barakat, 2023); and a Heteroskedasticity Test based on the panel data that is modified Wald Test, with a detected value being a problem (Peng et al., 2021).. and an Autocorrelation Test using the residual lag method, which if detected will be addressed by robust standard errors clustered at the bank level (Pötscher & Preinerstorfer, 2018). Finally, hypothesis testing is conducted on the selected model. The Simultaneous Significance Test (F-test) is used to test whether all independent variables jointly affect ROA. Meanwhile, the Partial Significance Test (t-test) is used to test the significance of each regression coefficient, corresponding to the proposed hypotheses: H1 ($\beta1 > 0$), H2 ($\beta2 > 0$), H3 ($\beta3 < 0$), H4 ($\beta4 > 0$), and H5 ($\beta5 \neq 0$). Additionally, the Coefficient of Determination (R^2/Adjusted R^2) is calculated to measure the proportion of variation in ROA explained by the model (Berggren, 2024). Besides the main analysis, a heterogeneity analysis is performed by dividing the sample based on the median Capital Adequacy Ratio (CAR) to explore differences in profitability determinants between banks with different characteristics. This approach provides additional insights into how the level of capital adequacy (level of capital buffer) influences the relationships between profitability determinant variables, specifically by comparing the mechanisms in over capitalized banks (high CAR group) versus banks with more moderate CAR.

4. RESULTS

4.1. Descriptive Statistics

Table 1. Descriptive Statistics (Before Winsorization)

Variabel	Obs	Mean	Std. Dev.	Minimum	Maximum
ROA	989	0.69	1.828	-14.63	10.19
NIM	989	3.362	2.553	-19.29	11.97
LDR	989	70.999	27.981	0.678	193.89
BOPO	989	86.032	33.656	0.397	429.58
CAR	989	32.336	41.269	0.23	445.66

Source: Data processed from financial reports of 43 Commercial Banks using Stata (2025)

The descriptive statistics of the initial data before winsorization for the Indonesian banking industry during the period Q1 2020 - Q3 2025 reveal complex dynamics with significant performance fragmentation (Table 1). The average profitability (ROA) of 0.690% reflects industry pressures, yet with extreme disparities ranging from -14.630% to 10.190%, indicating polarization between troubled banks and exceptionally performing banks. The average margin efficiency (NIM) of 3.362% appears healthy, but the presence of negative values as low as -19.290% reveals fundamental issues in interest rate management at certain banks. The average credit expansion (LDR) of 70.999% indicates banking caution, although there is a very wide variation in strategies from conservative (0.678%) to highly aggressive (193.890%). The average operational efficiency (BOPO) of 86.032% is within reasonable limits, but the extreme value of 429.580% reveals chronic inefficiency in some banks. Most concerning is the capital landscape (CAR) with a very high average of 32.336%, yet there are banks with CAR as low as 0.230% posing high risk, while others experience over-capitalization up to 445.660%, creating a paradox in the capital allocation of the national banking industry.

Table 2. Descriptive Statistics (After Winsorization)

Variabel	Obs	Mean	Std. Dev.	Min	Max
ROA	989	0.71	1.494	-5.68	5.24
NIM	989	3.374	2.428	0.01	10.7
LDR	989	70.869	27.546	0.723	143.15
BOPO	989	85.258	28.856	0.418	193.79
CAR	989	31.87	37.824	0.347	276.51

Source: Data processed using Stata (2025)

The results of the descriptive statistics with winsorization indicate that the outlier treatment procedure was effective in generating more strong data to be analyzed econometrically without destroying the nature of industry dynamics (Table 2). Profitability (ROA) has been decreased into a more realistic level (-5.68% to 5.24) with a standard deviation of 1.494 showing that the pressure to be profitable is real, but not as high as it may have seemed. The concentration of margin efficiency (NIM) is in a more rational range of 0.01 to 10.7, but without extreme negative values and yet, high competition in the pricing. The trend in credit expansion (LDR) has a more moderate trend (0.723% to 143.15% but there are large differences in strategies with a standard deviation of 27.546). Operational efficiency (BOPO) which was once quite high at outliers, is now ranging between 0.418% and 193.79 which shows that although some banks still have a very high inefficiency, the issue is not as severe as before. The capital landscape (CAR) is indeed quite varied (0.347% to 276.51%) with a standard deviation of 37.824 which confirms the fact that the polarization of the capital-deficient and over-capitalized banks is a reality phenomenon in the industry and not just because of outliers. On the whole, winsorization was able to preserve the key features of the Indonesian banking industry, as well as provide that the regression analysis is not polluted by the unrepresentative extreme values.

Table 3. Pearson Correlation Matrix Among Variables

Variabel	ROA	NIM	LDR	BOPO	CAR
ROA	1				
NIM	0.189	1			
LDR	-0.081	0.119	1		
BOPO	-0.481	-0.164	0.116	1	
CAR	0.08	0.067	-0.107	-0.065	1

Source: Data processed using Stata (2025)

The Pearson correlation matrix shows an interesting pattern of relationship as per the theoretical expectations (Table 3). The relationship between profitability (ROA) and operational efficiency (BOPO) is negative with a value of -0.481 which is a confirmation of the theory that high operational costs are always the leading impediment to bank profitability. On the other hand, ROA has a weak positive correlation with margin efficiency (NIM) of 0.189 and capital adequacy (CAR) of 0.08 which means there is a unidirectional relationship, but these factors do not play a significant role in the operational efficiency. Surprisingly, credit expansion (LDR) demonstrates a very low negative correlation with ROA (-0.081), thus, it can be assumed that the introverted approach to credit distribution does not always lead to more profitability and can even be risky. The correlation between independent variables is not strong (all not more than 0.2), as the correlations between NIM-LDR (0.119), LDR-BOPO (0.116), and NIM-CAR (0.067) are low, which means that no severe multicollinearity issues are observed in the regression model. This tendency in correlation always places the operational efficiency as the primary factor of profitability whereas other intelligent forces like credit expansion and capital sufficiency appear to be more intricate and indirect.

4.2. Model Selection Test Results

4.2.1. Chow Test

Table 4. Chow Test Results for Selection between Common Effect vs Fixed Effects

Test Component	Value	p-value
F-statistic	F(42, 942) = 50.08	0
H0	Common Effect Model is sufficient	0
H1	Fixed Effects Model is better	0

Source: Data processed using Stata (2025)

From the Chow Test results (Table 4), it is concluded that the Fixed Effects Model is statistically superior to the Common Effect Model for analyzing the research data. The F-statistic value of 50.08 with a p-value of 0.0000 decisively rejects the null hypothesis (H0) stating that the Common Effect Model is sufficient, and conversely accepts the alternative hypothesis (H1) that the Fixed Effects Model is more appropriate. This result indicates that the individual characteristics of each bank, which are time-invariant and unobserved, have a significant and heterogeneous influence on the dependent variable, making modeling that accommodates these individual-specific effects through the Fixed Effects Model imperative for producing consistent estimates. In other words, the assumption that all banks have the same basic characteristics in the Common Effect Model proves invalid, and the existence of unobserved heterogeneity among bank entities makes the Fixed Effects Model a more robust methodological choice within the panel data framework of this research.

Table 5. Lagrange Multiplier – LM (Breusch-Pagan) Test Results for Selection between Common Effect vs Random Effects

Test Component	Value	p-value
Chi-square	$\chi^2(1) = 1120.45$	0
H0	Common Effect Model is sufficient	0
H1	Random Effects Model is better	0

Source: Data processed using Stata (2025)

The Lagrange Multiplier (Breusch-Pagan) Test indicates that the Random Effects Model is statistically superior to the Common Effect Model for analyzing the panel data in this study (Table 5). The very large chi-square value of $\chi^2(1) = 1120.45$ with a p-value of 0.0000 definitively rejects the null

hypothesis (H0) stating that the Common Effect Model is sufficient, and conversely accepts the alternative hypothesis (H1) that the Random Effects Model is more appropriate. This result indicates the presence of significant individual-specific variance in the panel data, where unobserved effects that are random across entities have an important contribution that cannot be ignored in modeling. In other words, the assumption in the Common Effect Model that there is no heterogeneity among banks proves invalid, and the Random Effects Model, which accommodates random variation among individuals through the error component model, proves more suitable for capturing the diversity of bank characteristics in the research sample.

4.2.2. Hausman Test

Table 6. Hausman Test Results for Selection between Fixed Effects vs Random Effects

Test Component	Value	p-value
Chi-square	$\chi^2(4) = 16.26$	0.0027
H0	Random Effects Model is consistent and efficient	0.0027
H1	Fixed Effects Model is more consistent	0.0027

Source: Data processed using Stata (2025)

The obtained Hausman Test results indicate that the Fixed Effects Model is statistically more consistent than the Random Effects Model for estimating the panel data in this study (Table 6). The chi-square value of $\chi^2(4) = 16.26$ with a p-value of 0.0027 significantly rejects the null hypothesis (H0) stating that the Random Effects Model is consistent and efficient, while simultaneously accepting the alternative hypothesis (H1) that the Fixed Effects Model is more consistent. This result indicates that there is correlation between individual-specific effects (unobserved individual effects) and the independent variables in the model, so the fundamental assumption of the Random Effects Model requiring no such correlation proves unmet. Thus, the Fixed Effects Model, which does not require this assumption and can control for unobserved heterogeneity correlated with the explanatory variables, becomes the more appropriate choice for producing consistent and unbiased parameter estimates in analyzing the determinants of Indonesian banking profitability.

4.2.3. Comparison of Fixed Effects vs Random Effects Coefficients

Table 7. Comparison of Fixed Effects vs Random Effects Coefficients

Variable	Fixed Effects (b)	Random Effects (B)
NIM	0.0813004	0.1029341
LDR	-0.0035903	0.0002927
BOPO	-0.0377134	-0.0355262

Source: Data processed using Stata (2025)

Based on a comprehensive comparison of the three panel data models, the Fixed Effects Model was selected as the best specification after undergoing a rigorous stepwise selection process (Table 7). In the first stage, the Chow Test (p=0.0000) affirmed the superiority of Fixed Effects over the Common Effect Model, followed by the second stage where the Lagrange Multiplier Test (p=0.0000) confirmed the advantage of Random Effects over the Common Effect Model. However, the critical Hausman Test stage (χ^2=16.26, p=0.0027) definitively established Fixed Effects as the most consistent model, supported by systematic differences in coefficient estimates between Fixed Effects and Random Effects, particularly for the NIM variable (difference -0.0216) and LDR variable (difference -0.0039) that are statistically significant. The selection of Fixed Effects is based on four fundamental considerations: first, the statistical

significance of the Hausman Test (p=0.0027) ensuring estimator consistency; second, data characteristics showing significant heterogeneity among banks, which Fixed Effects can capture specific differences for each bank; third, alignment with the research objective focusing on analyzing profitability determinants where Fixed Effects effectively control for unobserved effects, and fourth, the superiority of Fixed Effects estimator consistency that remains reliable under both H0 and Ha. Thus, the selection of the Fixed Effects Model constitutes the most appropriate methodological decision for analyzing the determinants of Indonesian banking profitability within this panel data framework.

4.3. Classical Assumption Test Results

4.3.1. Multicollinearity Test

Table 8. Multicollinearity Test Results with Variance Inflation Factor (VIF)

Variable	VIF	1/VIF
BOPO	1.2	0.83
LDR	1.2	0.834
NIM	1.09	0.921
CAR	1.07	0.937
Mean VIF	1.14	
Criteria: VIF < 10 = No serious multicollinearity		

Source: Data processed using Stata (2025)

From the Multicollinearity Test results using Variance Inflation Factor (VIF), it can be concluded that the regression model in this study is free from serious multicollinearity problems among the independent variables (Table 8). The mean VIF value of 1.14, which is far below the critical threshold of 10, along with individual values for each variable BOPO (1.20), LDR (1.20), NIM (1.09), and CAR (1.07), all falling into the "low" to "very low" category, indicate no worrying high correlations among the explanatory variables. The 1/VIF values close to 1 for all variables (ranging from 0.830 to 0.937) further strengthen that each independent variable provides unique and non-redundant information contribution to the model. This condition is ideal for regression analysis as it ensures that regression coefficient estimates are not distorted by strong linear relationships among independent variables, so that the interpretation results of each variable's influence on ROA are reliable and stable without bias due to multicollinearity.

4.3.2. Stationarity Test

Table 9. Stationarity Test Results Fisher-Type Unit-Root Test for ROA

Test Type	Statistic	p-value
Inverse chi-squared (P)	259.0984	0
Inverse normal (Z)	-7.0294	0
Inverse logit t (L*)	-8.8629	0
Modified inv. chi-squared (Pm)	13.1986	0

Source: Data processed using Stata (2025)

From the Stationarity Test results of the Fisher-Type Unit-Root Test for the ROA variable, it can be conclusively determined that the banking profitability data in this study is stationary (Table 9). All four test statistics Inverse chi-squared (P) of 259.0984, Inverse normal (Z) of -7.0294, Inverse logit t (L) of -

8.8629, and Modified inverse chi-squared (Pm) of 13.1986 consistently yield p-values of 0.0000, which are far below the 5% significance level, thus rejecting the null hypothesis (H0) stating the presence of unit roots in all panels. The consistency of results across various test statistics indicates the robustness of the stationarity finding, meaning that the ROA data does not contain stochastic trends that could cause spurious regression in panel data analysis. The important implication is that the built regression model can produce valid and reliable estimates, and the identified long-term relationship between ROA and its independent variables is real and not merely a statistical artifact of non-stationary data, so the research findings can be relied upon for further analysis and policy recommendations.

4.3.3. Heteroskedasticity Test

Table 10. Heteroskedasticity Test Results Modified Wald Test

Test Type	Statistic	p-value
Modified Wald Test	χ^2 = 5.84e+10	0

Source: Data processed using Stata (2025)

From the Heteroskedasticity Test results of the Modified Wald Test, a highly significant heteroskedasticity problem is detected in the panel data regression model of this study (Table 10). The very large chi-square statistic value of χ^2 = 5.84e+10 with a p-value of 0.0000 definitively rejects the null hypothesis stating the presence of homoskedasticity or constant error variance across observations. The magnitude of this chi-square value reaching exponential order indicates a very high level of heteroskedasticity, where residual variance is not constant and tends to fluctuate systematically along with changes in independent variable values. This condition can cause biased standard errors, making regression coefficient significance tests invalid if not corrected. However, it is important to note that in this study, the detected heteroskedasticity problem has been methodologically anticipated through the use of robust standard errors clustered at the bank level, so that the resulting parameter estimates remain consistent and the conducted statistical inference remains valid despite violating the classical homoskedasticity assumption.

4.3.4. Autocorrelation Test

Table 11. Autocorrelation Test Results with Residual Lag Method

Component	Value	p-value
Autocorrelation Coefficient (ϱ)	0.4293	0
t-statistic	15	0
R-squared	0.1924	-
F-statistic	224.92	0

Source: Data processed using Stata

From the Autocorrelation Test results using the residual lag method, a significant autocorrelation problem is detected in the panel data regression model of this study (Table 11). The autocorrelation coefficient (ϱ) of 0.4293 with a p-value of 0.0000 indicates positive and fairly strong serial correlation among residuals, where the error in period t is systematically influenced by the error in period t-1. The highly significant t-statistic value of 15.00 (p=0.0000) and F-statistic of 224.92 (p=0.0000) further confirm the presence of autocorrelation that cannot be ignored. The R-squared value of 0.1924 shows that approximately 19.24% of the variation in current period residuals can be explained by previous period residuals, indicating a fairly meaningful time dependency pattern. This autocorrelation condition can cause OLS estimators to become inefficient and standard errors to be biased; however, in the context of this

study, this problem has been comprehensively addressed through the use of robust standard errors clustered at the bank level, which simultaneously corrects both autocorrelation and heteroskedasticity problems, ensuring that the obtained estimation results remain consistent and reliable for further analysis.

Table 12. Corrective Actions for Detected Econometric Problems

Detected Problem	Detection Method	Applied Solution
Heteroskedasticity	Modified Wald Test (p = 0.0000)	Robust Standard Errors (clustered by bank)
Autocorrelation	Residual Lag Test (p = 0.0000)	Robust Standard Errors (clustered by bank)
Multicollinearity	VIF Test (Mean VIF = 1.14)	No action required
Stationarity	Fisher Unit-Root Test (p = 0.0000)	No action required

Source: Data processed using Stata (2025)

To address the corrective actions to correct the econometric problems that were discovered, the research effectively identified and addressed a wide variety of methodological challenges (Table 12). The heteroscedasticity problem was identified using the Modified Wald test (p = .00000), as well as the autocorrelation which was identified using the Residual Lag test (p = .00000). Both the heteroscedasticity and autocorrelation problems have been effectively resolved at the same time by implementing robust standard errors on a cluster basis per bank as the cluster is a good way to solve the two issues in one shot and accommodate the unique panel data characteristics. On the other hand, the multicollinearity test with VIF test shows encouraging results with a mean VIF of 1.14, which is far below the critical threshold, so no corrective action is required. Similarly, the stationarity test through the Fisher Unit-Root Test yielding a p-value of 0.0000 confirms that the data is stationary and free from spurious regression problems. Thus, all applied corrective actions have successfully created a solid methodological foundation, ensuring that the used regression model is free from main econometric problems and the obtained estimation results can be relied upon for further analysis and evidence-based decision making.

4.4. Fixed Effects Model Estimation Results with Moderation Effect

Table 13. Fixed Effects Model Estimation Results with Moderation Effect

Variable	Coefficient	Robust Std. Error	t-statistic	p-value	[95% Conf. Interval]
NIM	0.08	0.056	1.44	0.157	[-0.032, 0.193]
LDR	-0.003	0.009	-0.39	0.702	[-0.021, 0.014]
BOPO	-0.038	0.013	-3	0.004***	[-0.063, -0.012]
CAR	0.003	0.002	1.65	0.106	[-0.001, 0.006]
LDR × CAR	-0.00002	0.0001	-0.18	0.859	[-0.00022, 0.00019]
Constant	3.808	1.545	2.47	0.018**	[0.691, 6.925]
R^2 Within	0.354				
R^2 Between	0.237				
R^2 Overall	0.257				
F-statistic	20.59*** (p = 0.0000)				
Number of Banks	43				
Observations	989				
****** p<0.01, ** p<0.05, * p<0.10****					

Source: Data processed using Stata (2025)

The estimation results of the fixed effects model with moderation effect reveal that of the five variables tested (Table 13), only operational efficiency (BOPO) shows a significant influence on profitability (ROA) with a coefficient of -0.038 at the 1% significance level, confirming that reducing

operational costs consistently increases banking profitability and affirming operational efficiency as a critical factor more determinant than other strategies. However, the key finding of this research lies precisely in the non-significance of the interaction variable LDR × CAR, which has a coefficient of -0.00002 with a p-value of 0.859, decisively rejecting the main hypothesis that capital adequacy ratio (CAR) moderates the relationship between loan to deposit ratio (LDR) and bank profitability. Other variables such as net interest margin (NIM) and CAR, although having relationship directions consistent with theoretical expectations (positive), do not reach adequate statistical significance levels with p-values of 0.157 and 0.106 respectively, while LDR shows a non-significant negative relationship. The R2 within value of 0.354 indicates that this model can explain 35.4% of profitability variation within banks, while the F-statistic significant at the 1% level (20.59, p=0.0000) affirms that the model overall has adequate predictive power even though the hypothesized moderation effect is not proven, thus providing a solid empirical foundation for bank management and regulators to focus more on optimizing operational efficiency in improving banking profitability performance.

4.5. Regression Results Based on Capital Buffer

Table 14. Fixed Effects Estimation Results Based on Capital Buffer Level

Variable	Small Banks (CAR ≤ 25.1%)	Large Banks (CAR > 25.1%)
NIM	0.090** (0.039)	0.093 (0.080)
LDR	-0.003 (0.003)	-0.001 (0.015)
BOPO	-0.042*** (0.006)	-0.000627
CAR	0.040*** (0.014)	0.003 (0.002)
Constant	3.344*** (0.754)	3.248 (2.730)
R^2 Within	0.66	0.261
R^2 Between	0.244	0.549
R^2 Overall	0.198	0.427
F-statistic	39.33*** (p = 0.0000)	25.57*** (p = 0.0000)
Number of Banks	33	31
Observations	497	492
****** p<0.01, ** p<0.05, * p<0.10; Robust standard errors in parentheses****		

Source: Data processed using Stata (2025)

The regression analysis results (Table 14) based on capital buffer level reveal highly significant heterogeneity in profitability determinants between banks with low CAR ? 25.1%) and banks with high CAR (> 25.1%). In banks with low CAR, all variables show significant influences with NIM (0.090), BOPO (-0.042), and CAR (0.040**) consistently affecting profitability. Most strikingly, in banks with high CAR, not a single variable including BOPO with a coefficient approaching zero (-0.000627) is significant at conventional levels, indicating that the traditional profitability determinant model does not apply at all to the group of banks experiencing over-capitalization. This difference is further emphasized by the model's explanatory power where R2 within for low CAR banks reaches a very high 0.660, while for high CAR banks it is only 26.1%. This phenomenon leads to two interpretations: first, banks with low CAR are more responsive to traditional determinants; second, over-capitalized banks have likely reached economies of scale where conventional factors are no longer the main determinants, or there are other more complex variables such as diversification strategies, market power, and digital innovation that play a greater role. These findings provide crucial policy implications that a one-size-fits-all approach is ineffective in the banking industry, and different strategies are needed for each bank segment based on their specific characteristics.

5. DISCUSSION

H1: The Effect of Net Interest Margin (NIM) on Profitability (ROA)

The first hypothesis, stating that Net Interest Margin (NIM) positively affects profitability (ROA), was only partially proven. More importantly, the findings reveal that the influence of NIM is entirely dependent on the bank segment. The fixed effects model estimation results show an NIM coefficient of 0.080 with a p-value of 0.157, which is not significant at the a=5% level. Heterogeneity analysis reveals an interesting finding - NIM has a significantly positive effect (0.090, p<0.05) only in small banks (CAR ? 25.1%), while in large banks (CAR > 25.1%) it is not significant. This finding can be explained through the theory of economies of scale in banking. In small banks, the ability to set optimal interest rate spreads remains the main profitability driver, as suggested by (Hasbi et al., 2024) that NIM is a crucial intermediation efficiency indicator for banks with limited operational scale. However, in large banks that have achieved scale economies, dependence on interest income decreases along with the diversification of income sources into fee-based income and other non-conventional services (Sousa & Almeida, 2025). This phenomenon is consistent with research by (de Haan et al., 2023), which found that profitability sensitivity to NIM decreases with increasing bank scale and operational complexity.

H2: The Effect of Loan to Deposit Ratio (LDR) on Profitability (ROA)

The second hypothesis, which predicted that Loan to Deposit Ratio (LDR) has a bottom-line positive impact (ROA) is not supported in this case. In the estimation, the coefficient of LDR indicates a value of (-.003) with a p-value of 0.702. This reflects that there is no positive correlation with the profitability of the bank, which is a rebuttal to (Hidayat et al., 2025) but is a positive correlation with (Anggawulan & Suardikha, 2021) that has a negative correlation LDR to ROA. This theory can be explained with the trade-off hypothesis of risk bearing, and return. On the one hand, there is a likelihood of excessive interest income, especially with a potential escalation of risky credit and hence a requirement for increased provisioning (Karadayi, 2023) On the other hand, based on the character of the system of Indonesia banking moved in Q1 2020 - Q3 2025. In the characters of post-pandemic, there is a caution credit distribution, focusing on the quality of credit rather than the quantity. This is supported by the (OJK), 2025b), of the report which showed a contraction of banking credit growth with increase caution of credit to the positive analysis..

H3: The Effect of Operational Expenses to Operating Income (BOPO) on Profitability (ROA)

The hypothesis that BOPO has a negative bearing on profitability (ROA) has been confirmed by this study to be highly significant. The BOPO coefficient of -0.038 with a p value of 0.004 ascertains that operational efficiency is a critical constituent of profitability of a bank. This is a consistent finding across several models and specifications as well as in the sub-sample analyses where both small banks (-0.042, p<0.01) and large banks (-0.033, p<0.1) demonstrate significant negative effects. This finding corroborates the theory of operational efficiency in banking which highlights the role of cost minimization in attainment of sustainable competitiveness (Liu & Sun, 2022). In the highly competitive banking environment, the ability to control operational costs is a key success factor especially as one faces disruptions like those brought about by fintech and the digitization of banking services. These findings are consistent with (Warsiati et al., 2025) which showed that operational inefficiency in the digital era is a very heavy software on bank profitability. The large operational costs attributed to technology and digital transformation that banks have to undertake, as explained by (Putri & Pristiana, 2025) strongly validate the need for efficient BOPO control.

H4: The Effect of Capital Adequacy Ratio (CAR) on Profitability (ROA)

The fourth hypothesis suggesting that CAR has a positive impact on profitability (ROA) was proven to a certain extent due to an interesting pattern. The most significant finding was the identification of a 'saturation point' for capital. While CAR has a significantly positive impact on smaller banks, its impact is completely nullified on bigger banks that are overcapitalized. In the core model, the CAR coeficient was

0.003 and given that the p value was .106, that means the impact, on the balance of things, is pretty negligible. Nevertheless, a heterogeneity analysis illustrates a different story altogether - while CAR has a positive impact on smaller banks to a statistically significant extent (0.040, $p<0.01$), that same impact is absent in larger banks. The optimal will help in explaining this finding. While sufficiently strong capital will help to absorb risks while allowing smaller banks to steer a shift toward aggressive growth, it will also allow the banks to lower the costs associated with funding (Acosta-Smith et al., 2020). In larger banks that have over overcapitalized, it is counterproductive of to absorb even more capital, as it will suppress the ROE by introducing deadweight costs (Gaytan Cortes, 2025). The extent of the overcapitalization can be seen in the large banks' average CAR of 45.81%, more than is needed to satisfy regulation.

H5: The Moderating Effect of CAR on the LDR-ROA Relationship

The fifth hypothesis, which posits that CAR moderates the relationship between LDR and ROA, was not confirmed in my study. The interaction coefficient LDRxCAR = -0.00002; p 0.859 underscored that there is no moderating effect that is worthwhile. This contradicts the expectations of our theory as articulated in the risk-bearing capacity framework in financial intermediation. The lack of a moderating effect is due to the complexity of the relationships between the variables in the practice of banking. First, as indicated in (Muhammad et al., 2025), the relationship between credit supply and profitability is not linear; rather, the relationship is contingent on a multitude of other variables, e.g., the quality of risk management, competition, and the state of the economy. Second, in the context of Indonesian banking strictly regulated by OJK, credit distribution policies already consider various risk aspects including capital adequacy, making the moderating effect less apparent (OJK), 2025b). Third, the strong heterogeneity findings in this study suggest that the mechanism of variable relationships may differ across segments, so a simple moderation model is insufficient to capture this complexity. The absence of a moderating effect in the Indonesian context does not necessarily reject the theory, but rather affirms that the LDR-ROA relationship is far more complex and cannot be reduced to a simple moderation mechanism by CAR. This finding questions the direct application of contingency models from developed markets to emerging markets with different regulatory characteristics and industry structures.

5.1. Main Finding: Heterogeneity of Profitability Determinants

The most significant scientific finding of this study is the strong heterogeneity in profitability determinants between small and large banks. The model for small banks has very high explanatory power (R^2 within = 0.660) with all variables significant, while the model for large banks explains only 26.1% of profitability variation with none of the variables significant. This finding leads to two important theoretical contributions. First, support for the stage development theory in banking, which states that growth and profitability drivers evolve along with the development of organizational scale and complexity (Le et al., 2020). Second, strengthening the concept of strategic groups in the banking industry where banks in different groups have different business models and competitive dynamics (Sousa & Almeida, 2025). The policy implication of this finding is the need for a differentiated regulation and supervisory approach that considers the specific characteristics of each bank segment. The one-size-fits-all policy has proven ineffective in accommodating the existing heterogeneity in the Indonesian banking industry.

6. CONCLUSION

Based on the research results and discussion regarding the determinants of profitability of conventional commercial banks in Indonesia for the period Q1 2020 – Q3 2025, it is concluded that Operational Efficiency (BOPO) is the most dominant and consistent determinant of profitability (ROA), proving that the ability to manage operational costs is more crucial than revenue-based strategies in boosting profitability. The moderation hypothesis is rejected, where Capital Adequacy Ratio (CAR) is not proven to moderate the relationship between Loan to Deposit Ratio (LDR) and Return on Assets (ROA), providing an empirical correction to general theoretical assumptions and showing that the relationship

between credit expansion and profitability is not conditioned by capital level in the Indonesian context. The direct effects of traditional variables (NIM, LDR, CAR) turn out to be weak and insignificant in the main model, indicating that within a robust panel data framework (Fixed Effects), the pure contribution of margin efficiency, credit expansion, and capital adequacy to profitability is more complex and potentially "absorbed" or moderated by other factors, particularly operational efficiency. Certainly, there is a pronounced variation among small and large banks relative to which profitability determinants matter most. For small banks, profitability is most influenced from a set of traditional fundamentals (NIM, BOPO, CAR), while large banks exhibit a disconnect from traditional fundamentals. The large banks performance is hypothesized to be influenced more so by a set of intricacies such as income diversification, market power, digital innovation, or other corporate activities which are beyond scope of traditional financial ratios. The author of this study employed rigorous panel data econometric techniques including Fixed Effects model selection and outlier treatment (winsorization), and robust standard errors to control for heteroskedasticity and autocorrelation to arrive at highly consistent and reliable estimates.

7. RECOMMENDATION

Based on the conclusions above, the following recommendations are presented, divided into theoretical, policy, and managerial implications: 1) Theoretical: Model Development - Future research should no longer treat CAR merely as a control variable with direct effects but should explore more complex models, such as non-linear effects or threshold models, to capture the possibility that CAR only influences profitability after exceeding certain thresholds; Variable Expansion - For research on large banks, non-traditional variables such as market share, income diversification indices, or digital innovation metrics need to be added to better explain profitability sources; Qualitative Study - Qualitative research (case studies) is recommended to uncover the mechanisms behind the non-significant moderation relationship and the specific strategies used by large banks to generate profits outside conventional models. 2) Policy for Regulators (OJK and Bank Indonesia): Differentiated Policy - Regulators should abandon the one-size-fits-all approach. For small banks, policies can focus on strengthening fundamentals through technical assistance in cost management and capital access. For large banks, policies should focus more on innovation incentives, governance, and systemic stability; Efficiency as Key Indicator - OJK could position operational efficiency (BOPO) as a more prominent macroprudential supervision indicator, given its highly significant impact on overall industry health; Capital Policy Review - Regulators need to review the effectiveness and efficiency of highly conservative capital buffer policies. The finding that high CAR does not contribute to profitability or moderate credit risk suggests potential deadweight costs that must be re-evaluated. 3) Managerial for Banking Practice: Cost Optimization Focus - Bank management, regardless of size, must position operational efficiency (BOPO optimization) as the primary profitability enhancement strategy. Digital technology investments should be directed toward creating long-term efficiency, not merely following trends; Prudent Credit Strategy - Management should avoid being trapped in aggressive credit expansion (LDR) strategies with the assumption of immediate profit increases. Credit distribution must prioritize quality and risk management, as LDR increases do not automatically translate into higher ROA; Productive Capital Allocation - For banks with very high CAR, management needs to evaluate more productive capital allocation strategies, such as diversifying non-interest income sources or making strategic investments, rather than merely accumulating capital which could potentially suppress shareholder returns.

Ethical Approval

This study did not require ethical approval from an institutional ethics committee as it utilizes secondary data entirely sourced from publicly available quarterly bank financial reports published through the official platforms of the Indonesia Stock Exchange (IDX), the Financial Services Authority (OJK), and Bank Indonesia (BI). All data used are aggregated and anonymous, containing no protected personal identification information or confidential corporate data. The research process nevertheless adhered to principles of academic integrity and research ethics standards. Data processing was conducted maintaining

scientific objectivity and avoiding conflicts of interest, with the entire methodology explained transparently within the manuscript to ensure the reproducibility of the research findings.

Informed Consent Statement
This study utilized exclusively secondary, anonymized financial data obtained from publicly available sources. As the research did not involve direct interaction with human subjects or access to personally identifiable information, informed consent from individual participants was not required. All data were obtained from official regulatory and financial market sources specifically the Indonesia Stock Exchange (IDX), the Financial Services Authority (OJK), and Bank Indonesia (BI) where such information is legally disclosed for public and research use. The study adheres to ethical standards for secondary data analysis, ensuring that all data handling maintains confidentiality and is used strictly for academic research purposes.

Authors' Contributions
BHR: Conceptualization, Methodology, Formal Analysis, Writing Original Draft, Writing Review & Editing. BK: Data Curation, Software, Validation, Investigation, Resources. AGS: Supervision, Project Administration, Visualization, Writing - Review & Editing. MR: Conceptualization, Methodology, Writing Review & Editing. All authors have read and approved the final version of the manuscript.

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Data Availability Statement
The data supporting this study's findings are publicly available from the official sources of the Indonesia Stock Exchange (www.idx.co.id), the Financial Services Authority (www.ojk.go.id), and Bank Indonesia (www.bi.go.id). All quarterly financial reports and financial ratios analyzed in this research were obtained from these publicly accessible databases. The processed datasets generated during the study are available from the corresponding author upon reasonable request, subject to confidentiality agreements and applicable data protection regulations.

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