JAFM: Journal of Accounting and Finance Management
E-ISSN: 2721-3013
P-ISSN: 2721-3005
https://dinastires.org/JAFM dinasti.info@gmail.com +62 811 7404 455
DOI: https://doi.org/10.38035/jafm.v7i4.3938
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Received: October 3rd 2026 | **Revised:** October 19th 2026 | **Accepted:** October 30th 2026

Capital Adequacy, Operating Efficiency and Non-Performing Loans in Bank Valuation: The Moderating Role of Return on Assets

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Abstract: Bank valuation may reflect multiple dimensions of financial performance, yet prior evidence remains inconclusive regarding the valuation effects of capital adequacy, operating efficiency, and credit risk, particularly when profitability is considered as a moderating factor. This study examines these relationships and the moderating role of return on assets in banks listed on the Indonesia Stock Exchange. Using a balanced panel of 43 banks over 2021–2025, yielding 215 firm-year observations, the study employs fixed-effects panel regression and moderated regression analysis. The results show that capital adequacy is positively associated with price-to-book value, whereas operating inefficiency and non-performing loans are negatively associated with bank valuation. Return on assets has no significant direct association with valuation but significantly strengthens the relationship between capital adequacy and price-to-book value. No moderating effects are found for operating efficiency or non-performing loans. The findings indicate that profitability does not uniformly condition the valuation relevance of bank fundamentals but plays a selective moderating role in the capital adequacy–valuation relationship.

Keywords: Bank Valuation, Capital Adequacy, Operating Efficiency, Non-Performing Loans, Return on Assets

INTRODUCTION

Bank valuation reflects investors' assessment of a bank's financial condition and future prospects. In banking, price-to-book value (PBV) captures market valuation relative to book equity (Brigham & Houston, 2019; Wong, 2012). Among banks listed on the Indonesia Stock Exchange (IDX), average PBV declined from 3.224 in 2021 to 1.594 in 2022, 1.474 in 2023, and 1.335 in 2024, before slightly increasing to 1.368 in 2025. This overall decline provides an empirical basis for examining the financial factors associated with bank valuation.

Capital adequacy, operating efficiency, credit risk, and profitability represent key dimensions of bank financial performance. The Capital Adequacy Ratio (CAR) reflects a bank's capacity to maintain sufficient capital against potential losses, while the ratio of Operating Expenses to Operating Income (BOPO) reflects operating efficiency. The Non-Performing Loan (NPL) ratio captures credit risk, whereas Return on Assets (ROA) represents

a bank's ability to generate earnings from its assets (Kasmir, 2019; Brigham & Houston, 2019). These financial characteristics have also been linked to bank performance and valuation in prior studies (Hanantijo et al., 2018; Wiadnyani & Artini, 2023; Umeorah et al., 2024). From the perspective of Signaling Theory, financial information may convey signals regarding firm condition and prospects that shape investors' assessments (Spence, 1973; Ross, 1977; Connelly et al., 2011). However, the observed patterns among IDX-listed banks are not entirely consistent with these expectations: CAR fluctuated, BOPO generally declined, and NPL declined through 2024, while PBV continued to trend downward. ROA also increased through 2023 while PBV declined.

Prior empirical findings are similarly inconclusive. Putri and Waluyo (2025) reported a positive and significant effect of CAR on PBV, whereas Niryanto et al. (2025) found no significant effect. Hanantijo et al. (2018) documented a significant effect of BOPO on PBV, while Wiadnyani and Artini (2023) reported no significant effect on firm value. For credit risk, Wiadnyani and Artini (2023) found a negative and significant effect of NPL, whereas Putri and Waluyo (2025) found no significant effect on PBV. Umeorah et al. (2024) further identified credit quality and operating efficiency as relevant factors in bank valuation. These contrasting findings leave the valuation effects of bank-specific financial indicators empirically unresolved.

A further gap concerns the role of profitability. Putri and Waluyo (2025) examined ROA as a mediator, Jati and Pardistya (2025) examined CAR as a moderator of the ROA–PBV relationship, and Marsifa et al. (2025) positioned ROA as a moderator of RGEC-based bank health indicators, with varying moderating effects across indicators. Building on these differences, this study adopts a replication-extension approach by examining CAR, BOPO, and NPL within a common bank valuation framework and testing ROA as a moderator of each relationship over the more recent 2021–2025 period.

Accordingly, this study examines the effects of CAR, BOPO, NPL, and ROA on PBV among IDX-listed banks and determines whether ROA moderates the effects of CAR, BOPO, and NPL on PBV. The study provides updated evidence on the direct relationships between bank-specific financial indicators and market valuation and on the conditional role of profitability in these relationships.

Based on the theoretical framework and prior empirical evidence, the study proposes that CAR affects PBV (H1), BOPO affects PBV (H2), NPL affects PBV (H3), and ROA affects PBV (H4). Furthermore, ROA is proposed to moderate the CAR–PBV (H5), BOPO–PBV (H6), and NPL–PBV (H7) relationships. The proposed relationships are presented in Figure 1.

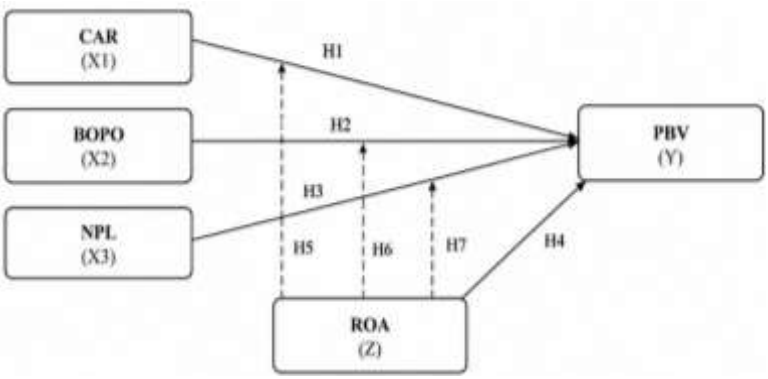


Figure 1. Research Model
Source: Authors Elaboration, 2026

METHODS

This study employed a quantitative research design using secondary panel data from banks listed on the Indonesia Stock Exchange (IDX) during 2021–2025. The quantitative approach was used to examine the relationships among variables through numerical data and

statistical analysis (Arikunto, 2021; Sugiyono, 2020). Data were obtained from annual reports and published financial statements available through the IDX and the respective banks' official websites. The population comprised 45 listed banks. Using purposive sampling, 43 banks that were continuously listed throughout the observation period were selected, resulting in a balanced panel of 215 firm-year observations.

Bank valuation was measured using price-to-book value (PBV), calculated as market price per share divided by book value per share. Capital adequacy ratio (CAR) was measured as capital divided by risk-weighted assets. The ratio of operating expenses to operating income (BOPO) was used to measure operating efficiency, while non-performing loans (NPL), calculated as non-performing loans divided by total loans, represented credit risk. Return on assets (ROA), measured as net income divided by total assets, served as the moderating variable (Kasmir, 2019; Brigham & Houston, 2019).

The empirical analysis was conducted using EViews. Descriptive statistics were followed by panel-data regression, with model selection based on the Chow, Hausman, and Lagrange Multiplier tests (Widarjono, 2018). Relevant classical assumption tests were subsequently performed to evaluate the adequacy of the regression model (Ghozali, 2021). The moderating role of ROA was examined using Moderated Regression Analysis (MRA) by incorporating interaction terms between ROA and CAR, BOPO, and NPL. Moderating effects were evaluated based on the direction and statistical significance of the interaction terms. Hypotheses were tested at the 5% significance level using t-tests and the F-test, while the coefficient of determination was used to assess model explanatory power.

RESULTS AND DISCUSSION

Descriptive Statistics and Model Results

The analysis begins with descriptive statistics for the 215 firm-year observations. Table 1 summarizes the distribution of PBV, CAR, BOPO, NPL, and ROA during the 2021–2025 period.

Table 1. Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev
PBV	0.9401	0.8026	1.980	0.3182	0.4675
CAR	0.3935	0.310	0.823	0.1720	0.1930
BOPO	0.9187	0.901	1.2416	0.5924	0.1766
NPL	0.0338	0.0322	0.006	0.0081	0.0149
ROA	0.0064	0.0064	0.0325	-0.0209	0.0131

Source: EViews output, processed by the author (2026)

As shown in Table 1, PBV had a mean of 0.9401 and ranged from 0.3182 to 1.9800, indicating variation in market valuation across the sampled banks. CAR averaged 0.3935, while BOPO and NPL had mean values of 0.9187 and 0.0338, respectively. ROA averaged 0.0064 and ranged from −0.0209 to 0.0325. Its standard deviation of 0.0131 exceeded its mean, indicating relatively greater variation in profitability across banks during the observation period.

Panel-model selection was subsequently conducted to determine the appropriate estimator. The model-selection procedure supported the Fixed Effect Model (FEM), which was used to estimate both the baseline and moderation specifications. Table 2 presents the regression results.

Table 2. Fixed-Effects Regression and Moderation Results

Variable	Baseline Model β	P-Value	Moderation Model β	P-Value
CAR	0.9447	<0.001	0.4649	0.0166
BOPO	-0.4567	0.001	-0.1951	0.1772
NPL	-6.8224	<0.001	-5.4259	0.0013
ROA	-	-	8.9749	0.3915

CAR x ROA	-	-	28.6059	0.0075
BOPO x ROA	-	-	-11.6387	0.1987
NPL x ROA	-	-	-6.8208	0.9492
Adjusted R2	0.702		0.7452	
F Statistics	12.2034	<0.001	13.7704	<0.001

Source: EViews output, processed by the author (2026).

The baseline specification was jointly significant ($F = 12.2034$, $p < 0.001$) and yielded an adjusted R^2 of 0.7020. CAR had a positive and significant effect on PBV ($\beta = 0.9447$, $p < 0.001$), whereas BOPO ($\beta = -0.4567$, $p = 0.0010$) and NPL ($\beta = -6.8224$, $p < 0.001$) had negative and significant effects.

The moderation specification was also jointly significant ($F = 13.7704$, $p < 0.001$) and yielded a higher adjusted R^2 of 0.7452. ROA had a positive but insignificant direct effect on PBV ($\beta = 8.9749$, $p = 0.3915$). The CAR × ROA interaction was positive and significant ($\beta = 28.6059$, $p = 0.0075$), indicating that ROA strengthens the positive relationship between CAR and PBV. In contrast, the BOPO × ROA ($\beta = -11.6387$, $p = 0.1987$) and NPL × ROA ($\beta = -6.8208$, $p = 0.9492$) interactions were not statistically significant.

Hypothesis Testing

The regression estimates were evaluated against the seven hypotheses formulated in the research framework. The direct effects of CAR, BOPO, and NPL were evaluated using the baseline model, while the direct effect of ROA and the moderating effects were assessed using the moderation model. Table 3 summarizes the hypothesis-testing results.

Table 3. Summary of Hypothesis Testing

Hypothesis	Relationship Tested	Empirical Finding	Decision
H1	Effect of CAR on PBV	Positive and significant	Supported
H2	Effect of BOPO on PBV	Negative and insignificant	Supported
H3	Effect of NPL on PBV	Negative and insignificant	Supported
H4	Effect of ROA on PBV	Positive and significant	Not Supported
H5	Moderating Effect of ROA on the CAR-PBV Relationship	Positive and significant; strengthens the relationship	Supported
H6	Moderating Effect of ROA on the BOPO-PBV Relationship	Negative and insignificant	Not Supported
H7	Moderating Effect of ROA on the NPL-PBV Relationship	Negative and insignificant	Not Supported

Source: EViews output, processed by the author (2026)

As summarized in Table 3, H1, H2, H3, and H5 were supported, whereas H4, H6, and H7 were not supported. The direct-effect results indicate that capital adequacy, operating efficiency, and credit risk are significantly associated with bank valuation, although the directions of their effects differ. More importantly, the moderation results indicate that profitability does not uniformly condition these relationships. ROA strengthens only the positive relationship between CAR and PBV, while no significant moderating effect is observed for BOPO or NPL. These findings provide the basis for discussing the financial mechanisms underlying each relationship.

Effect of Capital Adequacy on Bank Valuation

The positive and significant effect of CAR on PBV indicates that stronger capital adequacy is associated with higher bank valuation. Adequate capital increases a bank's capacity to absorb potential losses, maintain financial stability, and support business expansion and lending activities. From a signaling perspective, a stronger capital position conveys favorable information regarding the bank's resilience and ability to manage risk, which may strengthen investor confidence and market valuation (Spence, 1973). Previous banking

evidence also indicates that capital adequacy is relevant to bank financial performance, although its empirical effects may vary across model specifications and performance measures (Surtikanti et al., 2022; Noor & Suhendra, 2024). The present finding is consistent with Putri and Waluyo (2025), who reported a positive and significant effect of CAR on PBV, and supports the relevance of capital adequacy as a bank-health indicator in valuation analysis (Marsifa et al., 2025). Accordingly, H1 is supported.

Effect of Operating Efficiency on Bank Valuation

BOPO has a negative and significant effect on PBV, indicating that a higher operating expense-to-operating income ratio is associated with lower bank valuation. A higher BOPO implies that a larger proportion of operating income is absorbed by operating expenses, reducing operational efficiency and potentially constraining profitability and shareholder returns. Previous evidence also links operating efficiency with bank profitability and financial performance (Al Zaidanin & Al Zaidanin, 2021; Wahyuni & Umam, 2023; Situmorang et al., 2024). Evidence from Indonesian banking further indicates that BOPO is relevant to financial outcomes, although its effects may vary depending on the performance measure and empirical setting (Yamin, 2022). Conversely, a lower BOPO reflects stronger cost control and more efficient utilization of operating income, which may provide a favorable signal regarding management effectiveness and strengthen investor confidence. The result is consistent with Hanantijo et al. (2018), who documented a significant relationship between BOPO and PBV, and is supported by evidence that operating efficiency is relevant to book-value-based bank valuation (Umeorah et al., 2024). Accordingly, H2 is supported.

Effect of Credit Risk on Bank Valuation

NPL has a negative and significant effect on PBV, indicating that deteriorating credit quality is associated with lower bank valuation. Higher NPL increases credit risk and requires banks to provide greater allowances for impairment losses, which may reduce earnings and constrain business and lending expansion. Problem loans may also increase monitoring and resolution costs and place additional pressure on bank efficiency and financial performance (Berger & DeYoung, 1997). Effective credit-risk management is therefore important for maintaining asset quality, profitability, and bank stability (Akomeah et al., 2020). More recent evidence also identifies credit risk as a relevant component of bank financial performance, reinforcing the importance of effective risk management in banking operations (Akinselure et al., 2024). From the perspective of Signaling Theory, higher NPL may convey unfavorable information regarding asset quality and credit-risk management, increasing perceived risk among investors and reducing market valuation (Spence, 1973). This finding is consistent with Wiadnyani and Artini (2023), who reported a negative and significant effect of NPL on firm value, but differs from Putri and Waluyo (2025), who found no significant effect on PBV. Accordingly, H3 is supported.

Effect of Profitability on Bank Valuation

ROA has a positive but statistically insignificant effect on PBV, indicating that profitability alone does not significantly explain differences in bank valuation during the observation period. Although higher ROA reflects a stronger ability to generate earnings from assets and may theoretically convey a favorable signal to investors, the observed pattern shows that changes in profitability were not consistently accompanied by corresponding changes in PBV. During 2021–2023, ROA increased while PBV declined, indicating that investors may not evaluate profitability in isolation when assessing banks. This result differs from Medyawati and Yunanto (2021), who reported that ROA was associated with firm value in the Indonesian banking subsector, further illustrating that the valuation relevance of profitability may vary across empirical settings. Accordingly, H4 is not supported.

Moderating Role of Profitability in the Capital Adequacy–Valuation Relationship

The interaction between CAR and ROA is positive and significant, indicating that ROA strengthens the positive relationship between capital adequacy and PBV. A well-capitalized bank has greater capacity to absorb potential losses, while higher ROA indicates that its assets are being utilized effectively to generate earnings. When these conditions occur simultaneously, investors receive a stronger signal that capital strength is supported by earnings-generating capacity rather than representing capital adequacy alone. Previous evidence has also linked capital adequacy and profitability in banking, although their relationships vary across empirical specifications (Surtikanti et al., 2022; Noor & Suhendra, 2024). More directly, Jati and Pardistya (2025) identified a moderating mechanism involving profitability, capital adequacy, and PBV, while Marsifa et al. (2025) found that the moderating role of profitability varies across bank-health indicators. Accordingly, H5 is supported.

Moderating Role of Profitability in the Operating Efficiency–Valuation Relationship

The BOPO × ROA interaction is negative but statistically insignificant, indicating that ROA does not moderate the relationship between operating efficiency and PBV. Profitability therefore does not materially change how operating efficiency is reflected in market valuation. Previous studies have nevertheless documented a relationship between operating efficiency and bank profitability, indicating that BOPO remains relevant to earnings performance (Al Zaidanin & Al Zaidanin, 2021; Wahyuni & Umam, 2023; Situmorang et al., 2024). However, profitability may arise from several sources beyond operating cost efficiency, and a bank may therefore generate relatively high ROA even when the valuation effect of BOPO remains unchanged. This finding reinforces the evidence of Marsifa et al. (2025) that profitability does not uniformly moderate all bank-health indicators. Accordingly, H6 is not supported.

Moderating Role of Profitability in the Credit Risk–Valuation Relationship

The NPL × ROA interaction is negative and statistically insignificant, indicating that ROA does not moderate the relationship between NPL and PBV. Higher profitability does not eliminate the risks associated with deteriorating credit quality. Problem loans continue to imply potential losses, additional monitoring and resolution costs, and greater provisioning requirements, which may constrain bank performance (Berger & DeYoung, 1997; Akomeah et al., 2020). Previous evidence also indicates that NPL is relevant to bank valuation, while profitability may contribute to firm value (Umeorah et al., 2024; Medyawati & Yunanto, 2021). The insignificant interaction found in this study therefore indicates that profitability does not materially alter the valuation effect of credit risk. This result is consistent with the selective moderating pattern reported by Marsifa et al. (2025). Accordingly, H7 is not supported.

Research Finding and Novelty

The central finding of this study is the selective moderating role of profitability in bank valuation. ROA does not have a significant direct effect on PBV and does not significantly moderate the relationships of operating efficiency or credit risk with market valuation. However, ROA significantly strengthens the positive relationship between capital adequacy and PBV. This pattern indicates that profitability does not function as a uniform conditioning factor across bank-specific financial indicators. Rather, within IDX-listed banks during 2021–2025, its moderating role is specifically evident in the capital adequacy–valuation relationship. By examining capital adequacy, operating efficiency, and credit risk within a unified moderation framework, this study extends prior evidence by indicating that the valuation relevance of profitability depends on the specific financial attribute with which it interacts.

CONCLUSION AND SUGGESTIONS

Conclusion

This study examines the effects of capital adequacy, operating efficiency, credit risk, and profitability on the market valuation of banks listed on the Indonesia Stock Exchange during 2021–2025, with profitability also examined as a moderating factor. The findings indicate that capital adequacy positively affects price-to-book value, whereas a higher operating expense-to-operating income ratio and higher non-performing loans negatively affect bank valuation. Return on assets has no significant direct effect on price-to-book value but significantly strengthens the positive relationship between capital adequacy and bank valuation. In contrast, it does not significantly moderate the relationships of operating efficiency or credit risk with valuation.

Overall, the findings indicate that profitability does not operate as a uniform determinant of how bank fundamentals are reflected in market valuation. Its moderating role is specifically evident in the capital adequacy–valuation relationship, suggesting that capital strength becomes more relevant to market valuation when accompanied by stronger earnings generation. From the perspective of Signaling Theory, the findings indicate that the valuation relevance of financial signals may depend on the financial condition with which they are jointly observed.

Limitations

The findings should be interpreted within the scope of banks listed on the Indonesia Stock Exchange during 2021–2025 and the financial indicators examined in this study. The model focuses on CAR, BOPO, and NPL, with ROA as the moderating variable and PBV as the measure of market valuation. Other bank-specific and macroeconomic factors that may contribute to differences in bank valuation are therefore outside the scope of the analysis. In addition, the use of PBV as the valuation measure limits the findings to market valuation represented by book-value-based pricing.

Recommendations

For bank management, maintaining adequate capitalization should be accompanied by effective asset utilization to generate earnings, as profitability strengthens the valuation relevance of capital adequacy. Banks should also improve operating efficiency through effective cost control and strengthen credit-risk management through sound credit analysis, periodic debtor monitoring, and appropriate resolution of problem loans. For investors, CAR, BOPO, and NPL provide complementary information regarding capital strength, operating efficiency, and credit quality, while ROA may provide additional information when evaluating a bank's capital position.

Future research may incorporate additional determinants of bank valuation, including Net Interest Margin (NIM), Loan to Deposit Ratio (LDR), Good Corporate Governance (GCG), firm size, and macroeconomic factors. Broader research settings and longer observation periods may provide evidence across different market and economic conditions. Alternative valuation measures, such as Tobin's Q and the Price Earnings Ratio (PER), may also be examined, while the moderating role of ROA may be tested in other industries to assess whether its selective role is specific to the banking sector.

Author Contributions

Both authors contributed to the conceptualization of the study, development of the theoretical framework and research design, interpretation of the findings, and preparation and revision of the manuscript. The authors reviewed and approved the final manuscript and take responsibility for its content.

AI Disclosure Statement

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) to assist with language refinement, academic editing, and manuscript structuring. The AI tool was not used to generate research data, perform statistical analyses, or determine the empirical findings. The authors thoroughly reviewed and edited the manuscript and take full responsibility for the content of this publication.

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