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Credit Risk and Banking Performance in Indonesia: The Moderating Role of Bank Size

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Abstract

This study examines the effect of credit risk on banking performance and tests the moderating role of bank size among banking firms listed on the Indonesia Stock Exchange during 2021–2024. Credit risk is measured by non-performing loans (NPL), bank performance by return on assets (ROA), and bank size by the natural logarithm of total assets. Using a quantitative approach based on secondary data from financial and annual reports, the study analyzes 27 banks with 108 observations. The analysis employs a moderation model involving the interaction between NPL and bank size, supported by robustness tests using several control variables. The results show that credit risk has no significant direct effect on bank performance in the main model. However, bank size significantly moderates this relationship by strengthening the negative effect of credit risk on ROA. Conditional effect analysis indicates that the effect of NPL on ROA becomes negative and significant among medium-sized and large banks. These findings suggest that bank size reflects not only asset capacity but also the complexity of risk exposure. The study implies that credit risk management and banking supervision should account for differences in institutional scale.

Keywords: bank performance, bank size, credit risk, non-performing loans, return on assets.

INTRODUCTION

The banking sector plays a strategic role in maintaining economic stability and growth through its financial intermediation function, namely collecting public funds and redistributing them in the form of credit. In Indonesia's financial market, banking is also a major sector on the Indonesia Stock Exchange because it supports financing, liquidity, and investor confidence in the financial system. For this reason, banking performance is important not only for bank management, but also for regulators, investors, debtors, and the broader economy. This study focuses on the effect of credit risk on bank performance, with bank size as a moderating variable, among banking firms listed on the Indonesia Stock Exchange during 2021–2024.

Bank performance is generally understood as the ability of a bank to generate profit, maintain operational efficiency, manage risk, and create value for stakeholders. One widely used indicator of bank performance is return on assets, or ROA. ROA reflects how effectively a bank uses its assets to generate earnings. A higher ROA indicates stronger managerial ability to utilize assets productively. In banking, ROA is particularly relevant because most bank assets originate from public funds and must be managed prudently to generate optimal income. Previous studies have also used ROA as a key measure of bank profitability because it captures managerial efficiency in transforming assets into earnings (Abdelaziz et al., 2022; Boussaada et al., 2023; Ekinici & Poyraz, 2019; Siddique et al., 2022).

In recent years, Indonesian banking performance has improved after the pressure of the COVID-19 pandemic. However, this recovery has continued to face challenges in credit risk management. The Financial Services Authority reported that, in the fourth quarter of 2024, Indonesia's banking credit risk improved, with gross NPL declining to 2.08% and net NPL remaining relatively stable at 0.74%; at the same time, bank capital remained solid, with the capital adequacy ratio reaching 26.69% (Otoritas Jasa Keuangan, 2025a). The Indonesian Banking Statistics for December 2024 also indicate that the national banking industry remained relatively resilient (Otoritas Jasa Keuangan, 2025b). Nevertheless, stronger industry-level indicators do not imply that all banks have equal capacity to manage credit risk and generate profitability.

Credit risk is one of the central risks in banking activity. It arises when borrowers fail to meet their obligations to repay principal or interest according to the credit agreement. In banking research, credit risk is commonly proxied by non-performing loans, or NPL. NPL shows the proportion of problematic loans to total loans. A higher NPL ratio indicates greater potential losses because interest income declines, provisioning needs increase, and asset quality deteriorates. Theoretically, rising credit risk should reduce bank profitability because non-performing loans weaken the intermediation function and reduce the bank's ability to generate income (Abdelaziz et al., 2022; Arhinful et al., 2025; Ekinici & Poyraz, 2019; Saleh & Abu Afifa, 2020).

However, the relationship between NPL and bank performance is not always straightforward. Some studies find a significant negative effect of NPL on bank performance. Boussaada et al. (2023), for example, show that NPL is negatively associated with European bank performance measured by ROA and Tobin's Q. Abdelaziz et al. (2022) also find that bank profitability in the MENA region is sensitive to credit and liquidity risks. Other studies report different findings. In the Indonesian context, NPL does not always significantly affect ROA, especially when models include other internal bank factors such as the loan-to-deposit ratio, bank size, and other institutional characteristics (Al Zafir & Satria, 2025; Irawan & Kusuma, 2020; Mafaza & Zulfikar, 2025; Rusli & Fitriana, 2023). These mixed findings suggest that the effect of credit risk on bank performance may depend on contingency factors.

One important contingency factor is bank size. Bank size is commonly measured using the natural logarithm of total assets. Larger banks generally have stronger resources, broader portfolio diversification, better funding access, more established risk management systems, and greater technological and compliance capacity. These advantages may allow large banks to absorb credit risk pressure more effectively than smaller banks. At the same time, large size

can also generate organizational complexity, higher monitoring costs, and wider credit exposure. Thus, bank size may not only influence profitability directly, but also alter the direction and strength of the relationship between credit risk and bank performance (Asrori et al., 2024; Ozili, 2025; Saleh & Abu Afifa, 2020; Utari & Widiastuti, 2024).

The moderating role of bank size is relevant because previous findings remain inconclusive. Asrori et al. (2024) found that bank size can moderate the relationship between financial risk and the performance of Indonesian Islamic commercial banks. This suggests that institutional scale may reshape the impact of risk on financial outcomes. However, other studies show that bank size does not always moderate the relationship between financial ratios and ROA. Therefore, the moderating effect of bank size remains open for further testing, especially among commercial banks listed on the Indonesia Stock Exchange (Agung Prayogi, 2024; Asrori et al., 2024; Herlina & Wilujeng, 2025).

This research gap is important because the period 2021–2024 represents a post-pandemic transition. During this period, banks faced two simultaneous pressures: maintaining credit quality after pandemic-related restructuring and improving profitability amid economic recovery. In Indonesia, credit restructuring policies helped limit the deterioration of loan quality during the pandemic. Yet, as policy relaxation gradually ended, credit risk again became a key concern. The Financial Services Authority reported that banking NPL remained under control at the end of 2024, but credit risk continued to be strategic because banks had to balance credit growth, capital adequacy, and profitability (Otoritas Jasa Keuangan, 2025a). Recent evidence on Indonesian conventional banks also confirms that the relationship between credit risk and profitability should be understood within the post-pandemic context and the dynamics of bank-specific characteristics (Al Zafir & Satria, 2025).

Based on this background, the present study analyzes the effect of credit risk on Indonesian banking performance and examines whether bank size moderates this relationship. NPL is used as a proxy for credit risk, ROA as a proxy for bank performance, and the natural logarithm of total assets as a proxy for bank size. The object of the study is banking firms listed on the Indonesia Stock Exchange during 2021–2024. Accordingly, the study does not only test the direct relationship between credit risk and bank performance, but also examines whether bank size strengthens, weakens, or changes that relationship.

This study contributes in three ways. First, it provides empirical evidence on the relationship between credit risk and bank performance in the post-pandemic Indonesian banking context. Second, it extends the credit risk literature by incorporating bank size as a moderating variable, so the analysis goes beyond the direct effect of NPL on ROA. Third, it offers practical implications by showing that credit risk management and banking supervision should consider bank scale, since the capacity, complexity, and risk exposure of each bank are not identical.

Thus, the central question of this article is whether credit risk affects bank performance and whether bank size moderates the relationship between credit risk and bank performance among banking firms listed on the Indonesia Stock Exchange. Addressing this question is expected to strengthen understanding of the dynamics of credit risk, profitability, and bank size in the Indonesian banking industry, while also providing empirical insights for managerial decisions and supervisory policy.

LITERATURE REVIEW

This literature review explains the main concepts underlying the research model: credit risk, bank performance, bank size, and the conceptual relationship between credit risk and bank performance. The discussion focuses on literature relevant to credit risk and bank profitability, particularly in the context of banking firms listed on the Indonesia Stock Exchange during 2021–2024.

Credit Risk in the Banking Industry

Credit risk is one of the most important risks in banking because the core function of banks is to distribute funds to the public through credit. It occurs when borrowers fail to meet principal or interest payment obligations according to agreed terms. In banking practice, credit risk affects not only asset quality but also profitability, liquidity, capital adequacy, and overall bank stability. For this reason, credit risk remains a central concern, especially in the post-pandemic period when banks must simultaneously support credit growth and maintain portfolio quality (Boussaada et al., 2023; Fadun & Silwimba, 2023; Saleh & Abu Afifa, 2020).

One of the most widely used indicators of credit risk is non-performing loans, or NPL. NPL reflects the proportion of problem loans to total loans. A higher NPL ratio indicates greater potential losses from declining interest income, higher loss provisions, and deteriorating asset quality. Therefore, NPL is a key indicator for assessing asset quality and the effectiveness of bank credit risk management (Abdelaziz et al., 2022; Ekinci & Poyraz, 2019; Utari & Widiastuti, 2024). Recent studies in Indonesia also use NPL as a primary measure of credit risk when examining ROA-based bank profitability (Al Zafir & Satria, 2025).

From a financial literature perspective, credit risk is closely linked to the effectiveness of the intermediation function. Banks that can distribute credit productively while maintaining loan quality have greater potential to generate stable income. Conversely, banks with high NPL face profit pressure because a portion of productive assets fails to produce expected cash flows. Boussaada et al. (2023) show that NPL is negatively related to bank performance because it increases provisioning and lowers profitability. Similar findings are reported by Abdelaziz et al. (2022), Ekinci and Poyraz (2019), and Utari and Widiastuti (2024), who argue that credit risk can weaken banks' ability to generate profit.

In developing economies, credit risk becomes more complex because banks operate in environments shaped by changing interest rates, inflation, exchange rates, and institutional conditions. Saleh and Abu Afifa (2020) argue that credit risk, liquidity risk, and bank capital are important factors associated with bank profitability in emerging markets. Siddique et al. (2022) also show that bank-specific factors and credit risk management are related to the performance of commercial banks in South Asia. Thus, credit risk management cannot be separated from macroeconomic stability and the internal capacity of banks to manage credit exposure.

In Indonesia, credit risk became particularly important during 2021–2024 because this period represented the recovery phase after the COVID-19 pandemic. Credit restructuring policies helped prevent a sharp increase in non-performing loans during the pandemic. However, as policy relaxation was gradually withdrawn, loan quality again became a central

concern. The Financial Services Authority reported that Indonesia's gross banking NPL in the fourth quarter of 2024 reached 2.08%, while net NPL stood at 0.74% (Otoritas Jasa Keuangan, 2025a). These figures indicate that industry-level credit risk remained manageable, although bank-level conditions may vary substantially.

Bank Performance and Return on Assets

Bank performance reflects the ability of a bank to perform its intermediation function, manage assets, generate profit, and maintain stakeholder trust. In banking literature, performance is commonly associated with profitability, operational efficiency, asset quality, liquidity, and capital adequacy. Profitability is especially important because it indicates the bank's ability to generate earnings from its operational activities.

One widely used profitability indicator is return on assets, or ROA. ROA measures how effectively a bank generates profit from its total assets. This indicator is highly relevant because most bank assets are sourced from public funds and must therefore be managed productively. A higher ROA indicates stronger managerial capacity to use assets for profit generation. Conversely, a lower ROA suggests that the bank may face inefficiency, rising costs, weak asset quality, or risk-related pressure.

Siddique et al. (2022) use ROA as a main measure of bank performance because it captures managerial efficiency in asset utilization. ROA is also widely used in cross-country banking studies because it allows comparison across banks and periods. Abdelaziz et al. (2022) employ ROA to analyze the relationship between credit risk, liquidity risk, and bank profitability. Boussaada et al. (2023) also use ROA as a key indicator in examining the effect of NPL on bank performance. In Indonesia, ROA has been used in recent studies on credit risk and conventional bank profitability (Al Zafir & Satria, 2025).

Bank performance is not only determined by income generation but also by risk control. High credit growth does not necessarily indicate strong performance if it is not supported by sound loan quality. A bank may record asset and credit expansion, yet profitability may decline when a portion of loans becomes non-performing. Therefore, bank performance assessment should also consider asset quality, particularly credit risk as proxied by NPL (Ekinici & Poyraz, 2019; Saleh & Abu Afifa, 2020; Utari & Widiastuti, 2024).

During 2021–2024, Indonesian banking performance was in a recovery phase after the pandemic. The Financial Services Authority shows that key banking indicators, including assets, credit, third-party funds, capital adequacy, and non-performing loan ratios, continued to improve (Otoritas Jasa Keuangan, 2025b). Nevertheless, although industry indicators suggest recovery, profitability may still differ across banks due to variations in asset structure, credit quality, operational efficiency, and bank size.

Relationship between Credit Risk and Bank Performance

The relationship between credit risk and bank performance is a central topic in banking studies. Conceptually, higher credit risk is expected to reduce bank performance because non-performing loans require larger provisions and reduce interest income. This condition lowers net income and weakens the productivity of bank assets. Therefore, NPL is often positioned

as an important indicator explaining asset quality and profitability (Abdelaziz et al., 2022; Boussaada et al., 2023; Ekinci & Poyraz, 2019; Saleh & Abu Afifa, 2020).

Empirical literature generally shows that credit risk is negatively associated with bank performance. Boussaada et al. (2023) find that NPL negatively affects European bank performance, while Abdelaziz et al. (2022) show that credit risk reduces bank profitability in the MENA region. Fadun and Silwimba (2023) also emphasize that credit risk management plays an important role in shaping the financial performance of commercial banks. Evidence from South Asia by Siddique et al. (2022) indicates that bank-specific factors, including credit risk management, are associated with bank performance. Similar findings have been reported in recent studies on credit risk and bank profitability in Indonesia and other developing economies (Al Zafir & Satria, 2025; Febrianti et al., 2026; Utari & Widiastuti, 2024).

However, findings on the NPL–performance relationship are not always consistent. Some studies find that NPL has no significant effect on bank profitability. Rusli and Fitriana (2023), for instance, report that NPL does not always significantly affect the profitability of certain Indonesian banks during the COVID-19 pandemic. Such differences may arise from variations in research period, bank characteristics, macroeconomic conditions, credit restructuring policies, and analytical methods. Therefore, the relationship between credit risk and bank performance should not be treated as a simple direct relationship.

In Indonesia, the relationship between NPL and ROA is especially relevant because 2021–2024 was a post-pandemic recovery period. During this period, banks had to maintain credit quality after restructuring policies while also improving profitability as economic activity recovered. This condition requires a better understanding of contingency factors that may strengthen or weaken the relationship between credit risk and bank performance.

Bank Size as a Contingency Factor

Bank size is an important characteristic that may influence a bank's ability to manage risk and generate profit. It is commonly measured by the natural logarithm of total assets to represent operational scale and reduce extreme differences across banks. Large banks generally have stronger operational capacity, technology, human resources, and capital than smaller banks. In banking literature, bank size is often associated with economies of scale, funding access, reputation, and the capacity to invest in risk management systems (Asrori et al., 2024; Herlina & Wilujeng, 2025; Ozili, 2025).

However, large size does not always create unlimited advantages. Large banks may also face greater organizational complexity, wider credit exposure, and higher compliance and monitoring costs. This complexity may make risk management more difficult. Thus, bank size can be both a source of strength and a source of complexity in the relationship between credit risk and bank performance (Boussaada et al., 2023; Saleh & Abu Afifa, 2020).

In the credit risk–performance relationship, bank size may function as a contingency factor. Large banks may be better able to absorb the negative effect of NPL because they have broader portfolio diversification, stronger capital buffers, and more developed risk management systems. Yet, large banks may also suffer stronger effects when NPL increases because their credit exposure is broader and more complex. Therefore, bank size may change the strength or even the direction of the relationship between credit risk and bank performance.

Asrori et al. (2024) show that bank size can moderate the relationship between financial risk and the performance of Islamic commercial banks. Agung Prayogi (2024) also positions bank size as a moderating variable in the relationship between NPL, LDR, CAR, and bank profitability. Other studies in Indonesian banking suggest that bank size may moderate the relationship between credit risk and profitability, although the direction and significance may differ across bank types and research periods (Ayunda, 2026; Dewi, 2026; Herlina & Wilujeng, 2025). Therefore, bank size is relevant in analyzing banking risk and profitability.

In this study, bank size is understood as an institutional characteristic that explains differences in banks' ability to deal with credit risk. Banks of different sizes may not respond similarly to rising NPL. Including bank size in the research model therefore provides a more comprehensive understanding of the relationship between credit risk and bank performance.

Previous studies have widely examined the relationship between credit risk and bank performance. Most of them find that NPL negatively affects bank profitability, although some report insignificant or mixed results. These differences indicate that the relationship between credit risk and bank performance still requires further investigation, particularly by considering contingency factors.

This study is positioned within that gap by examining the relationship between credit risk and bank performance while incorporating bank size as a moderating variable in the Indonesian banking sector during 2021–2024. This context is relevant because the period reflects the post-COVID-19 recovery phase, in which banks faced the simultaneous challenge of maintaining credit quality, profitability, and financial stability. By considering bank size, this study seeks to explain whether the effect of credit risk on performance differs across banks with different asset scales.

The study also focuses on banking firms listed on the Indonesia Stock Exchange. This context is important because listed banks face dual pressure: maintaining operational performance while meeting investor and regulatory expectations. Therefore, examining the interaction among credit risk, bank size, and bank performance is relevant both academically and practically.

METHODOLOGY

This study uses a quantitative approach with an explanatory design. This approach is appropriate because the research examines relationships among variables using numerical data obtained from financial statements and annual reports of banking firms. The explanatory design is used not only to describe credit risk, bank size, and bank performance, but also to test the effect of credit risk on bank performance and the moderating role of bank size.

The object of the study is banking firms listed on the Indonesia Stock Exchange during 2021–2024. This period was selected because it represents the recovery phase of Indonesian banking after the pressure of the COVID-19 pandemic, when credit quality and profitability again became central concerns. The study uses panel data, combining a four-year time dimension with firm-level observations.

The population consists of banking firms listed on the Indonesia Stock Exchange. The sample was selected using purposive sampling with the following criteria: banking firms listed

during 2021–2024, firms publishing annual or financial reports throughout the observation period, and firms with complete data for measuring credit risk, bank performance, and bank size. Based on these criteria, 27 banks were selected, resulting in 108 observations.

The data were obtained from secondary sources, including annual reports, financial statements, Indonesia Stock Exchange publications, Financial Services Authority publications, and official company sources. Secondary data were used because the variables analyzed in this study are financial indicators that are officially published and verifiable.

This study consists of three main variables: credit risk as the independent variable, bank performance as the dependent variable, and bank size as the moderating variable. Credit risk is measured by non-performing loans, or NPL, calculated as the ratio of problem loans to total loans. Bank performance is measured by return on assets, or ROA, which indicates the ability of a bank to generate profit from total assets. Bank size is measured using the natural logarithm of total assets to reduce extreme scale differences across banks. The interaction variable is formed by multiplying NPL and bank size.

Table 1. The operationalization of the variables is presented below.

Variable	Proxy	Measurement Formula	Scale
Credit Risk	Non-Performing Loan / NPL	Problem Loans / Total Loans × 100%	Ratio
Bank Performance	Return on Assets / ROA	Net Income / Total Assets × 100%	Ratio
Bank Size	Bank Size	Ln Total Assets	Ratio
Moderating Interaction	NPL × Bank Size	NPL × Ln Total Assets	Ratio

Data analysis was conducted through descriptive and verificative analysis. Descriptive analysis was used to present the minimum, maximum, mean, and standard deviation of each variable. Verificative analysis was used to test the relationships among variables through a moderation model involving the interaction between credit risk and bank size.

The main research model is formulated as follows:

$$ROA = \beta_0 + \beta_1 NPL + \beta_2 SIZE + \beta_3 (NPL \times SIZE) + \epsilon \dots \dots \dots (1)$$

In this model, ROA represents bank performance, NPL represents credit risk, SIZE represents bank size, NPL × SIZE represents the interaction variable, β_0 is the constant, β_1 to β_3 are regression coefficients, and ϵ is the error term. The coefficient β_1 is used to identify the direct effect of credit risk on bank performance, β_2 shows the effect of bank size on bank performance, while β_3 is the main focus of the moderation test. If the interaction coefficient is significant, bank size is considered to function as a moderating variable.

Model testing was conducted by examining the significance of regression coefficients, the coefficient of determination, and model feasibility. The partial significance test was used to assess the effect of each variable on bank performance, while the coefficient of determination was used to evaluate the model's ability to explain variations in ROA.

In addition to the main model, this study conducts a robustness test by including relevant control variables: interest rate, exchange rate, inflation, good corporate governance, BOPO, and capital adequacy ratio. These controls are included to ensure that the relationship among

credit risk, bank size, and bank performance is not merely driven by external conditions or other internal bank characteristics.

The robustness model is formulated as follows:

$$ROA = \beta_0 + \beta_1 NPL + \beta_2 SIZE + \beta_3 (NPL \times SIZE) + \beta_4 IR + \beta_5 EXR + \beta_6 INF + \beta_7 GCG + \beta_8 BOPO + \beta_9 CAR + \varepsilon \dots \dots \dots (2)$$

In this model, IR represents the interest rate, EXR the exchange rate, INF inflation, GCG good corporate governance, BOPO operating expenses to operating income, and CAR the capital adequacy ratio. The robustness test evaluates whether the main findings remain consistent after controlling for macroeconomic factors, governance, operational efficiency, and capital adequacy. If the interaction between NPL and bank size remains significant, the moderating role of bank size can be considered more robust.

RESULT

This section presents the findings based on data from banking firms listed on the Indonesia Stock Exchange during 2021–2024. The sample consists of 27 banks with 108 observations. The analysis begins with descriptive statistics for credit risk, bank performance, and bank size, followed by tests of the effect of credit risk on bank performance and the moderating role of bank size.

Descriptive Analysis

The descriptive analysis shows that bank performance, measured by ROA, has a minimum value of -6.8789 and a maximum value of 3.7171. The mean ROA is 0.4916, with a standard deviation of 1.4692. This indicates that the banks in the sample generally recorded positive profitability, although performance varied considerably across banks. The negative minimum value suggests that some banks experienced losses or were unable to generate positive returns from their assets during the observation period.

Credit risk, measured by NPL, has a minimum value of 0.0100 and a maximum value of 14.0900. The mean NPL is 2.9907, with a standard deviation of 2.4434. This average indicates that credit risk in the sample was relatively controlled, as it remained below the common 5% threshold. However, the maximum NPL of 14.0900 shows that some banks faced substantial credit risk pressure.

Bank size has a minimum value of 7.3709 and a maximum value of 14.6588, with a mean of 11.2533 and a standard deviation of 1.8448. These figures indicate that the sample includes banks with diverse asset scales. This variation is important because the study positions bank size as a moderating variable..

Table 2. Descriptive Analysis of Research Variables

Variable	Minimum	Maximum	Mean	Standard Deviation
ROA	-6.8789	3.7171	0.4916	1.4692
NPL	0.0100	14.0900	2.9907	2.4434
Bank Size	7.3709	14.6588	11.2533	1.8448

Source: Analysis Result, 2026

Overall, the descriptive results show that average NPL remained manageable, while ROA displayed substantial variation across banks. The variation in bank size also supports the moderation test, as it allows the analysis to examine whether the effect of credit risk on performance differs across banks with different asset scales.

Main Model Testing

The main model was tested by including NPL, bank size, and the interaction between NPL and bank size. The estimation results are presented below.

Table 3. Main Model Testing

Variable	Coefficient	Standard Error	p-value	Interpretation
Constant	-3.2590	1.3229	0.0154	Significant
NPL	0.6910	0.3882	0.0780	Not significant at 5%
Bank Size	0.3925	0.1186	0.0013	Significant
NPL × Bank Size	-0.0811	0.0351	0.0229	Significant

Source: Analysis Result, 2026

The results show that credit risk, measured by NPL, does not significantly affect ROA at the 5% level. The NPL coefficient of 0.6910 with a p-value of 0.0780 indicates that the direct effect of credit risk on bank performance is not statistically confirmed in the main model. This suggests that an increase in credit risk does not automatically reduce or improve bank performance when only the direct effect is considered.

Bank size has a positive and significant effect on ROA. The coefficient of 0.3925 with a p-value of 0.0013 indicates that larger banks tend to achieve higher ROA. This suggests that banks with greater asset scale may have stronger capacity to generate profitability.

The key finding lies in the interaction between NPL and bank size. The interaction coefficient is -0.0811 with a p-value of 0.0229, indicating that bank size significantly moderates the relationship between credit risk and bank performance. The negative coefficient means that as bank size increases, the effect of NPL on ROA becomes more negative. Thus, bank size not only directly influences bank performance but also changes the strength of the relationship between credit risk and bank performance.

Conditional Effect of Moderation

To clarify the moderation pattern, the conditional effect of NPL on ROA was examined at different levels of bank size. The results are presented below.

Table 4. Conditional Effect of Moderation

Bank Size Level	Effect of NPL on ROA	p-value	Interpretation
9.4085	-0.0723	0.3409	Not significant
11.2534	-0.2220	0.0001	Negative and significant
13.0982	-0.3717	0.0001	Negative and significant

Source: Analysis Result, 2026

The conditional effect results show that, among small banks, the effect of NPL on ROA is not significant. However, among medium-sized banks, the effect becomes negative and significant. This negative effect becomes even stronger among large banks. These results indicate that bank size strengthens the negative effect of credit risk on bank performance, particularly for medium-sized and large banks.

This finding suggests that large banks are more sensitive to increases in NPL than small banks. This may occur because large banks have greater credit volume, more complex asset structures, and broader risk exposure. Consequently, an increase in NPL may exert stronger pressure on profitability. Therefore, bank size should not be viewed merely as an indicator of capacity, but also as an indicator of risk complexity.

Coefficient of Determination

The R-square value of the main model is 0.1942. This means that credit risk, bank size, and the interaction between credit risk and bank size explain 19.42% of the variation in bank performance. The remaining 80.58% is explained by other factors outside the model.

This value indicates that bank performance is not determined only by credit risk and bank size. Profitability may also be influenced by operational efficiency, capital adequacy, liquidity, governance, funding structure, interest rates, inflation, exchange rates, and other macroeconomic conditions. Therefore, a robustness test is needed to examine whether the main findings remain consistent after including additional control variables.

Robustness Test

The robustness test includes several control variables: interest rate, exchange rate, inflation, good corporate governance, BOPO, and CAR. The results are presented below.

Table 5. Robustness Test

Variable	Coefficient	p-value	Interpretation
NPL	1.7319	0.0223	Significant
Bank Size	1.4193	0.0001	Significant
NPL × Bank Size	-0.3150	0.0030	Negative and significant
Interest Rate	294.1784	0.0000	Significant
Exchange Rate	-29.5977	0.0105	Significant
Inflation	-101.8886	0.0000	Significant
GCG	-0.5292	0.1009	Not significant
BOPO	-0.0578	0.0002	Significant
CAR	-0.8510	0.2707	Not significant

Source: Analysis Result, 2026

The robustness test shows that the interaction between NPL and bank size remains negative and significant in explaining ROA. The interaction coefficient of -0.3150 with a p-value of 0.0030 strengthens the main model result that bank size moderates the relationship between credit risk and bank performance. Thus, the moderating role of bank size remains consistent even after controlling for macroeconomic factors and internal bank characteristics.

In the robustness model, NPL has a significant effect on ROA. The NPL coefficient of 1.7319 with a p-value of 0.0223 indicates that the direct relationship between credit risk and bank performance becomes visible after control variables are included. This change suggests that the relationship between NPL and ROA is sensitive to other factors in the model. Bank size also remains significant, confirming its role in explaining profitability differences across banks.

Macroeconomic control variables also show relevant results. Interest rate, exchange rate, and inflation significantly affect ROA. This indicates that bank performance is closely related to external economic conditions. Among internal bank characteristics, BOPO has a negative and significant effect on ROA, showing that higher operating expenses relative to operating income reduce profitability. Meanwhile, GCG and CAR are not significant in the robustness model.

Overall, the robustness test supports the main findings. The interaction between credit risk and bank size remains negative and significant, indicating that the moderating role of bank size is relatively stable. These results strengthen the argument that the impact of credit risk on bank performance differs according to bank size.

Summary of Results

The findings can be summarized into six points. First, the average NPL of the sampled banks remained relatively controlled, while ROA varied considerably across banks. Second, in the main model, credit risk does not have a significant direct effect on bank performance at the 5% level. Third, bank size has a positive and significant effect on ROA. Fourth, the interaction between NPL and bank size has a negative and significant effect on ROA, indicating that bank size moderates the relationship between credit risk and bank performance. Fifth, the conditional effect analysis shows that the effect of NPL on ROA becomes negative and significant among medium-sized and large banks. Sixth, the robustness test confirms the main findings because the interaction between NPL and bank size remains negative and significant after including control variables.

DISCUSSION

The results show that the relationship between credit risk and bank performance cannot be understood merely as a direct relationship between NPL and ROA. In the main model, credit risk, measured by NPL, does not significantly affect ROA at the 5% level. However, when bank size is included as a moderating variable, the interaction between NPL and bank size becomes negative and significant. This finding indicates that the effect of credit risk on bank profitability differs according to the scale of bank assets.

The insignificant direct effect of NPL on ROA in the main model can be explained in several ways. First, during 2021–2024, credit risk in Indonesian banking was relatively controlled. The average NPL in the sample was 2.9907%, still below the common 5% threshold. When NPL variation is not too extreme for most banks, its direct effect on ROA may not be strong enough to appear statistically significant. Second, the study period reflects a post-pandemic recovery phase, during which many banks were still adjusting after credit restructuring policies. These policies may have delayed or softened the effect of credit risk on profit through provisioning, restructuring, and portfolio adjustment.

Third, bank performance is not determined only by credit risk. ROA may also be affected by operational efficiency, cost of funds, asset structure, non-interest income, governance, capital adequacy, and macroeconomic conditions. The robustness test supports this explanation, since the effect of NPL on ROA becomes significant after control variables are included. This means that the relationship between credit risk and bank performance becomes clearer once macroeconomic and internal bank factors are controlled.

This result is consistent with studies showing that NPL does not always significantly affect bank profitability, particularly during pandemic and post-pandemic periods (Al Zafir & Satria, 2025; Mafaza & Zulfikar, 2025; Rusli & Fitriana, 2023). At the same time, the finding remains aligned with the broader literature arguing that credit risk can reduce bank performance. Boussaada et al. (2023) show that NPL negatively affects European bank performance because problem loans increase provisioning costs and reduce income. Abdelaziz et al. (2022), Ekinci and Poyraz (2019), and Arhinful et al. (2025) similarly emphasize that rising problem loans can weaken profitability and bank growth.

The most important finding of this study is the significant interaction between credit risk and bank size. The negative interaction coefficient indicates that the larger the bank, the more negative the effect of NPL on ROA. This finding suggests that bank size is not only an institutional characteristic but also a contingency factor that shapes how credit risk translates into financial performance. Bank size therefore helps explain why the effect of NPL on ROA is not identical across banks.

Conceptually, this finding shows that large banks are not always better protected from credit risk. In much of the literature, large banks are often assumed to have stronger risk absorption capacity because they possess greater capital, broader diversification, more advanced risk management systems, and better access to funding. However, the present study shows that as bank size increases, the negative effect of NPL on ROA becomes stronger. In other words, bank size represents not only capacity but also complexity. Large banks have broader loan portfolios, more complex business networks, and wider exposure to economic sectors. When non-performing loans increase, the impact on profitability may therefore become more severe.

The conditional effect results strengthen this interpretation. Among small banks, the effect of NPL on ROA is not significant. Among medium-sized and large banks, however, the effect becomes negative and significant, with the strongest negative effect appearing among large banks. This indicates that bank size changes the sensitivity of profitability to credit risk. Put differently, large banks are more sensitive to increasing NPL in relation to ROA.

Several explanations may account for this result. First, large banks have much larger credit volume. With a large credit portfolio, even a small increase in the NPL ratio may represent a substantial nominal amount of problem loans. This increases provisioning needs and reduces profit. Second, portfolio diversification in large banks does not necessarily eliminate risk, especially when economic pressure affects many sectors at once. Third, large banks face stronger performance expectations from investors and regulators. A deterioration in loan quality among large banks may trigger closer market and supervisory attention because large banks are often viewed as indicators of banking sector stability.

This finding extends the work of Asrori et al. (2024), who show that bank size can moderate the relationship between financial risk and bank performance. The present study provides additional evidence from banking firms listed on the Indonesia Stock Exchange, showing that bank size matters in explaining the relationship between credit risk and profitability. Other studies that position bank size as a moderator also suggest that asset scale may change the effect of risk or financial ratios on bank profitability, although the direction and significance may differ across contexts, periods, and bank types (Agung Prayogi, 2024; Ayunda, 2026; Dewi, 2026; Fitriana, 2025; Herlina & Wilujeng, 2025).

The robustness test further supports this conclusion. After including interest rate, exchange rate, inflation, GCG, BOPO, and CAR as control variables, the interaction between NPL and bank size remains negative and significant. This means that the moderating role of bank size does not disappear after controlling for macroeconomic factors and internal bank characteristics. Therefore, the evidence on bank size as a moderator can be considered relatively stable.

The robustness test also shows that BOPO has a negative and significant effect on ROA. This confirms that operational efficiency remains a key determinant of bank performance. The higher the operating expenses relative to operating income, the lower the bank's profitability. Macroeconomic variables also produce relevant results. Interest rate, exchange rate, and inflation significantly affect ROA, showing that bank performance is closely linked to external economic conditions, as emphasized in banking literature on emerging markets (Saleh & Abu Afifa, 2020; Siddique et al., 2022).

Meanwhile, GCG and CAR are not significant in the robustness model. This does not mean that governance and capital adequacy are unimportant. Rather, it may indicate that, in this period and sample, variations in GCG and CAR were not strong enough to explain differences in ROA after other variables were included. In Indonesian banking, CAR is generally maintained at a relatively strong level due to strict capital requirements, so its variation may be insufficient to explain profitability differences across banks.

Theoretically, this study contributes to the literature on credit risk and bank performance by showing that bank size functions as a contingency factor. The relationship between NPL and ROA cannot be understood only through a direct-effect perspective. Bank-specific characteristics, particularly asset size, should be considered because they can change the effect of credit risk on performance. Thus, this study strengthens the argument that bank performance analysis needs to account for heterogeneity across banks.

Practically, the findings have implications for bank management. Large banks need to manage credit risk more carefully because an increase in NPL may have a stronger effect on

ROA. Large banks cannot rely solely on asset scale and portfolio diversification. They need to strengthen credit quality monitoring, conduct regular stress testing, improve provisioning accuracy, and enhance loan restructuring mechanisms. For smaller banks, the findings do not imply that credit risk can be ignored. Small banks still need to maintain loan quality because their portfolios tend to be more concentrated and their capital capacity is often more limited.

For regulators, the findings suggest that credit risk supervision should consider bank size. Supervision of large banks should pay closer attention to the complexity of credit portfolios and the potential systemic impact of rising NPL. Supervision of smaller banks, meanwhile, should focus on risk concentration, credit governance quality, and capital capacity to absorb losses. Hence, supervisory policy should not rely entirely on a one-size-fits-all approach.

For investors, the results imply that banking stock analysis should consider the interaction between NPL and bank size. Investors should not interpret NPL as a stand-alone indicator. Instead, NPL needs to be read together with asset size, operational efficiency, capital adequacy, and macroeconomic conditions. In large banks, even a small increase in NPL may carry greater profitability consequences because the nominal credit exposure is also larger.

Overall, the discussion confirms that bank size plays an important role in explaining the dynamics between credit risk and bank performance. In this study, bank size strengthens the negative effect of credit risk on ROA. This finding indicates that large scale in banking reflects not only strength, but also complexity and greater risk sensitivity. Therefore, credit risk management in Indonesian banking should not only aim to reduce NPL ratios, but also understand how NPL affects profitability across banks with different size characteristics.

CONCLUSION

This study examined the effect of credit risk on bank performance and tested the moderating role of bank size among banking firms listed on the Indonesia Stock Exchange during 2021–2024. Credit risk was measured by non-performing loans, bank performance by return on assets, and bank size by the natural logarithm of total assets. Based on 108 observations from 27 banks, the findings show that the relationship between credit risk and bank performance is not straightforward, but depends on bank size.

The results indicate that credit risk does not have a significant direct effect on bank performance in the main model. This suggests that an increase in NPL does not automatically reduce ROA when contingency factors are not considered. This condition may be explained by the relatively controlled average NPL in the sample, the presence of credit restructuring policies during the post-pandemic recovery period, and the influence of other factors on bank profitability, such as operational efficiency, capital adequacy, macroeconomic conditions, and asset structure.

The main finding of this study lies in the moderating role of bank size. The interaction between NPL and bank size has a negative and significant effect on ROA. This means that bank size changes the strength of the relationship between credit risk and bank performance. The larger the bank, the stronger the negative effect of credit risk on profitability. The conditional effect analysis also shows that the effect of NPL on ROA is not significant among

small banks, but becomes negative and significant among medium-sized and large banks. Therefore, large banks are not necessarily better protected from credit risk, because greater asset scale may also indicate more complex portfolios and broader risk exposure.

The robustness test strengthens this finding. After including interest rate, exchange rate, inflation, good corporate governance, BOPO, and capital adequacy ratio as control variables, the interaction between NPL and bank size remains negative and significant. This confirms that the moderating role of bank size is relatively stable and does not disappear after controlling for macroeconomic factors and internal bank characteristics. In addition, the robustness test shows that operational efficiency and macroeconomic conditions are important in explaining bank performance. BOPO negatively affects ROA, while interest rate, exchange rate, and inflation are relevant in explaining variations in bank profitability.

Practically, the findings provide implications for bank management, regulators, and investors. For bank management, credit risk management should be adjusted to bank scale. Large banks need to pay closer attention to credit quality because an increase in NPL may have a stronger effect on ROA. Credit expansion strategies should be balanced with risk monitoring, adequate provisioning, stress testing, and early warning systems for potential problem loans. Small banks must also maintain loan quality and avoid risk concentration in specific debtor segments, even though the effect of NPL on ROA among small banks is not significant in this study.

For regulators, the findings indicate that banking supervision should consider differences in bank size. Supervision of large banks should not focus only on capital adequacy and aggregate NPL ratios, but also on credit portfolio complexity, sectoral exposure, and the possible systemic impact of declining credit quality. For investors, the results suggest that banking stock assessment should not rely on NPL as an isolated indicator. NPL needs to be interpreted together with bank size, ROA, BOPO, CAR, and macroeconomic conditions..

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