

# Credit Risk Management via Capital Adequacy: Insights on Stability from Indonesia Regional Banks

Credit Risk  
Management via  
Capital Adequacy

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## ABSTRACT

*This study investigates the moderating role of Capital Adequacy Ratio on the relationship between Non-Performing Loans and core banking indicators Lerner Index, market share of loans, market share of deposits, technical efficiency, scale efficiency, and interest rate spread across two categories of Indonesian Regional Development Banks: undercapitalized (Category-1) and well-capitalized (Category-2). Using quarterly panel data from 24 Indonesian Regional Development Banks for the period 2012–2022 and estimated with Generalized Least Squares, the results show that Capital Adequacy Ratio significantly moderates the effect of Lerner Index, market share of deposits, and interest rate spread on Non-Performing Loans, strengthening risk absorption capacity in Category-2 banks. However, Capital Adequacy Ratio does not effectively mitigate risks arising from aggressive loan growth, particularly in Category-1 banks. Additionally, technical efficiency and scale efficiency reduce Non-Performing Loans only when capital buffers are adequate. These findings suggest that Capital Adequacy Ratio affects the risk–return trade-off differently across bank types, highlighting the importance of tailored regulatory frameworks and reinforcing the notion that capital adequacy must be supported by strong governance and operational efficiency to effectively manage credit risk.*

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**Keywords:** Capital Adequacy Ratio, Credit Risk, Non-Performing Loans, Regional Development Banks, Stability.

## ABSTRACT

*Studi ini menyelidiki peran moderasi Capital Adequacy Ratio pada hubungan antara Non-Performing Loans dan indikator inti perbankan Lerner Index, pangsa pasar pinjaman, pangsa pasar simpanan, efisiensi teknis, efisiensi skala, dan spread suku bunga di dua kategori Bank Pembangunan Daerah Indonesia: undercapitalized (Kategori-1) dan well-capitalized (Kategori-2). Dengan menggunakan data panel triwulanan dari 24 Bank Pembangunan Daerah Indonesia untuk periode 2012-2022 dan diperkirakan dengan Generalized Least Squares, hasilnya menunjukkan bahwa Capital Adequacy Ratio secara signifikan memoderasi efek Lerner Index, pangsa pasar simpanan, dan spread suku bunga pada Non-Performing Loans, memperkuat kapasitas penyerapan risiko di bank Kategori-2. Namun, Capital Adequacy Ratio tidak secara efektif mengurangi risiko yang timbul dari pertumbuhan pinjaman yang agresif, khususnya di bank Kategori-1. Selain itu, efisiensi teknis dan efisiensi skala mengurangi Non-Performing Loans hanya ketika penyangga modal memadai. Temuan-temuan ini menunjukkan bahwa Rasio Kecukupan Modal memengaruhi keseimbangan risiko-imbal hasil secara berbeda di antara berbagai jenis bank, menyoroti pentingnya kerangka regulasi yang disesuaikan dan memperkuat gagasan bahwa kecukupan modal harus didukung oleh tata kelola yang kuat dan efisiensi operasional untuk mengelola risiko kredit secara efektif.*

**Keywords:** Rasio Kecukupan Modal, Risiko Kredit, Pinjaman Bermasalah, Bank Pembangunan Daerah, Stabilitas.

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## **INTRODUCTION**

In the banking sector, the Capital Adequacy Ratio (CAR) and Non-Performing Loans (NPL) are interdependent indicators that influence a bank's performance and stability. CAR reflects a bank's ability to absorb risks such as credit and operational risks (Perhiar & Fathoni, 2023), while NPL shows the extent of problematic loans that threaten a bank's financial condition (Arnone et al., 2024). A strong CAR increases depositor confidence, whereas rising NPLs reduce profitability and exert pressure on available capital, potentially destabilizing the banking sector (Hasanuh et al., 2024). To address capital issues, OJK Regulation No.03/POJK.03/2021 introduced Four KBMI categories based on core capital. Banks with capital under IDR 6 trillion (KBMI 1) are more vulnerable to NPL shocks. As of September 30, 2023, 12 Regional Development Banks (RDBs) had capital under IDR 3 trillion, indicating high vulnerability. Strengthening CAR in these banks is crucial to withstand NPL growth and ensure stability.

NPL is a vital measure of credit risk management effectiveness (Iskandar et al., 2022). Category-1 RDBs struggle with higher NPL due to inadequate capital buffers and are subject to stricter regulatory scrutiny. In contrast, Category-2 banks with stronger CARs can absorb losses, sustain lending, and maintain lower NPL ratios (Yanti et al., 2020; Obiedallah & Abdelaziz, 2024). Most prior research treats CAR and NPL as universally applicable without accounting for differences in capital classification. This limits understanding of how capital adequacy influences credit risk differently across bank categories. Furthermore, operational efficiency and market structure such as market share, competition, and cost efficiency are understudied in relation to credit risk, especially in Indonesian RDBs. Many studies also lack longitudinal analysis. For instance, Fanesha et al. (2021) found CAR and NPL simultaneously influence profitability, while Shafira et al. (2022) identified factors like size, efficiency, and liquidity as NPL determinants but did not distinguish between bank categories or explore market dynamics. Rifansa et al. (2022) examined the effect of CAR and NPL on ROA in commercial banks, neglecting regional differences, while Riadi (2018) explored borrowing behavior but did not assess how technical and scale efficiencies moderate the CAR-NPL relationship.

These gaps necessitate further investigation. Theoretical perspectives offer conflicting insights some argue higher CAR reduces risk through buffers, others suggest it may increase risk due to moral hazard. Exploring CAR's moderating role between NPL and banking indicators in different capital categories is essential (Shafira et al., 2022). This study aims to examine the moderating effect of CAR on the relationship between NPL and various banking performance indicators, such as the Lerner Index (LI), Market Share of Loans (MSL), Market Share of Deposits (MSD), Technical Efficiency (TEF), Scale Efficiency (SEF), and Interest Rate Spread (IRS). It assesses whether CAR improves the capacity of banks especially Category-1 and Category-2 RDBs to manage credit risk under differing market structures and operational conditions.

Furthermore, this research investigates how CAR strengthens or weakens the influence of other variables on NPL. For instance, a high MSD provides stable funding but may only reduce NPLs if supported by sufficient CAR. Similarly, aggressive loan expansion (high MSL) increases credit risk unless mitigated by capital adequacy. DEA-based efficiencies (TEF and SEF) reflect operational prudence, and CAR can enhance their impact in lowering NPLs. The study also links IRS and NIM to explore CAR's buffering role between profitability and credit risk. Ultimately, this research offers practical implications for regulators, policymakers, and bank managers. It aids in designing risk-sensitive capital requirements, optimizing capital allocation, and enhancing the financial sustainability of Indonesian RDBs. Additionally, it contributes to the academic discourse by addressing the empirical void in how CAR moderates credit risk across bank categories in developing economies.

## **LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT**

### **Lerner Index and Non-Performing Loans**

The Lerner Index (LI) is a widely recognized measure of market power, representing the extent to which a bank can set prices above marginal cost. According to the Quiet Life Hypothesis, banks with higher market power may experience less pressure to compete, allowing them to invest more in credit screening and risk management, thereby reducing Non-Performing Loans (NPLs) (Jiménez et al., 2013; Anginer et al., 2014; Liao & Zhao, 2025; Kabir & Worthington, 2017). This is particularly relevant for Indonesian Regional Development Banks (BPDs), where greater LI may enable prudent lending practices (Louzis et al., 2012). Conversely, the Risk-Competition Trade-off Hypothesis suggests that more competitive environments (lower LI) may lead to looser lending standards, increasing NPLs (Tran & Nguyen, 2024).

H1: The Lerner Index has a significant effect on Non-Performing Loans.

### **Market Share of Deposits and Non-Performing Loans Market**

Market Share of Deposits (MSD) reflects liquidity strength and public confidence. A larger deposit base may offer stable funding and support better credit management (Alshebmi et al., 2020; Awaluddin et al., 2023). However, high MSD may also incentivize aggressive lending behavior due to moral hazard expectations of regulatory support (Laeven & Levine, 2009; Obiedallah & Abdelaziz, 2024). In contrast, the Franchise Value Hypothesis suggests that banks with higher MSD may prioritize long-term stability to protect their franchise (Jiménez et al., 2013). Previous research also noted that the impact of MSD on NPLs could vary based on capital adequacy (Ghosh, 2015; Yuliani et al., 2024). Thus, MSD is hypothesized to have a significant impact on NPLs.

H2: Market Share of Deposits has a significant effect on Non-Performing Loans.

### **Market Share of Loans and Non-Performing Loans**

Market Share of Loans (MSL) signifies a bank's competitive stance in lending markets. Aggressive expansion strategies may result in relaxed credit screening and higher NPLs, especially in undercapitalized banks (Louzis et al., 2012; Tran & Nguyen, 2024). However, efficient and well-capitalized banks can maintain loan quality while increasing MSL (Karagiannis & Kourtzidis, 2024; Sami et al., 2024). The Franchise Value Hypothesis further argues that banks with substantial MSL are motivated to sustain credit quality to maintain their market position (Kabir & Worthington, 2017). Thus, MSL is hypothesized to significantly impact NPLs.

H3: Market Share of Loans has a significant effect on Non-Performing Loans.

### **Interest Rate Spread and Non-Performing Loans**

Interest Rate Spread (IRS) indicates the difference between lending and deposit rates, influencing profitability and credit risk. A high IRS may compensate for elevated risk or reflect market inefficiencies (Maudos & Fernández de Guevara, 2004; Köhler, 2014). The Efficient Structure Hypothesis suggests that profitable banks with high spreads maintain better loan performance (Dang et al., 2025; Lawrence et al., 2024). However, the relationship may be non-linear and affected by capital adequacy (Fanesha et al., 2021). Thus, IRS is hypothesized to have a significant effect on NPLs.

H4: Interest Rate Spread has a significant effect on Non-Performing Loans.

### **Technical Efficiency and Non-Performing Loans**

Technical Efficiency (TEF) measures a bank's ability to use resources optimally. Higher TEF may reduce credit risk by enabling better loan screening (Abdulahi et al., 2023; Dang et al., 2025). Nevertheless, excessive focus on efficiency might undermine risk governance, increasing NPLs (Katuka et al., 2024). The relationship depends on bank-specific characteristics such as size and capital (Karagiannis & Kourtzidis, 2024). TEF is expected to significantly affect NPLs, with well-managed banks leveraging efficiency to improve loan quality. The effect may differ across capital adequacy levels, as undercapitalized banks struggle to translate efficiency into lower NPLs. Thus, TEF is hypothesized to have a significant effect on NPLs.

H5: Technical Efficiency has a significant effect on Non-Performing Loans.

### **Scale Efficiency and Non-Performing Loans**

Scale Efficiency (SEF) reflects cost efficiency achieved at an optimal production scale. The Efficient Structure Hypothesis holds that SEF enhances risk mitigation by leveraging economies of scale (Katuka et al., 2024; Perhiar & Fathoni, 2023). In undercapitalized banks, SEF is more critical, whereas in well-capitalized banks, macroeconomic factors may dominate (Karagiannis & Kourtzidis, 2024; Köhler, 2014). Those empirical studies show that SEF negatively affects NPLs in undercapitalized banks, where efficiency is critical. In well-capitalized banks, macroeconomic factors may overshadow SEF's impact. It is expected that SEF significantly influences NPLs, particularly in banks with lower capital, where efficiency improvements are vital. Thus, SEF is hypothesized to have a significant effect on NPLs.

H6: Scale Efficiency has a significant effect on Non-Performing Loans

### **Capital Adequacy Ratio and Non-Performing Loans**

The Capital Adequacy Ratio (CAR) reflects a bank's capacity to absorb losses and its risk-bearing ability. The Buffer Theory posits that higher CAR leads to reduced NPLs by promoting stability (Dias, 2021; Adinda, 2020; Yuliani et al., 2024). Higher CAR enhances resilience and risk governance, particularly under credit stress (Fanesha et al., 2021; Arnone et al., 2024). Empirical studies in Indonesia confirm a negative relationship between CAR and NPLs, as robust capital buffers support prudent lending (Hasanuh et al., 2024; Adinda, 2020; Yuliani et al., 2024). Moreover, recent empirical research supports the significance of CAR in mitigating credit risk. For instance, Safitri et al. (2023) and Suarmanayasa et al. (2024), using panel data from Indonesian banks listed on the Indonesia Stock Exchange, found a statistically significant inverse relationship between CAR and NPLs. Similarly, Firanti and Susy (2024) examined state-owned banks in Indonesia and concluded that CAR has a strong positive association with Net Interest Margin (NIM), which in turn influences Return on Assets (ROA). This finding suggests that banks with robust capital levels are more capable of managing credit risk exposure, thereby lowering the likelihood of loan defaults. CAR is expected to significantly reduce NPLs, particularly in undercapitalized banks where capital constraints amplify credit risk. CAR also indirectly enhances profitability, stabilizing loan quality. Thus, CAR is hypothesized to have a significant effect on NPLs.

H7: Capital Adequacy Ratio has a significant effect on Non-Performing Loans.

### **The Moderating Effects of Capital Adequacy Ratio (CAR)**

Non-Performing Loans (NPLs) are influenced by market structure and operational efficiency factors, with the Capital Adequacy Ratio (CAR) playing a pivotal moderating role. The Lerner Index (LI), reflecting market power, allows banks to set rates above marginal costs, potentially increasing profitability but also risking weaker lending

standards (Anginer et al., 2014; Kabir & Worthington, 2017). CAR mitigates this moral hazard by enabling prudent risk management, particularly in well-capitalized banks (Ozili, 2024). Similarly, a high Market Share of Deposits (MSD) signals liquidity strength and depositor trust, fostering stability (Maudos & Fernández, 2004). However, it may drive aggressive lending, elevating credit risk in undercapitalized banks, while robust CAR helps absorb losses from poor loan screening (Louzis et al., 2012; Ghosh, 2015). The Market Share of Loans (MSL) indicates competitive credit expansion but can lead to poor asset quality without sufficient CAR to cushion risks (Anginer et al., 2014; Ghenimi et al., 2017).

Operational efficiencies further shape NPLs, moderated by CAR. Technical Efficiency (TEF), which optimizes resource use, supports loan screening under the Efficient Structure Hypothesis but requires adequate capital to reduce credit risk effectively (Köhler, 2014; Abdulahi et al., 2023; Dang et al., 2025). Scale Efficiency (SEF) minimizes cost inefficiencies and enhances asset quality, yet large banks risk weak monitoring without strong CAR to maintain stability (Karagiannis & Kourtzidis, 2024). Interest Rate Spread (IRS) reflects pricing dynamics, where higher spreads may signal inefficiencies or risk compensation, but robust CAR helps banks manage volatile margins while preserving credit quality. Thus, CAR moderates the impact of LI, MSD, MSL, TEF, SEF, and IRS on NPLs, ensuring that market power, efficiency, and pricing strategies bolster banking stability rather than exacerbate credit risk.

H8: Capital Adequacy Ratio moderates the effect of Lerner Index on Non-Performing Loans.

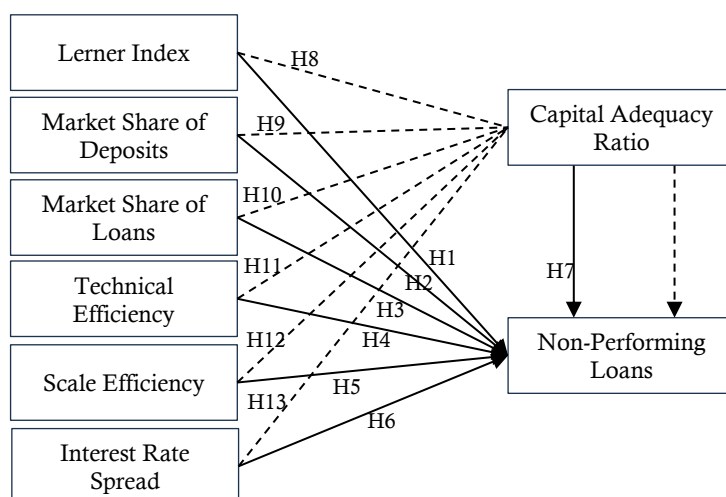
H9: Capital Adequacy Ratio moderates the effect of Market Share of Deposits on Non-Performing Loans.

H10: Capital Adequacy Ratio moderates the effect of Market Share of Loans on Non-Performing Loans.

H11: Capital Adequacy Ratio moderates the effect of Technical Efficiency on Non-Performing Loans

H12: Capital Adequacy Ratio moderates the effect of Scale Efficiency on Non-Performing Loans.

H13: Capital Adequacy Ratio moderates the effect of Interest Rate Spread on Non-Performing Loans.



**Figure 1.** Conceptual Framework: The Moderating Role of CAR on NPL Determinants Across Capital-Tiered Banks

Hence, this theoretical framework in Figure 1 shows the moderation effects of CAR towards the effect of some bank performance ratios on NPLs on two groups of banks,

namely capital adequacy banks category 1, the low-capital KBMI-1 banks, and category 2, adequately capitalized KBMI-2 banks. Six factors are also identified on either side of the model, Lerner Index (LI) as a proxy for market power and competition, Market Share of Loans (MSL) and Market Share of Deposits (MSD) representing the structural position of banks, Technical Efficiency (TEF) and Scale Efficiency (SEF) as operational performance measures based on DEA, Interest Rate Spread (IRS) describing pricing and profitability dynamics. These functions are thought to impact NPL levels by distinct mechanisms based on the banks' institution capital position. CAR serves as a moderating factor proposed to adjust or modify the impact, direction and significance of the relationships between credit risk determinants and credit risk exposure. In banks of category-1, which have thin capital buffers, CAR will have a pivotal stabilising effect, muting the adverse effects of inefficiency or market dominance. On the other hand, the CAR gives a stronger buffer for Category-2 banks with solid capitalization and may improve the effectiveness of risk-reducing mechanisms. The central box corresponds to the Non-Performing Loans (NPLs) which is used as the main successive dependent variable whose behaviour is monitored for both categories of banks. Banking Stability Performance, this concept at the very top points out the overall goal of the analysis: the analysis of CAR and related determinants that do keep sustainable credit performance in different regulatory and operational environments.

## **RESEARCH METHOD**

This study investigates 24 Regional Development Banks (BPDs) in Indonesia, selected from 27 BPDs—using quarterly panel data spanning from 2012 to 2022. The selection ensures data representativeness and availability for comprehensive analysis. The operational definitions of variables are specifically designed to reflect the Indonesian banking context. These definitions are derived from established conceptual frameworks and are aligned with previous empirical studies. The primary focus of the research is to analyze the relationship between Capital Adequacy Ratio (CAR), Non-Performing Loans (NPLs), and key banking performance indicators. In particular, the study examines how CAR moderates the effect of market conditions and efficiency indicators on the level of NPLs, offering a deeper understanding of credit risk dynamics within regional banking institutions.

The dependent variable in this study is the ratio of Non-Performing Loans to total loans ( $NPL_{it} / Total\ Loans_{it}$ ), which serves as a measure of banking performance and asset quality. The independent variables include Market Power, represented by the Lerner Index (LI), which is calculated as the markup of price over marginal cost. Market structure indicators are represented by the Market Share of Deposits (MSD) and Market Share of Loans (MSL), while Interest Rate Spread (IRS) reflects the margin between lending and deposit rates. All these variables are hypothesized to have a negative relationship with NPLs, implying that better market position and more competitive pricing should lead to lower credit risk.

Efficiency is measured using Technical Efficiency (TEF) and Scale Efficiency (SEF), both expected to reduce the level of NPLs by indicating better resource utilization and optimal scale of operations. The Capital Adequacy Ratio (CAR), calculated as Capital divided by Risk-Weighted Assets, functions not only as a standalone independent variable but also as a moderating variable. Its interactions with market power, deposit and loan market shares, interest spread, and efficiency indicators are examined through multiplicative interaction terms such as  $LI*CAR$ ,  $MSD*CAR$ ,  $MSL*CAR$ ,  $IRS*CAR$ ,  $TEF*CAR$ ,  $SEF*CAR$ . These interactions aim to assess whether a stronger capital base mitigates credit risk under different market and operational conditions.

The empirical model is formulated to test how capital adequacy influences the impact of external and internal factors on the quality of assets, as reflected by NPLs. By integrating theoretical perspectives with empirical observations, this model provides a robust framework to evaluate whether higher CAR can buffer banks against market

volatility and efficiency-related risk factors, offering valuable insights into the risk management practices of Indonesian BPDs.

## RESULTS

The analysis above shows the effect of Capital Adequacy Ratio (CAR) on Non-Performing Loans (NPLs) for category-1, category-2, and all banks are shown in Table 2. The results offer important understanding regarding how the NPL in each bank type could be impacted by the various banking determinants used in this study such as the market structure (LIDX, MSD, MSL), measures of efficiency (TEF, SEF), portfolio risk (IRS), and capital adequacy (CAR and the interactions of LI, MSD, MSL, TEF, SEF, IRS).

The regression model is estimated using Generalized Least Squares (GLS) for a homoskedastic panel with no autocorrelation, to ensure robust statistical inference. Observation of the model's explanatory power shows significant Wald chi-square values across all categories (Category-1: 119.65, Category-2: 182.36, All Banks: 190.17) with Prob > chi2 = 0.000, implying overall significance of the results.

**Table 1.** Results of Data analysis On the Influence of CAR NPL Based on Categories

NPL	Category-1	Category-2	All
	Coef.	Coef.	Coef.
LIDX	-0.0907***	-0.1020***	-0.1049***
	0.00100	0.00000	0.00000
MSD	-0.1022***	0.1124***	-0.00947
	0.00200	0.00000	-0.59000
MSL	0.0937***	-0.0778***	-0.00186
	0.00000	0.00100	-0.89300
TEF	0.03895	0.00795	0.03072**
	0.14200	0.73400	-0.02500
SEF	-0.0735**	0.00069	-0.02335
	0.03500	0.98000	-0.15700
IRS	-0.00549	-0.04604	-0.0459***
	0.82000	0.06500	-0.00100
CAR	-0.04215	0.14737**	0.04106
	0.65000	0.02800	-0.38000
LI*CAR	-0.03194	-0.2444***	-0.0832***
	0.27500	0.00000	0.00000
MSD*CAR	-0.0818**	-0.1679***	-0.1405***
	0.01000	0.00100	0.00000
MSL*CAR	0.2186***	0.00208	0.06196
	0.00000	0.96400	-0.00500
TEF*CAR	0.04352	-0.0528**	-0.01308
	0.10300	0.03800	-0.37500
SEF*CAR	-0.05712	-0.00479	0.00319
	0.50100	0.91500	-0.91900

Table 1 presents the results of a data analysis examining the influence of Capital Adequacy Ratio (CAR) and Non-Performing Loans (NPL) across two categories and an overall sample, using Generalized Least Squares (GLS) regression with homoskedastic panels and no autocorrelation. The table reports coefficients and p-values for various variables (LIDX, MSD, MSL, TEF, SEF, IRS, CAR) and their interactions with CAR, along with a constant term (\_cons). Significant coefficients (marked with \*\*, \*, or ) indicate statistical significance at different levels ( $p < 0.01$ ,  $p < 0.05$ ,  $p < 0.1$ , respectively). For instance, LIDX shows a consistently significant negative effect across all categories ( $p = 0.000$ ), while CAR's effect varies, being insignificant in Category-1 ( $p = 0.650$ ) but significant in Category-2 ( $p = 0.028$ ). Interaction terms like MSD\*CAR and LI\*CAR also show significant effects in multiple cases. The analysis includes 440 observations for Category-1, 616 for Category-2, and 1056 overall, with 10, 14, and 24 groups, respectively, across 44 time periods. The Wald chi-square tests (119.65, 182.36, 190.17) are highly significant ( $p = 0.000$ ), indicating strong model fit across all categories.

Using Generalized Least Squares regression, Table 2 analyzes Non-Performing Loans (NPLs) in Category-1 (undercapitalized) and Category-2 (well-capitalized) Regional Development Banks. The Lerner Index (LIDX) shows a negative correlation with NPLs (-0.0907, -0.1020, -0.1049,  $p = 0.000^{***}$ ), supporting the Quiet Life Hypothesis, with stronger effects in Category-2. Market Share of Deposits (MSD) reduces NPLs in Category-1 (-0.1022,  $p = 0.002^{**}$ ) but increases them in Category-2 (0.1124,  $p = 0.000^{***}$ ), reflecting Moral Hazard theory. Market Share of Loans (MSL) raises NPLs in Category-1 (0.0937,  $p = 0.000^{***}$ ) but lowers them in Category-2 (-0.0778,  $p = 0.001^{***}$ ). Technical Efficiency (TEF) is insignificant in both categories but significant overall (0.03072,  $p = 0.025^{**}$ ), suggesting efficiency may increase NPLs if risk management is weak. Scale Efficiency (SEF) reduces NPLs in Category-1 (-0.0735,  $p = 0.035^{**}$ ) but is insignificant in Category-2. Interest Rate Spread (IRS) is marginally significant in Category-2 (-0.04604,  $p = 0.065^*$ ) and significant overall (-0.0459,  $p = 0.001^{***}$ ). Capital Adequacy Ratio (CAR) is significant in Category-2 (0.14737,  $p = 0.028^{**}$ ). Interaction terms like LICAR (-0.0832,  $p = 0.000^{**}$ ) and MSD\*CAR (-0.1405,  $p = 0.000^{**}$ ) show CAR enhances risk reduction, while MSL\*CAR (0.2186,  $p = 0.000^{**}$ ) in Category-1 indicates amplified loan risks. TEF\*CAR and IRS\*CAR are significant in Category-2 (-0.0528,  $p = 0.038^{**}$ ; 0.1573,  $p = 0.000^{***}$ ), highlighting capital's role in efficiency and risk-taking.

The diverse relationships between variables and NPLs necessitate tailored regulatory frameworks for Category-1 and Category-2 BPDs to ensure financial stability and sustainable growth. For Category-1 banks, the positive MSL-NPL relationship and insignificant TEF, IRS, LI\*CAR, and SEF\*CAR effects indicate that weak capital buffers limit the benefits of market power and efficiency in reducing credit risk. Regulators, such as Indonesia's OJK, should prioritize capital-building strategies, including profit retention, capital injections, or mergers to meet Basel III standards, as supported by Tran & Nguyen (2024). Stricter lending criteria, enhanced credit screening using AI-driven analytics, and early warning systems can mitigate riskier lending as loan market share grows. The negative MSD-NPL relationship suggests deposit mobilization strengthens stability, so policies should encourage deposit growth while ensuring prudent lending to avoid moral hazard, per Laeven & Levine (2009). For Category-2 banks, the significant LI\*CAR, MSD\*CAR, and TEF\*CAR effects highlight that strong capital amplifies the benefits of market power and efficiency in reducing NPLs. However, the positive MSD-NPL and IRS\*CAR relationships indicate riskier lending due to overconfidence, necessitating robust risk-weighted capital requirements, stress testing, and loan pricing oversight to prevent excessive risk-taking, as suggested by Liao & Zhao (2025). The negative MSL-NPL effect shows that well-capitalized banks manage loan expansion effectively, so regulators should promote technological innovation (e.g., big data analytics) and diversified lending to SMEs and infrastructure projects to support regional growth. The insignificant TEF-NPL and SEF\*CAR effects across both categories suggest that efficiency improvements alone do not reduce NPLs without strong risk management, aligning with Kumbai (2021). Regulators should foster corporate governance, independent credit risk committees, and transparency to balance efficiency and risk. The Risk-Competition Tradeoff Hypothesis highlights the need to balance competition and stability, as excessive market concentration may limit credit access and inflate interest rates, per Jiménez et al. (2013). For Category-1 banks, targeted supervision and risk-based lending strategies are crucial, while Category-2 banks should focus on sustainable credit growth aligned with regional priorities. Macroprudential policies addressing inflation and GDP growth can stabilize NPLs, and regulators should encourage competitive yet stable markets to avoid systemic risks. Future research should explore interactions between market power, liquidity requirements, and risk-weighted assets to refine regulatory frameworks, ensuring BPDs support financial stability and regional economic development in Indonesia.

The analysis uses GLS regression to explore how Capital Adequacy Ratio (CAR) moderates relationships between Lerner Index (LI), Market Share of Deposits (MSD),

Market Share of Loans (MSL), Technical Efficiency (TEF), Scale Efficiency (SEF), Interest Rate Spread (IRS), and Non-Performing Loans (NPLs) in Regional Development Banks. For Category-1 (undercapitalized) banks, LI\*CAR (-0.03194,  $p = 0.275$ ) and TEF\*CAR (0.04352,  $p = 0.103$ ) are insignificant, indicating weak capital limits risk reduction. MSL\*CAR (0.2186,  $p = 0.000^{**}$ ) suggests capital amplifies loan expansion risks. In Category-2 (well-capitalized) banks, LICAR (-0.2444,  $p = 0.000^{**}$ ) and TEF\*CAR (-0.0528,  $p = 0.038^{**}$ ) show capital enhances risk reduction, while IRS\*CAR (0.1573,  $p = 0.000^{***}$ ) indicates higher spreads increase risk. MSD\*CAR is significant across both (-0.0818,  $p = 0.010^{**}$  for Category-1; -0.1679,  $p = 0.001^{**}$  for Category-2), showing capital mitigates deposit-related risks. SEF\*CAR is insignificant in both. Policy recommends stricter credit screening and capital-building for Category-1, and prudent lending with stress testing for Category-2 to ensure stability.

## **DISCUSSION**

This study explores how market structure, efficiency, and pricing strategies affect the level of Non-Performing Loans (NPLs) in Indonesian Regional Development Banks (BPDs), with special attention to the moderating role of Capital Adequacy Ratio (CAR). The findings are analyzed based on two capital-based categories of banks—Category-1 (less capitalized) and Category-2 (well-capitalized)—as well as across the entire sample. The results show that Market Power and Credit Risk (H1 & H8) The Lerner Index (LIDX), which measures market power, shows a consistent negative and significant relationship with NPLs across all categories. This supports the Quiet Life Hypothesis, which argues that banks with greater market power tend to face less competitive pressure, allowing them to invest in better credit risk management (Linnemer, 2022; Jiménez et al., 2013). Moreover, the interaction term LI\*CAR is significantly negative in Category-2 and the full sample, highlighting that capital adequacy enhances the risk-reducing benefits of market power (Berger & Bouwman, 2013). Thus, banks with strong market power and adequate capital are better positioned to maintain credit quality.

Deposit Market Share and Risk Behavior (H2 & H9) Findings on the Market Share of Deposits (MSD) reveal contrasting patterns. In Category-1 banks, a higher MSD is associated with lower NPLs, indicating that a strong and stable funding base helps these banks reduce risk exposure. In contrast, for Category-2 banks, MSD is positively related to NPLs, suggesting moral hazard behavior where banks with excess liquidity may pursue riskier lending strategies (Laeven & Levine, 2009). The negative and significant interaction of MSD\*CAR across all models indicates that capital adequacy helps mitigate the potential adverse effects of deposit concentration, particularly in larger or stronger banks (Obiedallah & Abdelaziz, 2024).

Loan Market Share and Lending Risk (H3 & H10) The impact of Market Share of Loans (MSL) on NPLs also varies. Category-1 banks exhibit a significant positive relationship, implying that aggressive loan growth without sufficient capital buffers leads to higher credit risk. Conversely, Category-2 banks show a significant negative relationship, suggesting that better-capitalized banks can expand lending without compromising credit quality (Karagiannis & Kourtzidis, 2024). However, the MSL\*CAR interaction is significantly positive in Category-1, indicating that increasing capital in weaker banks may unintentionally encourage further risky lending, reinforcing the need for complementary governance and monitoring mechanisms.

Technical Efficiency and Risk Management (H5 & H11) Technical Efficiency (TEF) does not have a significant direct effect on NPLs in either bank category, but it becomes significant in the overall sample. This suggests that TEF's effect on credit risk may only emerge when viewed systemically. Interestingly, the negative and significant interaction of TEF\*CAR in Category-2 banks shows that technical efficiency becomes more effective in reducing NPLs when supported by strong capital positions (Liao & Xu, 2021). In contrast, in weaker banks, efficiency alone may not be sufficient to ensure prudent lending.

Scale Efficiency and Operational Soundness (H6 & H12) Scale Efficiency (SEF) has a significant negative effect on NPLs in Category-1 banks, indicating that economies of scale play an important role in enhancing credit quality in smaller, undercapitalized banks. However, SEF is insignificant in Category-2 and the full sample, suggesting that well-capitalized banks rely more on their market position and risk buffers than scale efficiency. The lack of significant SEF\*CAR interaction further suggests that scale-related efficiencies operate independently of capital strength, particularly in less competitive environments.

Interest Rate Spread and Credit Discipline (H4 & H13) The Interest Rate Spread (IRS) is significant and negative only in the full sample model, implying that wider interest margins may contribute to lower NPLs systemically by improving profitability. However, this relationship is not observed within the individual categories. The insignificant moderation effect of IRS\*CAR indicates that pricing power alone may not translate into improved risk outcomes, especially when not complemented by effective risk assessment or capital management strategies (Köhler, 2014; Maudos & Fernández de Guevara, 2004).

Capital Adequacy and Risk Buffering (H7) Capital Adequacy Ratio (CAR) has a significant and positive impact on reducing NPLs only in Category-2 banks. This finding aligns with the Buffer Theory (Dias, 2021), which suggests that stronger capital positions provide banks with the resilience to absorb losses and manage credit risk more effectively. In Category-1 banks, CAR alone does not show a significant impact, underlining the notion that capital needs to be accompanied by better governance and credit evaluation processes.

The Role of CAR as a Moderator (H8–H13) CAR plays a critical moderating role across several dimensions. In well-capitalized banks (Category-2), CAR significantly strengthens the negative effects of market power (LI\*CAR), deposit share (MSD\*CAR), and technical efficiency (TEF\*CAR) on NPLs. These results validate the Risk-Competition Tradeoff Hypothesis, where adequate capital helps manage the risks associated with competitive behavior. However, in undercapitalized banks, CAR fails to significantly moderate many of these relationships and even worsens the impact of aggressive loan growth (MSL\*CAR), suggesting a risk of moral hazard when capital is not complemented by adequate supervision and discipline.

Overall, the study highlights that market structure, efficiency, and pricing strategies interact with capital adequacy in complex ways to shape credit risk outcomes. While capital buffers are generally beneficial in reducing NPLs, their effectiveness varies by bank category and must be supported by sound risk management and governance frameworks. The findings underscore the need for differentiated regulatory approaches: enhancing operational resilience in weaker banks and enforcing credit discipline in stronger ones to promote both financial stability and inclusive development.

## **CONCLUSION**

This study investigates the determinants of Non-Performing Loans (NPLs) in Indonesian Regional Development Banks (BPDs), focusing on the moderating role of the Capital Adequacy Ratio (CAR) in undercapitalized (Category-1) and well-capitalized (Category-2) banks. Results show that greater market power lowers NPLs more in Category-2 banks, while excessive market dominance may reduce competition. Deposit market share raises NPLs in Category-2 but lowers them in Category-1 banks, reflecting different risk profiles. Loan growth increases NPLs mainly in Category-1, whereas Category-2 banks maintain credit quality. Scale efficiency helps reduce NPLs in weaker banks, but overemphasis on technical efficiency can harm credit assessment. Interest rate spread has a limited but risk-sensitive effect in well-capitalized banks. Practically, Category-1 banks should improve capital via mergers or retained earnings and strengthen risk management. Category-2 banks need to enhance efficiency and adopt technology-driven risk assessments to avoid risky lending. Theoretically, the study deepens understanding of CAR's conditional influence on credit risk in segmented banking

systems. Limitations include focus on BPDs within a specific timeframe and exclusion of macroeconomic or governance factors. Future research should compare national and private banks, evaluate Basel III impacts, and explore fintech applications like AI for credit risk assessment to support resilient and inclusive banking.

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