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AUTHORS	Ngatno  Gilda Maulina 
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Ngatno, Ph.D., Professor,
Faculty of Social and Political
Sciences, Department of Business
Administration, Diponegoro University,
Indonesia. (Corresponding author)

Gilda Maulina, Ph.D., Lecturer,
Faculty of Social and Political
Sciences, Department of Business
Administration, Diponegoro University,
Indonesia.



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Ngatno (Indonesia), Gilda Maulina (Indonesia)

THE MODERATING EFFECT OF COMPETITIVE INTENSITY AND ENVIRONMENTAL COMPLEXITY ON THE RELATIONSHIP BETWEEN RISK TAKING AND PERFORMANCE OF RURAL BANKS

Abstract

This study investigates whether competitive intensity and environmental complexity moderate the relationship between risk-taking and performance among rural banks in Central Java, Indonesia. The study was conducted in Central Java, Indonesia, during January-December 2024, using secondary data from the audited financial statements of 239 rural banks for the fiscal year ending December 31, 2024. Moderated regression models were estimated to examine the effects of credit risk (non-performing loan ratio), market risk (net interest margin), liquidity risk (loan-to-deposit ratio), and operational risk (operating expenses to operating income) on rural banks' performance (return on assets), and to test interaction effects with competitive intensity (Lerner index) and environmental complexity. The results indicate that net interest margin is positively associated with return on assets, whereas the operating expenses to operating income ratio is negatively associated; the non-performing loan ratio and loan-to-deposit ratio are not statistically significant. Lerner index and environmental complexity show no direct association with return on assets. However, the Lerner index strengthens the positive association between net interest margin and return on assets and exacerbates the negative association between operating expenses and operating income and return on assets. Environmental complexity weakens the positive association between net interest margin and return on assets. These findings suggest that market conditions and environmental complexity shape how risk indicators translate into rural bank performance in 2024, underscoring the importance of operational efficiency and adaptive risk management in competitive and complex environments.

Keywords

competitive intensity, environmental complexity, risk taking, performance

JEL Classification

G21, G32

INTRODUCTION

In a rapidly evolving financial environment, the long-term viability and operational success of rural banks are becoming increasingly reliant on their capacity to implement effective risk management strategies. Rural banks serve a vital function in advancing financial inclusion and fostering local economic growth, especially in areas such as Central Java, Indonesia. However, these institutions face a variety of financial and operational risks that can significantly impact their performance if not managed effectively (Mokni & Rachdi, 2014; Al-Tamimi & Al-Mazrooei, 2007). Therefore, effective risk management is identified as a critical factor influencing financial stability and performance within the banking sector (Florio & Leoni, 2017).

While the significance of risk-taking is well acknowledged, the relationship between risk-taking practices and bank performance is inherently complex and may not follow a linear pattern. The influence of external environmental factors (such as competitive intensity and environmental complexity) can alter how risk management impacts organizational outcomes. Competitive intensity, defined as the degree of competition between firms in an industry, can strengthen or weaken the benefits of risk management, depending on how banks adapt their strategies in a highly competitive market (Porter, 1980; Jaworski & Kohli, 1993). Similarly, the complexity of the environment, characterized by the diversity and uncertainty of external factors, requires banks to adopt more sophisticated risk management systems to maintain performance (Duncan, 1972; Dess & Beard, 1984).

Previous research shows that banks operating in dynamic and competitive environments face greater uncertainty, thus requiring a stronger governance and risk management framework (Settembre-Blundo et al., 2021; Tadesse, 2020). However, studies examining how these contextual variables interact with risk-taking practices to influence the rural banks' performance, especially in developing countries like Indonesia, are still limited. Rural banks in Central Java, for example, operate in an environment characterized by intense competition, regulatory changes, and rising customer expectations driven by financial technology innovation. These conditions create a need for a deeper understanding of how external pressures shape the effectiveness of risk management in improving performance. However, there is limited research on how these contextual variables interact with risk-taking practices to influence the performance of rural banks, especially in developing countries such as Indonesia. The intense competition, regulatory changes, and rising customer expectations driven by financial technology innovation in Central Java underscore the need to understand how external pressures affect the effectiveness of risk management in enhancing performance. The scientific problem addressed in this study is how competitive intensity and environmental complexity moderate the relationship between risk-taking and the performance of rural banks in Central Java. This investigation aims to provide both theoretical and practical contributions to the literature on financial performance in small-scale banking institutions within emerging markets.

1. LITERATURE REVIEW AND HYPOTHESES

Rural banks operate in an environment where business expansion is accompanied by increasing exposure to risk. As rural banks expand their activities, stronger institutional structures and risk governance become necessary to enable banks to absorb potential shocks while still capturing growth opportunities. Because banks are exposed to multiple risk categories, they typically develop comprehensive risk management systems and comply with regulatory requirements set by the government.

Banking risks are commonly discussed through four core dimensions: credit, market, operational, and liquidity risk (Rose & Hudgins, 2013). Credit risk reflects potential losses when borrowers fail or refuse to meet contractual obligations; it is often captured through the Non-Performing Loan (NPL) ratio, which signals uncertainty about repayment

capacity (Hardanto, 2006). Market risk is closely linked to intermediation outcomes and is frequently proxied by the Net Interest Margin (NIM), representing the spread between interest income and interest (Almarzoqi & Ben Naceur, 2015). Operational risk refers to losses arising from failures in internal processes, human error, or technical disruptions, including fraud and cybersecurity incidents; the Operating Expenses to Operating Income (OEOI) ratio is widely used to reflect operational efficiency and internal control quality (Prabhu & Shankar, 2017; Rivai & Usman, 2013). Liquidity risk concerns a bank's inability to meet obligations as they fall due and is often assessed through the Loan-to-Deposit Ratio (LDR), reflecting funding pressure and the ability to liquidate assets without value loss in constrained markets (Rustam, 2017).

Performance in banking is commonly interpreted as how efficiently and profitably a bank utilizes its resources to achieve financial goals and sustain long-term stability (Rose & Hudgins, 2013).

Return on Assets (ROA) is frequently used because it captures profitability relative to total assets, reflecting managerial effectiveness in deploying resources and generating operating returns (Athanasoglou et al., 2008). This focus aligns with intermediation logic: banks create value by transforming deposits into earning assets while controlling default, funding, and operational frictions (Diamond, 1984).

Within this framework, credit risk is typically expected to reduce performance. Higher NPL indicates that a larger share of loans fails to generate expected interest income and requires higher provisioning, weakening profitability and asset efficiency (Athanasoglou et al., 2008; Diamond, 1984). Credit risk theory also emphasizes that rising credit risk increases the probability of loss due to default (Zou & Li, 2014). Empirical banking studies frequently report a negative association between NPL and profitability, supporting the view that loan quality deterioration undermines ROA (Ekinici & Poyraz, 2019; Islam & Shohel Rana, 2019; Khalifaturofi'ah, 2023; Nguyen, 2023; Ozili, 2023; Wahyuni et al., 2023; Iqbal, 2025).

In contrast, market-related returns represented by NIM are often linked to improved profitability because a larger interest spread increases net interest income. The financial intermediation perspective implies that stronger interest income generation should raise profits and therefore increase ROA (Diamond, 1984). This relationship is commonly supported in empirical work where NIM is found to be a meaningful driver of bank profitability (Molyneux & Thornton, 1992; Tumin & Mohd-Said, 2010; Soares & Yunanto, 2018; Karamoy & Tulung, 2019; Dao & Nguyen, 2020; Setiawan & Dana, 2024). Nevertheless, the magnitude of this benefit may depend on how competitive conditions constrain banks' ability to price loans and deposits.

Liquidity risk, proxied by LDR, is frequently interpreted through a strategic trade-off between growth and stability. A high LDR may reflect aggressive lending priorities that expose the bank to higher default probability and liquidity strain, consistent with agency concerns where managers may emphasize short-term expansion (Jensen & Meckling, 1976). Risk-return logic highlights that lending is a key income source but also the riskiest

activity; profitability gains from loan expansion depend on the quality of risk control and funding management (Kosmidou et al., 2006). Empirical evidence often suggests that higher LDR is associated with lower ROA, indicating that excessive loan expansion can increase vulnerability and reduce asset profitability (Inggawati et al., 2018; Karamoy & Tulung, 2019; Soares & Yunanto, 2018; Wiadnyani & Artini, 2023).

Operational risk is closely tied to efficiency and internal governance. Operational efficiency theory implies that higher OEOI signals weaker cost control and process effectiveness, reducing net income and lowering ROA. A substantial stream of evidence in banking research reports a negative relationship between OEOI and profitability (Athanasoglou et al., 2008; Hasan & Marton, 2003; Pasiouras & Kosmidou, 2007; Sofyan, 2022), although some studies document variations in sign or context-dependent effects (Mehzabin et al., 2023; Ali, 2020). Overall, these findings reinforce the importance of internal process discipline for sustaining asset-based profitability.

Beyond internal risk conditions, banks' outcomes are also shaped by market structure and the external environment. Competitive intensity in banking reflects the degree to which banks compete to attract customers, improve efficiency, and expand market share (Claessens & Laeven, 2004). Traditional industrial organization arguments emphasize that market structure influences conduct and performance; in concentrated markets, market power may increase pricing ability and profitability (Bain, 1951; Berger et al., 2004). In non-structural approaches, competitive conditions are inferred from observed pricing behavior and efficiency, where the Lerner Index (LI) is commonly used to capture market power by reflecting the ability to price above marginal cost (Claessens & Laeven, 2004). Empirical studies report a positive association between LI and profitability measures such as ROA/ROE, consistent with the idea that greater market power can enhance profitability (Beck et al., 2011; Shair et al., 2019; Tan et al., 2017; Yuanita, 2019).

Importantly, competition may also change how risk-taking translates into profitability. Strategic perspectives suggest that competitive hostility

can alter the payoff to risk-taking, where returns may weaken when competitive pressure becomes extreme and exceeds the firm's adaptive capacity (Covin & Slevin, 1989; Miller & Friesen, 1983). Banking research likewise recognizes that competition can moderate the risk-performance linkage by changing margins, failure costs, and the feasibility of experimentation (Schaeck & Cihak, 2014; Tan, 2016; Gupta & Moudud-Ul-Huq, 2020). In this sense, competitive intensity is relevant not only as a direct driver of profitability, but also as a contextual factor shaping whether credit, liquidity, market, and operational conditions are more or less damaging (or beneficial) to ROA.

Environmental complexity (EC) further shapes bank behavior and outcomes. Contingency theory argues that organizational effectiveness depends on how well structure and strategy fit environmental conditions, including the complexity and uncertainty of external elements (Donaldson, 2014; Jones & Linderman, 2014). Environmental complexity refers to the heterogeneity and interdependence of external factors that organizations must consider when making decisions (Daft, 2015). In banking, larger total assets and broader business scope may reflect more complex external demands – greater regulatory burden, systemic exposure, and market expectations – thereby increasing operational and governance challenges (Melecky & Podpiera, 2013). From this viewpoint, complexity can depress ROA because adapting to complexity typically requires higher costs for compliance, monitoring, and risk management (Donaldson, 2001; Lawrence & Lorsch, 1967). A range of studies also reports negative associations between environmental complexity and organizational performance (Wagner et al., 2001; Lu & Taylor, 2019; Aprisma & Sudaryati, 2020; Me. Gündüz & Mu. Gündüz, 2025).

EC is also relevant as a moderator because complexity may disrupt processes, increase overhead, and complicate governance, thereby weakening the benefits of risk-related strategies or amplifying their costs. The argument that complexity can undermine positive risk-performance effects and intensify negative strategic consequences is consistent with classic environment-organization perspectives (Dess & Beard, 1984; Aldrich, 1979; Atinc & Ocal, 2014). Evidence in related contexts

also suggests that environmental conditions can shape how financial or structural choices affect outcomes (Ngatno & Apriatni, 2020). Accordingly, understanding Rural banks' profitability requires not only examining direct impacts of NPL, NIM, LDR, and OEIOI on ROA but also assessing whether competitive intensity and environmental complexity change the strength and direction of those relationships.

In summary, prior literature frames RB profitability as an outcome of intermediation returns and multi-dimensional risk exposure, commonly proxied by NPL, NIM, LDR, and OEIOI, with ROA capturing asset-based performance (Diamond, 1984; Athanasoglou et al., 2008). At the same time, market power/competition and environmental complexity are repeatedly emphasized as contextual conditions that can directly shape profitability and alter how risk-taking affects performance (Claessens & Laeven, 2004; Donaldson, 2014). This study therefore positions competition and environmental complexity as integral parts of explaining variation in Rural banks' performance under risk.

This study aims to investigate how risk-taking in Rural banks, proxied by credit risk measured by Non-Performing Loan (NPL), market risk measured by Net Interest Margin (NIM), liquidity risk measured by Loan-to-Deposit Ratio (LDR), and operational risk measured by Operating Expenses to Operating Income (OEIOI), affects Rural banks' performance as measured by Return on Assets (ROA). In addition, this study examines the direct effects of competitive intensity measured by the Lerner Index (LI) and environmental complexity (EC) on ROA, as well as their moderating roles in shaping the relationships between each risk indicator (NPL, NIM, LDR, and OEIOI) and Rural banks' performance (ROA). Based on the theoretical arguments and empirical findings discussed in the literature review, the expected directions of these direct and moderating relationships are formulated into the following hypotheses:

H_1 : *NPL has a negative effect on ROA.*

H_2 : *NIM has a positive effect on ROA.*

H_3 : *LDR has a negative effect on ROA.*

H_4 : *OEOI has a negative effect on ROA.*

H_5 : *LI has a positive effect on ROA.*

H_6 : *LI weakens the negative effect of NPL on ROA.*

H_7 : *LI strengthens the positive effect of NIM on ROA.*

H_8 : *LI weakens the negative effect of LDR on ROA.*

H_9 : *LI weakens the negative effect of OEOI on ROA.*

H_{10} : *EC has a negative effect on ROA.*

H_{11} : *EC strengthens the negative effect of NPL on ROA.*

H_{12} : *EC weakens the positive effect of NIM on ROA.*

H_{13} : *EC strengthens the negative effect of LDR on ROA.*

H_{14} : *EC strengthens the negative effect of OEOI on ROA.*

2. METHOD

This study was conducted in Central Java Province, Indonesia, using secondary data from rural bank audited year-end financial statements as of December 31, 2024 (balance sheets and income statements). The analysis is restricted to the 2024 fiscal year, and banks with incomplete data were excluded from the sample.

Table 1. Variables and indicators

Variables	Indicators	Formula
Credit risk	Non-Performing Loan (NPL)	$(\text{Non-Performing Loan} / \text{Total Loan}) \times 100\%$
Market risk	Net Interest Margin (NIM)	$(\text{Net Interest Income} / \text{Average Earning Assets}) \times 100\%$
Liquidity risk	Loan-to-Deposit Ratio (LDR)	$\text{Total Loans} / \text{Deposits} \times 100\%$
Operational risk	Operating Expenses to Operating Income (OEOI)	$(\text{Operating Expenses} / \text{Operating Income}) \times 100\%$
Competitive Intensity	Lerner Index (LI)	$(\text{Price} - \text{Marginal Cost}) / \text{Price}$
Environment Complexity	Environmental Complexity (EC)	$(\text{Bank's Total Assets} / \text{Total Banking Industry Assets}) \times 100\%$
Profitability/Performance	Return on Asset (ROA)	$(\text{Net Profit (Before Tax)} / \text{Average Total Assets}) \times 100\%$

This study includes three main variables: independent variables (NPL, NIM, LDR, and OEOI), moderating variables (LI and EC), and a dependent variable (ROA). Table 1 explains the proxy of each variable.

This study uses regression analysis to investigate the direct influence of NPL, NIM, LDR, and OEOI on ROA. Meanwhile, Moderated Regression Analysis (MRA) is applied to examine the moderating effects of competitive intensity and environmental complexity on the relationships between NPL, NIM, LDR, and OEOI with ROA. The regression equations for analyzing the direct and moderating effects can be formulated as follows:

$$\begin{aligned}
 ROA = & a + B_1NPL + B_2NIM + B_3LDR \\
 & + B_4OEOI + B_5LI + B_6NPL \cdot LI \\
 & + B_7NIM \cdot LI + B_8LDR \cdot LI + B_9OEOI \cdot LI \quad (1) \\
 & + B_{10}EC + B_{11}NPL \cdot EC + B_{12}NIM \cdot EC \\
 & + B_{13}LDR \cdot EC + B_{14}OEOI \cdot EC + \varepsilon,
 \end{aligned}$$

3. RESULT AND DISCUSSION

3.1. Descriptive statistics

Table 2 presents the descriptive statistics for all variables examined in the study. The mean values of the data were analyzed by comparing them with the evaluation standards commonly applied by Bank Indonesia. The average NPL was 15.53, where this ratio is included in intensive monitoring and requires a restructuring plan. The average NIM of 9.29 (< 10%) indicates low efficiency or small interest income relative to productive assets. The average LDR of 106.26 (>95%) indicates high risk or the potential to lead to tight liquidity. The average

OEOI of 90.82 indicates unfavorable conditions or inefficiency. Viewed from external conditions, the average LI of 19.28 ($> .30$) indicates weak competition/dominance, so the bank has large market power (oligopoly). Meanwhile, the average EC of .42 ($< .5\%$) indicates low complexity or is included in a small rural bank. Furthermore, in terms of performance, the average ROA was 1.60 (ranging from 1.25% to $< 1.5\%$), indicating good or profitable conditions.

Table 2. Descriptive statistics

Variable	N	Min	Max	Mean	Std. Dev.
NPL	239	.44	59.67	15.53	10.68
NIM	239	-3.30	26.89	9.29	3.85
LDR	239	53.00	503.14	106.26	43.02
OEOI	239	61.79	252.46	90.82	19.01
LI	239	-41.15	63.75	19.28	13.36
EC	239	-.12	.504	.42	.72
ROA	239	-15.97	12.49	1.60	2.75
Valid N	239				

3.2. Correlation analysis

Table 3 reveals significant negative correlations between NPL and ROA, as well as between OEOI and ROA. This relationship explains that higher NPL and OEOI lower ROA. Conversely, there are significant positive correlations between NIM and ROA, and between LI and ROA. This relationship explains that higher NIM and LI increase ROA.

Table 3. Correlation analysis

Variable	NPL	NIM	LDR	OEOI	LI	EC	ROA
NPL	.111						
NIM	-.366**	1					
LDR	.110	.016	1				
OEOI	.629**	-.490**	.080	1			
LI	-.384**	.357**	-.022	-.657**	1		
EC	-.139*	-.158*	-.024	-.090	.197**	1	
ROA	-.576**	.666**	-.038	-.909**	.630**	.032	1

Note: ** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

3.3. Testing the hypotheses

3.3.1. Effect of risk-taking on rural banks' performance

First, regarding the effect of credit risk on the performance of Rural banks, Hypothesis 1 (H_1) predicts that NPL should negatively affect ROA.

However, as shown in Table 4, NPL exhibits no statistically significant relationship with ROA (coefficient = .005, not significant). Consequently, H_1 is rejected, indicating that credit quality is not a key driver of profitability within this sample or model. Second, concerning market risk, Hypothesis 2 (H_2) asserts that NIM positively affects ROA. The results confirm this expectation, with NIM demonstrating a significant positive effect on ROA (coefficient = .207, significant at the 1% level). Thus, H_2 is supported. Third, with respect to liquidity risk, Hypothesis 3 (H_3) proposes a negative influence of LDR on ROA. The findings in Table 4 show that LDR does not significantly affect ROA (coefficient = .001, not significant), leading to the rejection of H_3 . Lastly, the effect of operational risk on Rural banks' performance is observed through the OEOI variable, which exhibits a significant negative coefficient (coefficient = -.113, significant at the 1% level). Accordingly, H_4 is supported.

3.3.2. Direct effect of LI and EC on ROA

In Table 4, variables LI and EC do not significantly directly influence ROA. Therefore, H_5 and H_{10} are rejected. This indicates that rural banks' performance does not depend on competitive intensity or environmental complexity. This result contradicts competition theory (Lerner, 1934), where uncompetitive market conditions (high LI) can provide leverage in setting interest margins. Likewise, the effect of environmental complexity is not significant on ROA, showing the same results. These two results are inconsistent with previous findings, which explain that the macro environment and low complexity do not suppress intermediation efficiency (Athanasoglou et al., 2008).

3.3.3. Moderating effect of competitive intensity on the relationship between risk taking and rural banks' performance

Competitive intensity is expected to moderate the relationship between risk-taking and firm performance. The Moderated Regression Analysis (MRA) results of LI are shown in Table 4. First, the regression result of $NPL \times LI$ on ROA is positive but not significant, so H_6 is rejected. Second, the regression result of $NIM \times LI$ on ROA is significantly positive, so H_7 is accepted. Third, the regression results of $LDR \times LI$ on ROA are insignifi-

cant; therefore, H_8 is rejected. Finally, the regression result of $OEOI \times LI$ on ROA is significantly negative; therefore, H_9 is accepted.

3.3.4. Moderating effect of environment complexity on the relationship between risk taking and rural banks' performance

Environment complexity is expected to moderate the relationship between risk-taking and firm performance. First, Table 4 shows that the effect of $NPL \times EC$ on ROA is negative and insignificant, so H_{11} is rejected. Second, the regression results of $NIM \times EC$ on ROA are significantly positive, so H_{12} is supported. Third, the regression results of $LDR \times EC$ on ROA are positive and insignificant; therefore, H_{13} is rejected. Finally, the regression results of $OEOI \times EC$ on ROA are positive and insignificant. Accordingly, H_{14} is rejected.

Table 4. Regression analysis of risk taking on ROA

Independent variables	Dependent (ROA)
Constant	11.062**
NPL	-.011
NIM	.078*
LDR	.001
OEOI	-.117**
Moderation	
LI	.035
EC	-1.168
Interaction	
$NPL \times LI$	.001
$NIM \times LI$	.005**
$LDR \times LI$	.000
$OEOI \times LI$	-.001**
$NPL \times EC$	-.013
$NIM \times EC$	-.053*
$LDR \times EC$	.002
$OEOI \times EC$	.019
R^2	.927
Adjusted R^2	.922

Note: ** significant at the .01 level; * significant at the .05 level.

This study establishes a moderated relationship framework to investigate the effect of risk-taking on firm performance.

First, Table 4 shows the results of how risk-taking impacts firm performance. NIM positively impacts ROA. This aligns with banking profitability theory, which states that the higher the net interest margin, the higher the profit generated (Sealey

& Lindley, 1977). These results support previous research, which shows a positive influence of NIM on ROA (Astuti & Husna, 2020; Karamoy & Tulung, 2019; Molyneux & Thornton, 1992; Olalere et al., 2017; Setiawan & Dana, 2024; Soares & Yunanto, 2018; Tumin & Mohd-Said, 2010). Meanwhile, OEOI negatively impacts company performance and ROA. These results indicate that a higher ratio of operating expenses to operating income is associated with lower bank profitability. Based on cost efficiency theory, the higher the operating expenses relative to rational income, the lower the bank's efficiency, resulting in lower profitability. These findings are consistent with prior studies that demonstrate a negative effect of operational risk on firm performance (Athanasoglou et al., 2008; Hasan & Marton, 2003; Pasiouras & Kosmidou, 2007; Sofyan, 2022). Next, NPL and LDR did not significantly impact ROA. This result indicates that rural banks can manage their credit and liquidity risks effectively. This finding reinforces previous findings that these two risks do not necessarily impact performance if risk management is good (Gadzo et al., 2019).

Second, Table 4 shows the results of the analysis taking into account the moderator effect (Moderated Regression Analysis). The addition of this interaction effect strengthens the influence of risk taking on ROA (with R^2 changing from .890 to .927). However, LI and EC do not consistently moderate the relationship between risk-taking and ROA. The moderated regression results of $NIM \times LI$ on ROA are positive. This positive effect on ROA indicates that for banks with greater market dominance/competition, net interest margin becomes an important factor in maintaining asset profitability. These results support previous research showing that competition narrows interest margins and suppresses equity-based profitability (Demirgüç-Kunt & Huizinga, 1999; Mirović et al., 2024). The moderated regression results of $OEOI \times LI$ on ROA are negative. This result suggests that in a highly competitive market, operational efficiency becomes increasingly important, and banks with high expense ratios will lag behind the competition. This aligns with cost-efficiency literature showing that a low expense ratio is positively correlated with profitability. On the other hand, the interaction effect ($NPL \times LI$ and $LDR \times LI$) on

ROA showed insignificant results. This suggests that banks operating in more or less competitive markets exhibit a stable impact of NPL and LDR on ROA. This suggests that credit risk and liquidity risk may not be strongly influenced by the level of competition. The interaction effect of NIM and EC on ROA is negative and statistically significant, suggesting that in more complex environments, interest margins are less effective in

enhancing asset profitability. The findings of this study align with the perspectives of Child (1972) and Lawrence and Lorsch (1967), who stated that environmental complexity reduces the speed and accuracy of decision-making. This can occur due to external conditions such as strict regulations, disruptive technology, or non-bank market pressures that begin to reduce traditional margins (Chand et al., 2024).

CONCLUSION AND SUGGESTIONS

This study aimed to examine how competitive intensity and environmental complexity moderate the relationship between various types of risk-taking (credit, market, liquidity, and operational) and the performance of rural banks in Central Java, Indonesia. The findings indicate that market risk (NIM) and operational risk (OEOI) are the principal determinants of bank performance, measured by Return on Assets (ROA), with their effects significantly shaped by the competitive environment (LI) and environmental complexity (EC). Although credit risk (NPL) and liquidity risk (LDR) remain relevant as direct factors, their interaction with LI and EC was not statistically significant, suggesting limited moderating influence in these dimensions. Market power, as captured by the Lerner Index, positively influences profitability but can attenuate the favorable impact of market risk on ROA. Furthermore, operational efficiency gains importance in complex environments, where environmental complexity diminishes the positive effect of market risk on performance. These results underscore the necessity for rural banks to adapt financial and operational policies to the nuances of competitive and complex market conditions to sustain and enhance profitability.

Banks need to consider efficiency strategies and dynamic environmental adaptation, rather than solely pursuing interest margins or credit expansion. Banks with high market power (LI) can optimize NIM to increase ROA, but must be aware that inefficiency (high OEOI) will still reduce profits. In complex and uncertain environments (high EC), banks should not only focus on interest margins but also develop innovation and operational efficiency to remain competitive. Since many interactions were insignificant, future research could consider bank heterogeneity (e.g., bank size, domestic vs. foreign, digital adoption) to see if the moderating effects differ across subgroups. Furthermore, the environmental complexity (EC) variable could be refined into specific dimensions: for example, climate risk, financial technology regulation, and digital disruption, as recent literature (Jiang et al., 2025) demonstrates the importance of these aspects. Furthermore, longitudinal or dynamic panel research could help capture the effects of bank adaptation to competition and complexity over time.

AUTHOR CONTRIBUTIONS

Conceptualization: Ngatno, Gilda Maulina.

Data curation: Gilda Maulina.

Formal analysis: Ngatno, Gilda Maulina.

Methodology: Ngatno.

Writing – original draft: Ngatno, Gilda Maulina.

Writing – review & editing: Ngatno, Gilda Maulina.

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