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The impact of income diversification on non-performing loans of commercial banks: Empirical evidence from Southeast Asia

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Abstract: This study investigates the determinants of the non-performing loan (NPL) ratio (BDR) in 65 listed commercial banks in Southeast Asia from 2016 to 2023, using fixed-effects panel regression with robust standard errors to analyze 440 observations. Data are taken from annual financial reports. The results show that higher income diversification (IND), measured by the Herfindahl-Hirschman Index, unexpectedly leads to a statistically significant increase in BDR (coefficient: 0.0275, $p < 0.05$). The COVID-19 pandemic also significantly increases BDR (coefficient: 0.0033, $p < 0.01$). In contrast, a higher capital adequacy ratio (CAR) significantly reduces BDR (coefficient: -0.0013, $p < 0.01$). Lagged BDR also positively affects current BDR (coefficient: 0.1659, $p < 0.05$), highlighting the persistence of NPL. Surprisingly, the non-interest income ratio (NIR), loan-to-asset ratio, cost-to-income ratio, and deposit-to-asset ratio do not significantly affect BDR. The findings have important implications for Southeast Asian bank regulators and policymakers, who should focus on sustainable income diversification rather than rapid expansion, as crucial for long-term stability.

Keywords: *Capital Adequacy Ratio, FEM - Robust Standard Errors, Income Diversification, Non-Performing Loans.*

1. Introduction

The COVID-19 pandemic significantly impacted the global financial landscape, highlighting the vulnerability of commercial banks in Southeast Asia to economic shocks. This necessitates research on income diversification as a strategy to mitigate risks and enhance financial stability. While the provided framework focuses on Return on Equity (ROE), this analysis specifically addresses the need to study income diversification's impact on non-performing loan (NPL) ratios, reflecting financial stability and risk management.

Several studies underscore the importance of income diversification for commercial banks. Diversification reduces reliance on traditional interest income, mitigating vulnerabilities associated with interest rate fluctuations and credit risk [1, 2]. Furthermore, diversified income streams enhance profitability and stability, particularly during economic downturns [3]. These findings necessitate investigating the specific relationship between diversification and NPL in Southeast Asia.

While research on income diversification and bank performance exists, a gap remains in understanding its impact on NPL ratios specifically in the Southeast Asian context. Examining the region's unique characteristics, including diverse economic development levels and regulatory frameworks, is crucial. Moreover, exploring the various criteria used to measure income diversification (e.g., Herfindahl-Hirschman Index, revenue share from non-interest income) [4] allows for a comprehensive analysis of its impact on NPL.

The COVID-19 pandemic exacerbated existing vulnerabilities in the region's banking sector. Understanding how income diversification can mitigate credit risk and improve NPL ratios is crucial for

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stakeholders. Bank managers can utilize these findings to develop robust risk management strategies. Investors can evaluate banks' resilience and long-term sustainability. Policymakers and bank supervisors can leverage this research to strengthen regulatory frameworks and promote financial stability in the post-pandemic era. Therefore, studying the relationship between income diversification and NPL ratios of Southeast Asian commercial banks is timely and essential.

2. Literature Review

2.1. Income Diversification and NPL

Recent research explores the relationship between income diversification and NPL ratios in commercial banks, primarily focusing on the contribution of non-interest income. A common metric for assessing diversification is the ratio of non-interest income to total income (NII/TI). Higher NII/TI ratios generally indicate greater diversification [5].

Stiroh [4] provides a comprehensive overview of income diversification trends in the US banking sector, highlighting the increasing reliance on non-interest income sources like fees and trading revenue. While acknowledging potential benefits of diversification in mitigating credit risk, Stiroh [4] cautions against excessive reliance on volatile non-interest income streams. Similarly, De Jonghe, et al. [6] examine the impact of diversification on bank stability, finding that moderate levels of non-interest income can enhance stability, but excessive diversification may lead to increased risk-taking.

Empirical studies examining the direct link between income diversification and NPL ratios offer mixed findings. While some research suggests a negative relationship, indicating that higher diversification reduces NPL ratios [7] other studies report a non-significant or even positive relationship [8]. These inconsistencies highlight the complex interplay of factors influencing NPL ratios and underscore the need for further research exploring the specific channels through which income diversification impacts credit risk. Furthermore, the optimal level of diversification and its impact likely vary across different banking systems and regulatory environments [9].

The relationship between income diversification and NPL ratios in commercial banks has been a subject of ongoing debate in recent financial literature. Some studies suggest a positive impact, arguing that diversified income streams enhance a bank's resilience to economic shocks and reduce reliance on interest income, thus lowering credit risk [5, 10]. Diversification into fee-generating activities, such as investment banking and wealth management, can provide stable income during periods of credit stress, mitigating NPL increases.

However, other research indicates a potential negative relationship. Baicu, et al. [11] found that aggressive diversification into non-traditional banking activities can lead to increased risk-taking behavior and managerial complexity, potentially elevating NPL ratios. Similarly, Stiroh [4] argued that diversification may distract management from core lending activities and dilute expertise, leading to poorer credit quality and higher NPL. The mechanism for this negative impact lies in the potential for increased operational risk and informational asymmetry associated with venturing into unfamiliar business lines [12]. This divergence in findings highlights the complex and potentially non-linear relationship between income diversification and NPL ratios, warranting further research to clarify the contingent factors influencing this relationship.

2.2. Loans and NPL

The relationship between Loan to Asset Ratio (LAR) and NPL ratios in commercial banks is complex and contested. Some studies suggest a positive relationship, positing that higher lending activity, reflected in a higher LAR, increases profitability and strengthens a bank's ability to manage credit risk, leading to lower NPL ratios (e.g., Mesagan and Akanni [13]). A higher LAR could signify increased operating efficiency and income generation, bolstering loan loss reserves and enabling better risk management [14].

However, a larger body of literature supports a negative relationship. An increasing LAR indicates greater exposure to credit risk, as a larger proportion of assets are tied to potentially defaulting loans.

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This heightened risk can translate into a higher NPL ratios (e.g., Klein [15]). Specifically, excessive loan growth, particularly when driven by aggressive lending practices to meet performance targets, can deteriorate loan portfolio quality and contribute to rising NPLs [16]. Furthermore, a high LAR can restrict a bank's ability to absorb unexpected losses, amplifying the negative impact of economic downturns on asset quality and further exacerbating NPL ratios [17]. This conflicting evidence necessitates further investigation to determine the specific contextual factors that influence the direction of the LAR-NPL ratios relationship.

2.3. Cost, Income and NPL

The relationship between Cost-to-Income Ratio (CIR) and NPL ratio in commercial banks remains a subject of ongoing debate. While some studies posit a positive correlation, suggesting that higher operational inefficiency (higher CIR) leads to compromised lending practices and subsequently higher NPL, others contend a negative relationship. This contrasting perspective suggests that efficient banks (lower CIR) might engage in aggressive lending, potentially increasing NPL.

Supporting the positive relationship, a study by Kumar, et al. [18] on Indian banks found a significant positive correlation between CIR and NPL ratio, attributing it to weakened risk management in inefficient banks. Similarly, Ahmad and Bashir [19] observed a positive link in Pakistani banks, arguing that higher CIR reflects inadequate cost control, potentially leading to higher loan defaults.

Conversely, research by Nguyen and Pham [3] on Vietnamese banks revealed a negative relationship. They argued that efficient banks, with lower CIR, might pursue rapid loan growth, accepting higher risk and consequently leading to higher NPL ratios. A study by Islam and Khan [20] echoed these findings in the context of Bangladeshi banks, suggesting that lower CIR could indicate aggressive lending practices aimed at maximizing profits, potentially overlooking risk assessment.

This divergence in findings highlights the complex interplay between CIR and NPL ratio, influenced by factors such as bank-specific characteristics, macroeconomic conditions, and regulatory environment. Further research incorporating these contextual factors is needed to provide a more nuanced understanding of this critical relationship.

2.4. Capital Adequacy Ratio and NPL

The relationship between Capital Adequacy Ratio (CAR) and NPL ratio in commercial banks is a complex and contested issue in banking literature. A strand of research suggests a negative relationship, arguing that well-capitalized banks are more prudent in lending, leading to lower NPLs. Studies like Abbas, et al. [21] and Bougatef [22] utilizing panel data analysis across multiple countries find a statistically significant negative relationship between CAR and NPL ratio, indicating that higher CAR leads to lower NPLs. This is often attributed to the "moral hazard" effect, where higher capitalization incentivizes banks to avoid excessive risk-taking.

However, an alternative perspective suggests a positive or insignificant relationship. Some studies, such as Dietrich and Wanzenried [23] argued that excessively high CAR could incentivize banks to engage in riskier lending practices to achieve higher returns, potentially leading to increased NPLs. This "regulatory arbitrage" effect postulates that banks might shift towards riskier assets to compensate for the opportunity cost of holding high capital. Furthermore, studies examining specific contexts, like developing economies, have found a weaker or even positive relationship (e.g., Noman, et al. [24]). These findings highlight the importance of considering contextual factors, such as regulatory environment and macroeconomic conditions, when analyzing the CAR-NPL relationship. Further research is needed to fully understand the nuances of this relationship and its implications for bank stability and financial regulation.

2.6. Deposit to Total Asset Ratio and NPL

The relationship between the deposit to total asset ratio (DTA) and NPL ratio of commercial banks remains a contested issue in the literature. Some studies suggest a negative relationship, positing that a

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higher DTA indicates greater reliance on stable funding, reducing risk-taking and subsequently NPLs. For instance, Dietrich and Wanzenried [23] found that higher deposit funding leads to lower NPL ratios, attributing this to reduced moral hazard incentives for excessive lending. Similarly, Louzis, et al. [25] using a panel of European banks, confirmed a negative relationship between DTA and NPLs, highlighting the stabilizing effect of deposit funding.

Conversely, other research argues for a positive or insignificant relationship. Some argue that a high DTA may induce banks to engage in aggressive lending to deploy excess liquidity, potentially increasing NPLs. Furthermore, banks with high DTA might be less incentivized to monitor loan quality due to perceived lower risk, potentially exacerbating NPLs. Empirical evidence supporting this view remains limited in recent literature indexed in Web of Science and Scopus within the specified timeframe (2018-2024). This scarcity suggests a potential research gap in exploring the conditions under which a high DTA might contribute to increased NPLs. Future research should focus on investigating this nuanced relationship across different banking systems and economic cycles, considering factors like regulatory frameworks and macroeconomic conditions.

3. Methodology

This study uses a quantitative approach to examine how income diversification affects the bad debt ratio of Southeast Asian listed joint stock commercial banks. The study looks at secondary data from annual public financial reports to reflect recent changes in the income diversification of commercial banks. The study uses a purposive sample technique and focuses on large joint stock commercial banks with significant market shares in Southeast Asian countries. A panel dataset of 65 Southeast Asian listed joint-stock commercial banks covering the years 2016–2023 is used in this study. The 440 observations in the data are used to examine the factors that influence bank bad debt ratios (BDR).

A fixed-effects panel regression model is estimated to address potential unobserved heterogeneity across banks:

$$BDR_{it} = \beta_0 + \beta_1 * BDR\_lag1 + \beta_2 * LOA_{it} + \beta_3 * CTI_{it} + \beta_4 * NIR_{it} + \beta_5 * IND_{it} + \beta_6 * CAR_{it} + \beta_7 * DPS_{it} + \beta_8 * COV19_t + \varepsilon_{it}$$

Where:

- Non-performing loan ratio: BDR = Bad debt / Total credit sales
- BDR_lag1 represents the NPL ratio of the previous year
- Loan to total assets ratio: LOA = Total loans / Total assets
- Cost to income ratio: CTI = Operating expenses / Operating income
- Non-interest income ratio: NIR = Non-interest income / Total income
- Bank income dispersion: IND = 1 − HHI = 1 − [(Non-interest income / Total income)2 (Interest income / Total income)2]
- Capital adequacy ratio: CAR = (Tier I capital + Tier II capital + Tier III capital) / Risk-weighted assets (RWA)
- Deposit to total assets ratio: DPS = Total deposits / Total assets
- COV-19 is a dummy variable, taking the value of 1 during the period of impact of the COVID-19 pandemic on income diversification and bad debt ratio of commercial banks in Southeast Asia.
- ε_{it} is the error term.

Robust standard errors are employed to account for potential heteroskedasticity and within-bank correlation. Hausman test results favored the fixed-effects specification over the random-effects model. Diagnostic tests revealed the presence of heteroskedasticity, necessitating the use of robust standard errors.

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4. Results

4.1. Descriptive Statistics

The Southeast Asian banking industry exhibits distinct characteristics that are reflected in the financial performance indicators of member banks. The average non-interest income ratio (NIR) of 24.65% indicates a moderate level of income diversification, further supported by the average income diversification index (IND) of 37.77%. Although banks are generating income from sources other than traditional lending activities, there is still a significant dependence on interest income. This may be due to the developing economies in the region where traditional lending activities still dominate. However, the relatively high standard deviation of NIR (9.43%) suggests significant differences in diversification strategies among banks, with some institutions potentially pursuing the generation of non-interest income more aggressively.

Credit growth, as represented by the loan-to-assets (LOA) ratio, averaged 61.64%, signaling a robust expansion in lending activities. This is consistent with the region's economic growth trajectory and growing demand for credit. The average deposit-to-assets (DPS) ratio of 70.22% suggests that a strong deposit base is funding the credit expansion. However, potential liquidity risks need to be monitored, especially given the volatility observed in the DPS (standard deviation of 11.71%). The healthy average capital adequacy ratio (CAR) of 16.64%, well above the regulatory minimum, suggests a resilient banking sector with the ability to absorb potential losses.

Table 1.
Descriptive statistics of variables.

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
BDR	440	0.0246	0.0152	0.0002	0.0801
LOA	440	0.6164	0.1123	0.3556	0.9560
CTI	440	0.4845	0.1141	0.1730	0.9155
NIR	440	0.2465	0.0943	0.0289	0.7268
IND	440	0.3777	0.1034	0.0570	0.4996
CAR	440	16.6358	4.2203	8.0000	33.5000
DPS	440	0.7022	0.1171	0.2459	0.9963

However, the cost-to-income (CTI) ratio of 48.45% suggests relatively high operating expenses, potentially weighing on profitability. This may be driven by investments in technology, branch expansion, or increased competition. Overall, the Southeast Asian banking industry appears to be navigating a dynamic environment characterized by growth opportunities and challenges related to profitability, diversification, and maintaining a stable funding base. Further research could delve into the specific factors influencing commercial banks' NPL ratios to gain a deeper understanding of these trends.

The test results show that the variables including BDR, CTI, NIR, CAR and DPS have some outlier observations, the outlier data are corrected by Winsorization method; the data are then continued to be analyzed to perform the research tasks.

The correlation analysis provides insights into the relationships between bad debt ratio (BDR) and other financial indicators of joint-stock commercial banks in Southeast Asia from 2016 to 2023. BDR exhibits a positive and statistically significant correlation with the cost-to-income ratio (CTI), suggesting that banks with higher operating costs tend to experience higher bad debt levels. This could be attributed to inefficiencies in loan underwriting and monitoring processes, leading to increased loan defaults. The positive correlation between BDR and income diversification (IND), albeit weak, implies that banks relying more on non-interest income might experience slightly higher BDRs. This could be due to the riskier nature of some non-interest income activities.

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Table 2.
Pearson correlation matrix.

Variable	BDR	LOA	CTI	NIR	IND	CAR	DPS
BDR	1						
LOA	-0.0125	1					
CTI	0.2568	-0.019	1				
NIR	0.0062	-0.1781	-0.0415	1			
IND	0.0914	-0.2495	0.0477	0.8018	1		
CAR	0.0701	-0.2361	0.0267	0.22	0.2584	1	
DPS	-0.0669	0.0071	0.0352	-0.022	-0.1832	-0.143	1

Conversely, BDR shows a negative correlation with the deposit-to-asset ratio (DPS), indicating that banks with a higher proportion of deposit funding tend to have lower bad debts. This suggests that a stable deposit base could contribute to better loan quality and risk management. The negative relationship between BDR and loan-to-asset ratio (LOA) contradicts expectations, potentially reflecting specific lending practices or economic conditions in Southeast Asia during the study period that warrant further investigation.

The weak positive correlation between BDR and the capital adequacy ratio (CAR) could indicate that well-capitalized banks might engage in riskier lending, leading to marginally higher bad debts, or that higher BDRs necessitate increased capital buffers. Finally, the near-zero correlation between BDR and the non-interest income ratio (NIR) suggests that income diversification, in itself, might not have a direct impact on bad debt levels. These findings highlight the complex interplay of factors influencing bank performance in Southeast Asia and underscore the need for further research using more sophisticated analytical techniques.

4.2. Estimation Results

The Breusch-Pagan/Cook-Weisberg test results decisively reject the null hypothesis of homoskedasticity (constant variance) in the regression model. The chi-squared statistic of 79.90 with a p-value of 0.0000 indicates that there is statistically significant evidence of heteroskedasticity. This means that the variance of the error term in the regression model is not constant across all observations. Addressing this issue requires employing techniques like robust standard errors, which provide consistent estimates of standard errors even in the presence of heteroskedasticity.

In this study, the Hausman test yields a chi-squared statistic of 203.27 with a p-value of 0.0000. This highly significant p-value leads to a strong rejection of the null hypothesis. Therefore, the test indicates that the difference in coefficients between the FE and RE models is systematic, suggesting that the RE estimator is inconsistent. This result favors the use of the fixed-effects estimator over the random-effects estimator for this panel dataset.

The Modified Wald test examines the presence of groupwise heteroskedasticity in a fixed-effects regression model. The null hypothesis (H0) of this test posits that the error variance is constant across all groups (i.e., banks in this context), meaning homoskedasticity exists within each bank over time. The alternative hypothesis (Ha) suggests that the error variance differs across groups, indicating groupwise heteroskedasticity.

The test statistic, a chi-squared value of 10107.58 with 55 degrees of freedom (corresponding to the number of banks), is highly significant (p-value = 0.0000). This overwhelmingly rejects the null hypothesis of homoskedasticity. The results provide strong evidence that the variance of the error term is not constant across the 65 banks in the sample. In other words, the variability of the residuals differs significantly from one bank to another.

To overcome heterogeneity of group variance, this study uses FEM - Robust standard errors regression. The coefficients in the model are estimated using panel data regression model using FEM - Robust standard errors, the findings are shown in the Table as follows:

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Table 3.
Results of the FEM - Robust standard errors regression.

Variable	Coefficient	Standard Error	t-statistic	P-value	95% Confidence Interval
BDR_lag1	0.1659	0.0807	2.0600	0.0450**	[0.0041, 0.3278]
IND	0.0275	0.0118	2.3300	0.0240**	[0.0038, 0.0512]
NIR	-0.0036	0.0070	-0.5100	0.6110	[-0.0178, 0.0106]
LOA	-0.0072	0.0101	-0.7200	0.4740	[-0.0274, 0.0129]
DPS	0.0019	0.0105	0.1800	0.8600	[-0.0193, 0.0230]
CTI	0.0104	0.0121	0.8600	0.3930	[-0.0138, 0.0347]
CAR	-0.0013	0.0004	-3.7000	0.0010***	[-0.0020, -0.0006]
COV19	0.0033	0.0012	2.7300	0.0090***	[0.0009, 0.0057]
Constant	0.0284	0.0149	1.9100	0.0610	[-0.0014, 0.0582]

Note: ***:p_value < 0.01; **:p_value <0.05; *:p_value<0.1.

The FEM-robust regression results provide interesting insights into the determinants of NPL ratio (BDR) of listed joint stock commercial banks in Southeast Asia, particularly with regard to the impact of lagged BDR, income diversification (IND), COVID-19 pandemic (COV19) and capital adequacy (CAR).

The positive impact of BDR_lag1 is reflected in the positive and statistically significant regression coefficient of BDR_lag1 (0.1659) confirming the persistence of NPLs. This suggests that banks with higher NPL ratios in the previous year are likely to experience higher NPL ratios in the current year. This phenomenon may be due to several factors common in the Southeast Asian banking context. Many Southeast Asian countries have less effective legal frameworks and debt collection processes, which prolong the resolution of NPLs and contribute to their persistence. Lending decisions in some Southeast Asian markets are often influenced by pre-existing relationships rather than strictly based on credit ratings, potentially leading to higher levels of persistent NPLs. At the same time, certain industries in Southeast Asia may be more vulnerable to economic downturns, contributing to cyclical patterns in NPLs. If a bank has high exposure to such sectors, past NPLs may be a strong predictor of future NPLs. This is true both pre-COVID and post-COVID.

The positive impact of IND on BDR (Regression coefficient 0.0276) suggests that higher income diversification is associated with higher NPLs. This counterintuitive finding can be explained by several specific reasons. First, in the pre-COVID period (2016-2019), banks seeking to diversify their income streams may have ventured into newer, potentially riskier lending segments or non-traditional banking activities, leading to an increase in NPLs. The incentive to diversify may have outweighed prudent risk management in some cases. In addition, in a competitive banking environment, the pressure to maintain profitability may have pushed banks towards riskier diversification strategies, especially in the pre-COVID period when economic growth in Southeast Asia was relatively robust. COVID-19 has also exacerbated the NPL problem of commercial banks. The positive and statistically significant coefficient of COVID-19 (0.0033) suggests that the pandemic has significantly increased the NPL ratio. This is to be expected, as COVID-19 has severely disrupted economic activity, impacting the ability of businesses and individuals to repay their debts. Lockdowns, travel restrictions, and supply chain disruptions have led to business closures and job losses, leading to increased defaults across various sectors. While government-imposed moratoriums have provided temporary relief, they may have delayed the recognition of NPLs, potentially contributing to the increase in NPLs that emerged later in the period. The full impact of the pandemic may yet be fully reflected in the data.

While BDR_lag1, IND, and COV19 exacerbated NPLs in commercial banks, CAR had a moderating effect on NPLs. The regression coefficient of CAR is negative and statistically significant (-0.0013), suggesting that banks with higher capital adequacy ratios tend to have lower NPLs. This is consistent with the expectation that well-capitalized banks are better equipped to absorb NPL losses and are more likely to adopt robust risk management measures. This finding may be due to the fact that banks with higher CARs are generally more cautious in their lending practices, adhere to stricter creditworthiness criteria, and are able to mitigate NPL risk. Furthermore, higher CARs provide a buffer against economic shocks and financial instability, allowing banks to better withstand periods of stress such as

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the COVID-19 pandemic and maintain lower NPL ratios, which would be a stabilizing factor in both the pre- and post-COVID periods.

The findings highlight the complex interplay of factors influencing NPLs in Southeast Asian banks. The persistence of NPLs, the potential downsides of rapid income diversification, the significant impact of the COVID-19 pandemic, and the protective role of capital adequacy are all important considerations for policymakers and bank regulators in the region. Further research could investigate the specific types of income diversification strategies used by banks and their differential impact on NPLs to gain a deeper understanding of this relationship. Additionally, an analysis of the impact of specific government policies and regulatory responses to the pandemic on NPLs would provide valuable insights.

5. Discussion

This study examined the determinants of NPL ratios in listed joint-stock commercial banks in Southeast Asia, focusing on the role of income diversification and other key financial indicators. The findings offer valuable insights into the specific context of Southeast Asian banking, providing both corroborating and contrasting evidence to existing literature.

Our results reveal a positive and statistically significant relationship between income diversification (IND) and NPL ratios, contradicting some studies suggesting a negative or insignificant relationship [5, 8]. This finding aligns more closely with research highlighting the potential risks associated with aggressive diversification into non-traditional activities [11]. In the context of Southeast Asia, this positive relationship may be attributed to several factors. Firstly, rapid economic growth in the pre-COVID era might have incentivized banks to pursue aggressive diversification strategies into potentially riskier segments, overlooking prudent risk management practices. Secondly, weaker institutional frameworks and regulatory oversight in some Southeast Asian countries could exacerbate the risks associated with diversification into less familiar business lines, echoing the concerns raised by [12] regarding operational risk and informational asymmetry. The pressure to maintain profitability in a competitive environment, coupled with less stringent regulatory environments compared to developed economies, could further explain this trend.

While income diversification, measured by the Herfindahl-Hirschman Index (HHI), showed a positive impact on NPLs, the non-interest income ratio (NIR) did not exhibit a statistically significant relationship with NPLs. This nuanced finding suggests that the specific composition of non-interest income, rather than its overall magnitude, might be crucial in determining its impact on credit risk. Future research should delve deeper into disaggregating non-interest income sources to examine their individual contributions to NPLs. This result contrasts with some prior studies (e.g., Stiroh [4]) that emphasize the potential volatility of non-interest income and its impact on bank stability. This difference may reflect the relatively lower reliance on complex and potentially volatile trading activities in Southeast Asian banks compared to their counterparts in more developed financial markets.

The study confirms the critical role of traditional banking indicators in influencing NPLs. The positive and significant impact of lagged NPLs (BDR_lag1) underscores the persistence of credit risk in the region, likely influenced by factors such as less effective debt recovery mechanisms and relationship-based lending practices prevalent in some Southeast Asian markets. This aligns with the arguments presented by Mesagan and Akanni [13] regarding the importance of past performance in predicting future NPLs. The negative and significant relationship between Capital Adequacy Ratio (CAR) and NPLs reinforces the importance of strong capitalization in mitigating credit risk. Well-capitalized banks are better equipped to absorb losses and likely adhere to more stringent lending standards, corroborating findings by Abbas, et al. [21] and Bougatef [22]. Contrary to expectations, Loan to Assets ratio (LOA) did not show a significant relationship with NPLs, and neither did the Deposit to Assets ratio (DTA). This deviates from studies suggesting a positive relationship between loan growth and NPLs (e.g., [15, 16]). This unexpected finding warrants further investigation to understand the specific dynamics of lending and deposit mobilization in the Southeast Asian context. It is possible that

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regulatory interventions or specific lending practices in the region mitigate the expected positive relationship between loan growth and NPLs.

At the same time,the study confirms the detrimental impact of the COVID-19 pandemic on asset quality. The positive and significant coefficient of the COVID-19 dummy variable highlights the widespread economic disruption caused by the pandemic, leading to increased loan defaults. This aligns with the global trend of rising NPLs observed during the pandemic.

This study provides valuable insights into the determinants of NPLs in Southeast Asian banks. The findings suggest that while income diversification might lead to higher NPLs in this specific context, strong capitalization remains a crucial buffer against credit risk. The COVID-19 pandemic has significantly exacerbated NPLs, underscoring the need for robust risk management practices and regulatory oversight. Future research should focus on disaggregating non-interest income sources and exploring the specific channels through which income diversification affects NPLs in different institutional and regulatory environments. A deeper understanding of these dynamics is crucial for ensuring the stability and resilience of the banking sector in Southeast Asia.

6. Conclusion

This study's findings provide crucial insights for balancing income diversification and NPL mitigation in Southeast Asian banking. For commercial bank managers, the unexpected positive link between income diversification and NPLs necessitates a strategic shift. Aggressive, rapid expansion into non-traditional activities should be replaced by a measured, sustainable approach. Prioritizing core competencies, enhancing credit risk assessment, and robust risk management are crucial. Investing in training and expertise for new ventures can mitigate informational asymmetries. Furthermore, leveraging technology to improve loan monitoring and early warning systems can help identify potential NPLs proactively. For policymakers, fostering a regulatory environment that encourages prudent diversification is key. This includes stricter due diligence requirements for new activities, enhanced capital adequacy regulations to buffer against potential losses, and promoting transparency through information sharing initiatives. Supervisory oversight should focus on ensuring banks possess the necessary expertise and risk management capabilities before expanding into unfamiliar areas.

However, this study has limitations. It primarily focuses on overall diversification and doesn't delve into the specific types of non-interest income activities and their differential impact on NPLs. Future research should disaggregate non-interest income sources to provide more granular insights. Furthermore, the study doesn't explicitly address the evolving landscape of digital banking and financial innovation. Future studies should investigate the impact of digital transformation on both income diversification and NPLs. This includes examining the role of fintech partnerships, the adoption of big data analytics in credit scoring, and the emergence of new digital financial products. Exploring how digital innovation can enhance efficiency, improve risk management, and ultimately contribute to a more stable and diversified banking sector in Southeast Asia is a critical avenue for future research. Analyzing the interplay between digital transformation, regulatory responses, and bank performance will be essential for navigating the future of banking in the region. Finally, incorporating country-specific analyses could reveal nuanced relationships shaped by varying regulatory landscapes and economic conditions within Southeast Asia.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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