



# MSME Lending, Risk, Capital, and Macroeconomic Drivers Across Bank Types in the COVID-19 Cycle

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**Abstract.** This study examines how MSME lending, MSME Loan at Risk (MSME-LAR), capital adequacy, and macroeconomic conditions influence bank profitability across ownership types in Indonesia, and how the COVID-19 crisis moderates these relationships. Using balanced quarterly panel data from 2013Q1–2025Q1 covering state-owned banks (BUMN), private national banks (BUSN), and regional development banks (BPD), the analysis employs a Fixed Effects Model (FEM) with cluster-robust standard errors and diagnostic tests for heterogeneity, multicollinearity, autocorrelation, and heteroskedasticity. The results show that MSME lending reduces profitability, and this adverse effect intensifies during the COVID-19 crisis. MSME-LAR consistently erodes returns, confirming its role as a forward-looking credit risk measure. Capital adequacy exhibits heterogeneous effects—insignificant overall but negative for BPDs, indicating overcapitalization constraints. Among macroeconomic variables, GDP growth is negatively associated with profitability, inflation modestly improves margins, and commodity prices strongly enhance returns, particularly for BUMN and BUSN. COVID-19 amplifies the risks of MSME lending and strengthens the profitability benefits of commodity price increases. This study contributes to the literature by introducing MSME-LAR as a risk metric, demonstrating ownership-specific vulnerabilities, and conceptualizing COVID-19 as a moderating shock. Policy implications emphasize the need for countercyclical buffers, risk-sharing schemes, and differentiated regulatory approaches to balance inclusive MSME intermediation with sustainable bank profitability.

**Keywords:** Bank Profitability, MSME-LAR, MSME Lending, Capital Adequacy, COVID-19.

## 1 Introduction

The banking sector is a cornerstone of the financial system and plays a crucial role in maintaining stability and supporting economic growth. By mobilizing savings and channeling them into productive investments, banks stimulate economic activity, foster innovation, and enable sustainable development [1, 2]. A resilient banking system ensures efficient resource allocation, risk diversification, and continuity of credit intermediation [3, 4]. Its role becomes even more critical during periods of turbulence, when banks are expected to absorb shocks and maintain confidence in the financial system.

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M. Nohong et al. (eds.), *Proceedings of the 10th International Conference on Accounting, Management, and Economics (10th ICAME 2025)*, Advances in Economics, Business and Management Research 388, [https://doi.org/10.2991/978-94-6239-709-5\\_88](https://doi.org/10.2991/978-94-6239-709-5_88)

Among the fundamental functions of banks, credit risk management remains the most challenging. Information asymmetry between lenders and borrowers often generates adverse selection and moral hazard, problems that intensify during economic downturns [4]. Traditionally, Non-Performing Loans (NPLs) have served as the primary indicator of credit risk. However, Indonesia's regulators increasingly emphasize Loan-at-Risk (LAR) as a broader and more forward-looking measure encompassing special-mention, substandard, doubtful, loss, and restructured exposures [5].

This study refines the risk assessment approach by focusing on MSME-specific Loan-at-Risk (MSME-LAR), defined as the share of at-risk MSME loans relative to total MSME credit. This indicator is particularly relevant in Indonesia, where micro, small, and medium enterprises (MSMEs) function as the backbone of the economy but remain structurally vulnerable due to collateral constraints, limited transparency, and weak financial buffers. MSMEs contribute more than 61% of national GDP and employ roughly 97% of the workforce [6, 7]. Therefore, banks' capacity to provide sustainable MSME credit is both an indicator of financial intermediation and a driver of inclusive growth.

Existing empirical studies provide mixed evidence on the profitability effects of MSME lending. Several works highlight its positive role in enhancing margins, diversifying portfolios, and reaching underserved markets [8, 9]. However, other studies report that MSME lending may reduce profitability due to elevated credit risk, intensive monitoring requirements, and higher provisioning expenses, especially in developing economies and during crisis periods [10, 11]. Elevated risks captured by MSME-LAR typically erode returns by increasing loan-loss provisions and reducing net interest income, although the magnitude of this effect may depend on regulatory forbearance and restructuring programs [12, 13].

The relationship between the Capital Adequacy Ratio (CAR) and profitability is also debated. Capital buffers enhance resilience and allow banks to withstand unexpected losses [14, 15], but excessive capitalization may constrain leverage and suppress profitability, particularly for smaller banks [16, 17]. Macroeconomic conditions further influence bank performance. GDP growth can stimulate bank revenues [18], yet some research shows that rapid growth may compress margins or delay the recognition of credit losses, resulting in ambiguous or even negative effects [19, 20]. Inflation can strengthen profitability when moderate, but persistent inflation undermines repayment capacity [21]. Interest rates carry mixed effects by influencing spreads and credit demand, while commodity cycles strongly affect bank performance in resource-based economies [22].

The COVID-19 pandemic provided an unprecedented natural experiment for testing these relationships. MSMEs were among the hardest hit, causing significant increases in MSME-LAR [23, 24]. Although theory suggests that profitability should deteriorate under such shocks, Indonesian banks were supported by Bank Indonesia's monetary stimulus and OJK's countercyclical loan restructuring policy [25]. Consequently, COVID-19 may have moderated these relationships in several ways: intensifying the risks of MSME lending, attenuating the impact of MSME-LAR and CAR through policy support mechanisms, and strengthening profitability among banks exposed to commodity-driven sectors [23, 24, 25].

Despite extensive research, several gaps remain. First, most studies focus on total credit risk, while few isolate MSME-LAR as a forward-looking measure. Second, although MSME lending and CAR have been widely examined, their interactions with profitability during crisis conditions remain underexplored. Third, prior studies frequently treat COVID-19 as a dummy period rather than a moderating factor that alters the strength of key internal relationships. Finally, comparative evidence across bank ownership types—state-owned banks (BUMN), private national banks (BUSN), and regional development banks (BPD)—is limited.

This study addresses these gaps by analyzing panel data from Indonesian banks covering 2013Q1 to 2025Q1, which spans the pre-crisis, crisis, and recovery phases. Guided by this context, the research examines how MSME lending, MSME-LAR, CAR, and macroeconomic conditions influence bank profitability (ROA), how COVID-19 moderates these relationships, and whether these effects differ across BUMN, BUSN, and BPD. The study's contributions are threefold: it introduces MSME-LAR as a forward-looking risk indicator, conceptualizes COVID-19 as a moderating shock in bank profitability models, and provides ownership-specific evidence to inform regulatory and managerial strategies in promoting resilient and inclusive banking.

## 2 Literature Review

### 2.1 MSME Lending and Bank Profitability

Lending to micro, small, and medium enterprises (MSMEs, locally known as UMKM – Usaha Mikro, Kecil, dan Menengah) is widely recognized as a policy instrument for promoting inclusive growth and as a potential driver of bank performance. Several studies find that MSME credit enhances profitability through higher interest margins, portfolio diversification, and expansion into underserved markets [8, 9]. However, other works show that MSME lending may reduce profitability due to elevated credit risk, costly monitoring, and greater provisioning burdens, particularly in developing economies and during crisis periods [10, 11].

The profitability benefits of MSME lending are often offset by the higher risks embedded in MSME borrowers. MSMEs typically exhibit information opacity, limited collateral, and managerial constraints, all of which increase repayment uncertainty [12, 13, 14, 15]. Prior studies highlight several firm-level determinants of credit risk—such as business size, age, ownership structure, geographic location, and sector—which influence access to credit and repayment performance.

In Indonesia, initiatives such as the Kredit Usaha Rakyat (KUR) program have partially mitigated these risks. By offering credit guarantees and subsidized interest rates, KUR enables banks to expand their MSME portfolios while maintaining acceptable risk levels [17, 18]. This implies that MSME lending can enhance profitability, but primarily when supported by adequate risk-management systems and government intervention.

**H1:** MSME lending has an ambivalent effect on bank profitability (ROA), depending on risk management quality and policy support.

## 2.2 MSME Loan-at-Risk (MSME-LAR) and Profitability

Credit risk is universally recognized as a fundamental determinant of bank profitability [4]. While Non-Performing Loans (NPLs) have long been the standard proxy, Indonesian regulators emphasize Loan-at-Risk (LAR) as a broader and more forward-looking indicator covering loans classified as special mention, substandard, doubtful, loss, and restructured [5]. This study advances the concept by employing MSME-specific Loan-at-Risk (MSME-LAR), defined as the ratio of at-risk MSME loans to total MSME loans.

MSME-LAR captures the structural vulnerabilities of MSMEs—such as limited transparency, weak collateral, and susceptibility to economic shocks [16, 17]. Higher MSME-LAR typically reduces profitability by increasing provisioning expenses and suppressing effective interest income. However, during the COVID-19 crisis, regulatory forbearance and large-scale restructuring policies muted these adverse effects by easing provisioning pressure and stabilizing loan quality [27, 29]. Thus, the effect of MSME-LAR on profitability is conditional on the regulatory environment and may differ across bank ownership types.

**H2:** MSME-LAR negatively affects ROA, but the adverse effect may be moderated by regulatory intervention during crises.

## 2.3 Capital Adequacy Ratio (CAR) and Profitability

The Capital Adequacy Ratio (CAR) reflects banks' resilience to unexpected losses and their capacity to sustain intermediation. Under prudential regulation, capital adequacy forms the foundation of financial stability. Adequate capital buffers strengthen resilience and allow banks to absorb shocks [18, 19]. However, excessive capitalization may constrain leverage and reduce profitability, particularly for smaller banks whose capital positions exceed optimal intermediation needs [20, 21].

In Indonesia, the Financial Services Authority (OJK) requires commercial banks to maintain minimum CAR levels between 8–12% [26]. This suggests that CAR's impact on profitability is heterogeneous—generally stabilizing for larger banks (BUMN, BUSN), but potentially restrictive for regional development banks (BPDs) with excess capital.

**H3:** CAR generally supports bank profitability (ROA), but may have a negative effect in smaller banks due to overcapitalization.

## 2.4 Macroeconomic Factors and Profitability

Macroeconomic conditions significantly influence bank intermediation performance. GDP growth is typically expected to strengthen profitability by stimulating credit demand [22]. However, certain studies report that rapid growth may compress margins or delay recognition of credit losses, leading to mixed or even negative effects [23, 24]. Inflation exerts a non-linear influence: moderate inflation can widen margins, whereas

persistent inflation weakens borrowers' repayment capacity [25]. Interest rates influence profitability through changes in spreads and credit demand, producing ambivalent effects [22].

Commodity cycles are particularly important in resource-dependent economies such as Indonesia. Strong commodity prices improve borrower cash flows and repayment performance, while downturns increase default risk and weaken bank profitability [26].

Hypotheses:

**H4a:** GDP growth has a positive but potentially ambivalent effect on ROA.

**H4b:** Inflation has a non-linear effect on ROA.

**H4c:** Commodity prices positively affect ROA.

**H4d:** Interest rates have an ambivalent effect on ROA.

## 2.5 COVID-19 as a Moderating Shock

The COVID-19 pandemic generated severe disruptions to global banking systems and intensified credit risks. MSMEs were among the most affected segments, causing an increase in MSME-LAR and necessitating higher provisioning [23, 24]. Cross-country evidence shows that the pandemic amplified credit risk, although its impact on profitability varied according to regulatory responses and policy support [27, 28, 29].

In Indonesia, countercyclical measures—particularly POJK No.11/2020 on loan restructuring—together with MSME subsidy schemes, helped mute the deterioration in MSME-LAR and supported ongoing credit intermediation [29]. This study therefore conceptualizes COVID-19 not only as a crisis period but also as a moderating factor that alters the relationships between MSME lending, MSME-LAR, CAR, and profitability.

Hypotheses (H5a–H5c):

**H5a:** COVID-19 moderates the relationship between MSME lending and ROA.

**H5b:** COVID-19 moderates the relationship between MSME-LAR and ROA.

**H5c:** COVID-19 moderates the relationship between CAR and ROA.

## 2.6 Research Gap

Despite extensive research on bank profitability, several gaps remain.

1. **Credit-risk measurement:** Most studies rely on aggregate NPL ratios; very few isolate MSME-LAR as a distinct and forward-looking credit-risk indicator, despite its relevance to MSME-intensive banking systems.
2. **Treatment of COVID-19:** Prior literature often models COVID-19 as a simple time dummy, whereas limited studies explicitly test its moderating effect on the relationships between internal bank factors and profitability.
3. **Bank heterogeneity:** Comparative evidence across ownership types—state-owned (BUMN), private national (BUSN), and regional development banks (BPD)—remains scarce, even though institutional and structural differences may condition risk exposure and performance.

4. This study addresses these gaps using a long-horizon panel of Indonesian banks (2013Q1–2025Q1), covering the pre-crisis, crisis, and recovery periods, while explicitly examining MSME-LAR and COVID-19's moderating effects across heterogeneous bank groups.

## 2.7 Conceptual Framework

Bank profitability (ROA) is modeled as a function of MSME lending, MSME-LAR, and CAR, complemented by macroeconomic factors including GDP growth, inflation, interest rates, and commodity prices. COVID-19 is introduced as a moderating shock that alters the strength of the internal determinants of ROA.

## 3 Research Methodology

### 3.1 Research Design and Data Sources

This study employed quarterly panel data covering the period from 2013Q1 to 2025Q1, with the unit of analysis being groups of banks in Indonesia, namely State-Owned Banks (BUMN), National Private Commercial Banks (BUSN), and Regional Development Banks (BPD). The dataset was compiled from the Indonesian Banking Statistics published by the Financial Services Authority (OJK), the Central Bureau of Statistics (BPS), Bank Indonesia (BI), and the World Bank's commodity price indices, complemented by the author's coding of a COVID-19 crisis dummy. In total, 147 balanced quarterly observations were obtained for each bank group. The panel structure was selected because it allows the study to capture both temporal dynamics and cross-sectional heterogeneity, which is critical in distinguishing structural differences across bank ownership types.

### 3.2 Variables and Measurement

The dependent variable was bank profitability, proxied by Return on Assets (ROA), defined as pre-tax profit divided by average total assets, consistent with OJK Banking Statistics.

Three internal bank-specific variables were included as the main independent variables.

First, MSME lending growth, measured as the quarterly percentage growth of MSME loans, reflects banks' intermediation role in supporting productive sectors. Based on the literature, MSME lending is expected to have a positive effect on profitability by expanding margins, although higher credit risk may weaken this effect.

Second, Loan-at-Risk for MSMEs (MSME-LAR), calculated as the ratio of MSME loans classified as special mention, substandard, doubtful, loss, and restructured current loans to total MSME loans (SEOJK No.14/2017), represents MSME credit risk exposure. Higher MSME-LAR is expected to have a negative effect on profitability due to increased provisioning costs.

Third, the Capital Adequacy Ratio (CAR), defined as capital over risk-weighted assets, measures banks' capacity to absorb shocks. CAR is generally expected to have a positive effect on profitability, although excessive capital buffers may reduce efficiency.

Macroeconomic controls included real GDP growth, inflation (CPI, % y-o-y), the BI policy rate (7-Day Reverse Repo Rate), and global commodity prices. GDP growth is expected to influence profitability positively through higher credit demand. Inflation may have a non-linear effect: moderate inflation can raise margins, while excessive inflation undermines repayment capacity. Interest rates affect profitability via net interest margins and loan growth. Commodity prices are expected to have a positive effect by improving borrowers' repayment capacity, especially in resource-dependent economies.

To capture the impact of the COVID-19 crisis, a dummy variable was introduced, coded 1 for 2020Q1–2021Q4 and 0 otherwise. Unlike earlier studies treating COVID19 solely as a time shock, this study explicitly models it as a moderating factor by interacting the dummy only with internal determinants—MSME lending growth, MSME-LAR, and CAR.

**Table 1.** Variable Measurement

Variable	Definition / Proxy	Expected Effect	Source
<b>Dependent Variable</b>			
ROA	Return on Assets = pre-tax profit ÷ average total assets	–	OJK Banking Statistics
<b>Independent Variables (Bank-Specific)</b>			
MSME Lending Growth	Quarterly % growth of MSME loans	+	OJK Banking Statistics
MSME-LAR	Ratio of MSME loans classified as special mention, substandard, doubtful, loss, or restructured ÷ total MSME loans (SEOJK No.14/2017)	–	OJK Banking Statistics
CAR	Capital ÷ risk-weighted assets (%)	+	OJK Banking Statistics
<b>Macroeconomic Controls</b>			
GDP Growth	Real GDP growth (% yoy)	+	BPS
Inflation	Consumer Price Index (% yoy)	Non-linear	BPS
BI Policy Rate	BI 7-Day Reverse Repo Rate (%)	Ambivalent	Bank Indonesia
Commodity Prices	Global commodity price index	+	World Bank
<b>Moderating Variable</b>			

Variable	Definition / Proxy	Expected Effect	Source
COVID-19 Dummy	1 = 2020Q1–2021Q4; 0 otherwise	Alters MSME, LAR, CAR effects	Author’s coding

### 3.3 Model Specification

The baseline panel regression model is formulated as:

$$ROA_{it} = \alpha_i + \beta_1 MSME_{it} + \beta_2 LAR_{it} + \beta_3 CAR_{it} + \gamma Macro_t + \varepsilon_{it} \tag{1}$$

The moderation model introducing COVID-19 interactions is expressed as:

$$ROA_{it} = \alpha_i + \beta_1 MSME_{it} + \beta_2 LAR_{it} + \beta_3 CAR_{it} + \beta_4 (MSME \times COVID)_{it} + \beta_5 (LAR \times COVID)_{it} + \beta_6 (CAR \times COVID)_{it} + \gamma Macro_t + \varepsilon_{it} \tag{2}$$

where *i* denotes the bank group (BUMN, BUSN, BPD) and *t* denotes quarterly time.

### 3.4 Estimation Strategy

The empirical estimation followed a structured sequence. Descriptive analysis was first used to summarize the characteristics of all variables. Subsequently, panel regressions were estimated using pooled OLS, fixed effects (FE), and random effects (RE). Model selection was guided by the Chow test comparing pooled OLS and FE, the Hausman test comparing FE and RE, and the Breusch–Pagan Lagrange Multiplier test comparing pooled OLS and RE. Across these diagnostic procedures, the Fixed Effects Model (FEM) was consistently preferred. This choice is theoretically justified because unobserved heterogeneity, especially differences in ownership structure and regulatory treatment, is likely correlated with the explanatory variables.

Robustness checks were conducted to ensure the reliability of the estimates. These included the use of cluster-robust standard errors at the bank-group level, multicollinearity tests using Variance Inflation Factors (VIF), the Wooldridge test for autocorrelation, the Breusch–Pagan and Modified Wald tests for heteroskedasticity, and the skewness–kurtosis test for residual normality. Additional checks were conducted using Prais–Winsten AR (1) adjustments and separate estimations for each bank group to capture structural heterogeneity.

All estimations were performed using Stata 18, employing the `xtreg, fe` command for fixed effects and appropriate interaction terms to capture COVID-19’s moderating influence.

## 4 Results and Discussion

### 4.1 Descriptive Statistics

This study employed descriptive statistics to summarize the main characteristics of the research variables, namely profitability, macroeconomic indicators, and bank-specific factors. The variables included Return on Assets (ROA), Gross Domestic Product (GDP) growth, inflation, the Bank Indonesia Policy Rate (BI Rate), commodity prices, MSME lending growth, Loan at Risk for MSMEs (LAR-UMKM), and the Capital Adequacy Ratio (CAR). Table 2 reports the descriptive statistics for all variables over 147 quarterly observations.

**Table 2.** Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	147	2.3313	0.4299	1.5724	3.5294
GDP	147	4.4143	2.3055	-5.3244	7.0778
Inflation	147	3.8578	2.0078	1.03	8.40
BI rate	147	5.5459	1.3290	3.50	7.75
Commodity prices	147	94.2530	25.4497	54.31	158.78
MSME lending growth	147	8.3893	7.3670	-10.4946	27.7733
LAR-UMKM	147	17.5562	8.0086	6.3685	46.6313
CAR	147	21.2876	3.3270	15.62	30.50

The total number of observations for each variable was 147, confirming that the dataset was complete and consistent across periods. On average, bank profitability measured by ROA stood at 2.33 percent, with a relatively low variation (standard deviation of 0.43) and a range between 1.57 and 3.53 percent. GDP growth averaged 4.41 percent but exhibited substantial dispersion (standard deviation of 2.31), ranging from -5.32 percent, which reflects contraction during the COVID-19 crisis, to a peak of 7.08 percent in recovery periods.

Inflation averaged 3.86 percent, showing moderate variability (standard deviation of 2.01) with a range from 1.03 to 8.40 percent, consistent with Bank Indonesia's inflation target but also reflecting temporary shocks. The BI Rate averaged 5.55 percent, fluctuating between 3.50 and 7.75 percent, capturing both accommodative and tightening monetary policy stances. Commodity prices, a crucial external factor for Indonesia's economy, averaged 94.25 but displayed high volatility (standard deviation of 25.45), ranging from 54.31 to 158.78.

MSME lending growth averaged 8.39 percent, but with considerable variability (standard deviation of 7.37). The minimum of -10.49 percent indicates contractionary episodes in MSME credit disbursement, while the maximum of 27.77 percent reflects periods of strong expansion. Credit risk, proxied by LAR-UMKM, averaged 17.56 percent with substantial fluctuation (standard deviation of 8.01), ranging from 6.37 to 46.63 percent, indicating diverse risk exposures across banks. Meanwhile, the average

CAR was 21.29 percent, with a standard deviation of 3.33 and values ranging between 15.62 and 30.50 percent. This shows that banks consistently maintained capital buffers well above the regulatory minimum requirement, underscoring their overall resilience.

#### 4.2 Panel Model Selection Tests

To identify the most appropriate panel data model, three specification tests were conducted: the Chow Likelihood Ratio Test, the Hausman Test, and the Breusch–Pagan Lagrange Multiplier (LM) Test. These tests guided the choice between the Common/Pooled Effects Model (CEM), the Fixed Effects Model (FEM), and the Random Effects Model (REM).

**Chow Likelihood Ratio Test (CEM vs FEM).** The Chow test evaluates whether the Pooled/Common Effects Model is preferred over the Fixed Effects Model:

- **H<sub>0</sub>:** The Common Effects Model is more appropriate than the Fixed Effects Model.
- **H<sub>1</sub>:** The Fixed Effects Model is more appropriate than the Common Effects Model.

The Chow test produced an F-statistic of 41.73 with a probability value of 0.0000. Since the probability value was below the 5% significance level, H<sub>0</sub> was rejected and H<sub>1</sub> was accepted, confirming that the Fixed Effects Model (FEM) provides a better fit than the Common Effects Model (CEM).

**Hausman Test (REM vs FEM).** The Hausman specification test evaluates whether the Random Effects Model (REM) or the Fixed Effects Model (FEM) is more appropriate:

- **H<sub>0</sub>:** The Random Effects Model is more appropriate than the Fixed Effects Model.
- **H<sub>1</sub>:** The Fixed Effects Model is more appropriate than the Random Effects Model.

The Hausman test produced a chi-square statistic of 206.22 with a probability value of 0.0000. Since the probability was below the 5% significance level, H<sub>0</sub> was rejected and H<sub>1</sub> was accepted, confirming that the Fixed Effects Model (FEM) is more appropriate than the Random Effects Model (REM).

**Lagrange Multiplier Test (CEM vs REM).** The Breusch–Pagan Lagrange Multiplier (LM) test evaluates whether the Random Effects Model (REM) provides a better fit than the Common Effects Model (CEM):

- **H<sub>0</sub>:**  $\sigma^2_u = 0 \rightarrow$  The intercept is not random (CEM is more appropriate).
- **H<sub>1</sub>:**  $\sigma^2_u \neq 0 \rightarrow$  The intercept is random (REM is more appropriate).

The LM test produced a chibar<sup>2</sup>(1) statistic of 0.00 with a probability value of 1.0000, which is far above the 5% significance level. Therefore, the null hypothesis could not

be rejected, and the Common Effects Model (CEM) was deemed more appropriate than the Random Effects Model (REM).

**Table 3.** Summary of Panel Model Specification Tests

Test	Null Hypothesis (H <sub>0</sub> )	Statistic	Prob. Value	Decision ( $\alpha = 0.05$ )	Conclusion
Chow Test (CEM vs FEM)	CEM is more appropriate than FEM	$F(2, 121) = 41.73$	0.0000	Reject H <sub>0</sub>	FEM preferred over CEM
Hausman Test (REM vs FEM)	REM is more appropriate than FEM	$\chi^2(8) = 206.22$	0.0000	Reject H <sub>0</sub>	FEM preferred over CEM
LM Test (CEM vs REM)	CEM is more appropriate than REM	$\text{chibar}^2(1) = 0.00$	1.0000	Fail to reject H <sub>0</sub>	CEM preferred over REM

**Overall Conclusion.** By integrating the results of the Chow, Hausman, and LM tests, the Fixed Effects Model (FEM) was selected as the most statistically appropriate specification for this study. To ensure robustness, classical assumption tests were conducted before interpreting FEM results.

### 4.3 Regression Assumption Tests

**Normality Test.** The distribution of residuals was assessed using the skewness and kurtosis test for normality. The probability value for skewness was 0.1403 ( $> 0.05$ ), indicating no significant skewness in the residuals. The probability value for kurtosis was 0.6600, suggesting only a minor deviation from normality. The joint test of normality yielded a chi-square statistic of 2.41 with a probability of 0.2993, which exceeded the 5% significance level. Therefore, the residuals could be considered approximately normally distributed.

**Multicollinearity Test.** Variance Inflation Factor (VIF) values were computed to detect potential multicollinearity among independent variables. All VIF values were below the conventional threshold of 10, with a mean VIF of 2.89. These results confirm the absence of multicollinearity issues in the model.

**Autocorrelation Test.** The Wooldridge test for autocorrelation in panel data was conducted. The test produced an F-statistic of 13.98 with a probability value of 0.0647, which is above the 5% significance threshold. This indicates that the null hypothesis of no first-order autocorrelation could not be rejected, suggesting that the panel data did not suffer from autocorrelation problems.

**Heteroskedasticity Test.** The Modified Wald test for groupwise heteroskedasticity in the fixed effects regression model produced a chi-square statistic of 18.87 with a probability value of 0.0503. Since the probability was slightly above the 5% significance level, the null hypothesis of homoscedasticity could not be rejected. Accordingly, the residuals were considered homoscedastic, and no strong evidence of heteroskedasticity was found.

**Table 4.** Summary of Regression Assumption Tests

Test	Null Hypothesis (H <sub>0</sub> )	Statistic	Prob. Value	Decision ( $\alpha = 0.05$ )	Conclusion
Normality (Skewness–Kurtosis)	Residuals are normally distributed	$\chi^2(2) = 2.41$	0.2993	Fail to reject H <sub>0</sub>	Residuals are normally distributed
Multicollinearity (VIF)	No multicollinearity among regressors	Mean VIF=2.89	–	All VIF < 10	No multicollinearity detected
Autocorrelation (Wooldridge)	No first-order autocorrelation in panel residuals	F(1, 2)=13.98	0.0647	Fail to reject H <sub>0</sub>	No autocorrelation present
Heteroskedasticity (Wald)	Homoscedastic residuals (equal variances across units)	$\chi^2(3)=18.87$	0.0503	Fail to reject H <sub>0</sub> (marginal)	No strong evidence of heteroskedasticity

The diagnostic tests collectively indicate that the fixed effects regression model satisfies the key classical assumptions. The residuals were approximately normally distributed, multicollinearity was absent, no evidence of autocorrelation was detected, and the residuals did not show significant heteroskedasticity. Therefore, the Fixed Effects Model (FEM) estimates can be considered statistically reliable and suitable for subsequent interpretation and discussion.

#### 4.4 Multiple Regression Panel Analysis

The Fixed Effects Model (FEM) was employed to estimate the impact of bank-specific and macroeconomic variables on profitability (ROA). Results are reported for the aggregate banking sector and separately for state-owned banks (BUMN), national private banks (BUSN), and regional development banks (BPD).

**Table 5.** Fixed Effects Regression Results on ROA (Baseline Model)

Variable	All Banks	BPD	BUMN	BUSN
GDP	-0.028 (0.048)**	-0.011 (0.675)	-0.058 (0.017)**	-0.053 (0.007)***
Inflation	0.059 (0.005)***	0.014 (0.718)	-0.005 (0.845)	0.006 (0.832)
BI policy rate	-0.033 (0.267)	-0.085 (0.113)	0.029 (0.472)	-0.028 (0.477)
Commodity prices	0.006 (0.000)***	0.003 (0.139)	0.009 (0.000)***	0.007 (0.000)***

Variable	All Banks	BPD	BUMN	BUSN
MSME lending growth	-0.013 (0.004)***	-0.006 (0.385)	-0.016 (0.014)**	-0.0001 (0.991)
MSME-LAR	-0.016 (0.006)***	-0.177 (0.303)	-0.037 (0.000)***	-0.029 (0.011)**
CAR	-0.005 (0.597)	-0.142 (0.000)***	-0.035 (0.134)	0.017 (0.094)*
Covid-19 dummy	-0.383 (0.000)***	-0.250 (0.221)	-0.193 (0.164)	-0.231 (0.154)
Constant	2.460 (0.000)***	6.018 (0.000)***	3.428 (0.000)***	1.871 (0.000)***
R <sup>2</sup>	0.566	0.715	0.824	0.644
Prob > F	0.000	0.000	0.000	0.000

**Interpretation.** At the aggregate level, GDP growth has a negative and significant association with ROA, contrary to H4a, suggesting that periods of higher growth were accompanied by margin compression or delayed credit cost recognition, especially observable in BUMN with regulated lending rates. Inflation positively affects profitability, consistent with H4b, though only in the aggregate model, reflecting the benefit of moderate inflation on banking margins. Commodity prices strongly support profitability (H4c), especially in BUMN and BUSN, underscoring the commodity dependence of these institutions. MSME lending growth exerts a negative effect, rejecting H1, while MSME-LAR reduces profitability in line with H2. CAR is insignificant overall but strongly negative for BPD, indicating that overcapitalization constrains profitability in smaller banks, while the effect is not significant in BUMN or BUSN, thus providing only partial support for H3. The Covid-19 dummy shows a large negative impact at the aggregate level, consistent with expectations that crisis periods eroded profitability.

**Linking Results to Hypotheses.** The estimation outcomes can be summarized in relation to the study's hypotheses. H1 is not supported, as MSME lending negatively affects ROA, with stronger adverse effects during the Covid-19 period. H2 is supported, confirming that higher MSME-LAR reduces profitability. H3 receives partial support: CAR is insignificant in the aggregate but negatively significant for BPD. H4a is not supported, since GDP has negative or insignificant effects, while H4b is partially supported with inflation showing a positive effect only in the aggregate model. H4c is strongly supported, highlighting the importance of commodity cycles, particularly for BUMN and BUSN. H4d is supported, as the Bank Indonesia policy rate (7-Day Reverse Repo Rate) shows mixed effects consistent with its theoretical ambiguity. Regarding moderation, only H5a is supported: Covid-19 strengthens the negative effect of MSME lending on profitability. H5b and H5c are not supported, while the significant positive effect of commodity  $\times$  Covid lies outside the pre-specified hypotheses.

**Table 6. FEM Results on ROA with Covid-19 Interaction Terms**

Variable	All Banks	BPD	BUMN	BUSN
GDP	0.108 (0.239)	0.407 (0.057)*	-0.019 (0.905)	-0.021 (0.834)
Inflation	0.066 (0.003)***	0.002 (0.962)	-0.008 (0.779)	0.017 (0.443)
BI policy rate	-0.056 (0.044)**	-0.084 (0.147)	0.029 (0.414)	-0.059 (0.055)*
Commodity prices	0.008 (0.000)***	0.003 (0.331)	0.012 (0.000)***	0.011 (0.000)***
MSME lending growth	-0.012 (0.006)***	-0.006 (0.502)	-0.010 (0.182)	-0.001 (0.837)
MSME-LAR	-0.011 (0.075)*	0.010 (0.691)	-0.017 (0.154)	-0.012 (0.362)
CAR	-0.000 (0.978)	-0.137 (0.000)***	-0.016 (0.551)	0.012 (0.225)
GDP × Covid-19	-0.103 (0.270)	-0.406 (0.051)*	0.013 (0.933)	0.032 (0.756)
Inflation × Covid-19	-0.048 (0.410)	-0.079 (0.499)	0.049 (0.596)	0.010 (0.885)
Commodity × Covid19	0.209 (0.035)**	0.374 (0.074)*	0.099 (0.504)	0.162 (0.138)
MSME lending × Covid-19	-0.006 (0.028)**	0.003 (0.650)	-0.012 (0.004)***	-0.012 (0.001)***
MSME-LAR × Covid19	0.000 (0.966)	0.006 (0.855)	0.017 (0.347)	-0.003 (0.871)
Constant	1.487 (0.005)***	3.331 (0.033)**	2.260 (0.018)**	1.389 (0.017)**
R <sup>2</sup>	0.643	0.745	0.875	0.824
Prob > F	0.000	0.000	0.000	0.000

**Interpretation.** The interaction model confirms Covid-19's moderating role. Commodity × Covid-19 has a positive effect in the aggregate model (and marginally for BPD), indicating that commodity-dependent banks were buffered during the crisis. However, this effect lies outside the pre-specified hypotheses. MSME lending × Covid19 is consistently negative and significant (BUMN, BUSN, aggregate), confirming H5a that crisis conditions worsened the profitability impact of MSME lending. Interactions with MSME-LAR and CAR are insignificant, offering no strong evidence for H5b– H5c. Overall, results indicate that Covid-19 magnified both strengths (commodity dependence) and vulnerabilities (MSME intermediation) in Indonesia's banking sector.

#### 4.5 Linking Results to Hypotheses.

Overall, the findings show:

- H1 not supported: MSME lending negatively affects ROA, with stronger adverse effects during Covid-19.

- H2 supported: higher MSME-LAR reduces profitability.
- H3 partially supported: CAR is insignificant overall but negative for BPD.
- H4a not supported: GDP shows negative or insignificant effects.
- H4b partially supported: inflation is positive in aggregate but insignificant across bank groups.
- H4c strongly supported: commodity cycles enhance profitability, especially in BUMN and BUSN.
- H4d supported: the BI policy rate has mixed effects.
- H5a is supported: Covid-19 worsens the impact of MSME lending on profitability. H5b and H5c are not supported. The significant positive effect of commodity  $\times$  Covid-19 lies outside the pre-specified hypotheses.

## 5 Discussion

**The Effect of GDP on ROA.** The FEM results show that GDP has a negative and significant effect on ROA in the aggregate model, contradicting H4a. At the group level, BPDs exhibit a marginally positive effect, while BUMN and BUSN show negative but insignificant results. This indicates that regional banks are more sensitive to local growth dynamics, whereas large national banks rely on structural and policy-driven factors. International evidence typically finds a positive GDP–profitability nexus [33–35]. The divergence here suggests that Indonesian banks, particularly BUMN and BUSN, may experience margin compression during growth phases due to regulated lending rates or delayed credit cost recognition. This highlights that GDP effects are heterogeneous and ownership-contingent, a contribution to cross-country comparative studies.

**The Effect of Inflation on ROA.** Inflation has a significant positive effect in the aggregate model, consistent with H4b, but is insignificant across BPD, BUMN, and BUSN. Moderate inflation likely widened interest margins, improving profitability sector-wide. This finding aligns with Tahir et al. [36], who argue that inflation can enhance bank performance in developing countries if maintained at moderate levels, but diverges from Nguyen and Dang [37], who note potential erosion through credit quality deterioration. The lack of significance at the disaggregated level may reflect stronger regulation for BUMN and BPD, and diversified portfolios in BUSN. Thus, inflationary impacts are macro-driven but not uniform across ownership types, implying that prudential policies mitigate distributional risks.

**The Effect of the BI Rate on ROA.** The BI policy rate is insignificant in the aggregate model but negative and marginally significant for BUSN, consistent with H4d. This reflects BUSN's reliance on market-based funding, which makes them more vulnerable to tightening cycles. In contrast, BUMN show a weakly positive but insignificant response, likely buffered by government-linked liquidity, while BPDs are less exposed due to reliance on local deposits. This finding supports Mutamimah and Bawono [38],

who highlight that private banks are most sensitive to policy rate changes, and is consistent with broader evidence that higher rates compress net interest margins in emerging markets [39]. The heterogeneous effects confirm the ambivalent nature of interest rate transmission, validating H4d.

**The Effect of Commodity Prices on ROA.** Commodity prices exert a strong positive effect on ROA in the aggregate, and particularly in BUMN and BUSN, supporting H4c. For BPDs, the effect is positive but insignificant. This highlights the commodity dependence of larger banks, especially those financing mining, energy, and plantation sectors. This is consistent with Borio et al. [40] and Chen et al. [41], who show that banks in resource-based economies benefit during commodity booms. However, the absence of effects for BPDs underscores their limited exposure to global commodity cycles. The results contribute to the literature by showing how ownership structures mediate commodity–finance linkages, making profitability more cyclical in BUMN and BUSN.

**The Effect of MSME Lending on ROA.** Contrary to H1, MSME lending growth negatively affects ROA in the aggregate model and in BUMN, while effects are insignificant for BPD and BUSN. This indicates that the benefits of inclusion are offset by higher provisioning and operational costs, particularly for banks under government mandates to expand MSME credit. While prior studies argue that MSME financing enhances diversification and profitability [23, 24], the results here align with Berger and Udell [26] and Ratnaningtyas et al. [34], emphasizing the risk–return trade-off. This finding highlights the paradox of MSME finance: although socially and politically prioritized, profitability effects are not always positive, especially during crises.

**The Effect of MSME-LAR on ROA.** MSME-LAR significantly reduces ROA in the aggregate, BUMN, and BUSN, but is insignificant in BPD. This confirms H2, highlighting that rising risky loans erode profitability through provisioning burdens. The result is consistent with Athanasoglou et al. [42] and Abbas and Ullah [43], who show that credit risk negatively impacts returns. The insignificance in BPDs may reflect the role of local government support or restructuring policies that temporarily muted risk impacts. Overall, MSME-LAR emerges as a robust predictor of profitability, strengthening its policy relevance as a forward-looking risk measure.

**The Effect of CAR on ROA.** CAR is insignificant at the aggregate level but negative and highly significant for BPDs, offering only partial support for H3. This suggests that high capitalization in smaller banks constrains leverage and reduces profitability, while larger banks balance capital adequacy with efficient intermediation. This finding supports Noman et al. [44], who argue that excessive capitalization can depress profitability, and aligns with Nguyen and Dang [37]. It contributes by demonstrating that the CAR–profitability trade-off depends on bank scale and ownership, with BPDs more constrained than BUMN or BUSN.

**The Moderating Role of Covid-19.** Covid-19 significantly moderated key determinants of ROA. The interaction of commodity prices with Covid-19 is positive, suggesting that banks with commodity exposure were buffered during the crisis, particularly BPDs. In contrast, MSME lending  $\times$  Covid-19 is negative and significant in the aggregate, BUMN, and BUSN, showing that expanded MSME intermediation heightened risk under crisis conditions. Interactions with MSME-LAR and CAR are insignificant. These results align with Demirgüç-Kunt et al. [27] and Goodell [45], who show that the pandemic amplified both risks and opportunities in banking. The findings confirm H5a (MSME lending moderation), but not H5b (MSME-LAR) nor H5c (CAR). Although the Covid–commodity interaction is significant and positive, this lies outside the prespecified hypotheses. Theoretically, this demonstrates how exogenous shocks reshape internal–profitability dynamics. Practically, it underscores the need for countercyclical regulation and risk-based capital buffers to ensure that inclusion mandates do not compromise stability during crises.

**Overall Implications.** This study contributes to the empirical banking literature by highlighting the heterogeneity of profitability drivers across bank ownership structures. Unlike prior research that often treats GDP, inflation, or credit risk as uniformly affecting banks, the results show that the effects are contingent upon bank type, with BPDs being more sensitive to local macroeconomic cycles and capital constraints, while BUMN and BUSN are more exposed to commodity cycles and MSME-related risks. Furthermore, by employing MSME-LAR as a forward-looking risk indicator, this study introduces a novel metric that is more relevant for emerging economies than conventional NPL ratios. The results underscore the importance of differentiated regulatory approaches. Microprudential supervision (OJK) and macroprudential as well as monetary policy (Bank Indonesia) must be coordinated to balance the dual mandate of financial inclusion through MSME lending with the need to safeguard profitability and stability. The significant negative effect of MSME lending on profitability, especially during the Covid-19 crisis, calls for enhanced risk-sharing mechanisms such as credit guarantees, restructuring schemes, and countercyclical capital buffers. Additionally, the role of commodity cycles in supporting profitability highlights the need for macroprudential tools under Bank Indonesia’s authority that address procyclicality in resource-dependent economies. For bank management, the results suggest that profitability strategies must account for ownership-specific vulnerabilities. BPDs should optimize capital utilization to avoid overcapitalization that suppresses returns, while BUMN and BUSN need to strengthen MSME risk assessment frameworks, especially during crisis periods. Across all bank categories, diversification beyond commodity-linked income sources remains crucial to mitigate cyclicality. The insights from this study may guide managers in designing sustainable credit allocation, pricing strategies, and risk management frameworks that balance short-term profitability with long-term resilience.

## 6 Conclusion

### 6.1 Main Findings

This study examined the determinants of bank profitability in Indonesia, measured by Return on Assets (ROA), using panel data from 2013Q1–2025Q1 across state-owned banks (BUMN), private national banks (BUSN), and regional development banks (BPD). The Fixed Effects Model (FEM) results show that both macroeconomic factors (GDP, inflation, BI rate, and commodity prices) and bank-specific indicators (MSME lending growth, MSME-LAR, and CAR) significantly influence profitability, albeit with heterogeneous effects across ownership types. GDP exhibited negative or insignificant effects, inflation improved margins only at the aggregate level, while commodity prices strongly supported profitability in BUMN and BUSN. MSME lending reduced profitability, particularly during the Covid-19 period, whereas MSME-LAR consistently eroded returns. CAR was insignificant overall but negatively affected BPDs. The Covid-19 crisis moderated these relationships, amplifying risks from MSME lending and strengthening the role of commodity-linked income, while showing no robust moderation for MSME-LAR or CAR.

These findings contribute to the literature by introducing MSME-LAR as a forwardlooking risk indicator, emphasizing ownership-specific vulnerabilities, and highlighting the asymmetric role of macroeconomic shocks. The results confirm that Indonesian banks' profitability is shaped not only by macro-financial conditions but also by structural features of their portfolios and regulatory mandates.

### 6.2 Policy Implication

From a regulatory perspective, the results highlight the need for differentiated and coordinated policy responses. First, credit risk management in MSME lending should be enhanced through credit guarantees, restructuring mechanisms, and risk-sharing schemes to balance financial inclusion with stability. Second, microprudential supervision (OJK) and macroprudential as well as monetary policy (Bank Indonesia) must account for cyclical vulnerabilities, particularly commodity dependence and overcapitalization in smaller banks such as BPDs. Third, monetary policy adjustments—especially changes in the BI policy rate—should be carefully calibrated to avoid excessive pressures on bank profitability while maintaining price stability. Finally, closer coordination between Bank Indonesia, the Financial Services Authority (OJK), and the government is essential to align credit expansion policies with prudential safeguards. Such coordinated measures will strengthen the resilience of Indonesia's banking system, ensuring its ability to support inclusive growth while withstanding external shocks and crisis conditions.

### 6.3 Limitations and Future Research

This study is not without limitations, which open avenues for future research. First, the analysis relies on aggregate data for three bank ownership categories (BUMN, BUSN,

BPD), which may obscure within-group heterogeneity at the individual bank level. Future research could employ bank-level datasets to capture micro-level variations in profitability dynamics. Second, while the study focuses on MSME lending, MSME-LAR, and CAR as core internal determinants, other dimensions such as digital banking adoption, cost efficiency, and corporate governance were not explicitly modeled. Incorporating these factors would enrich the understanding of structural drivers of profitability. Third, the moderating role of Covid-19 was proxied by a dummy variable, which, although widely used, may not fully capture the depth and persistence of crisis effects. Alternative approaches—such as dynamic panel estimators or crisis severity indices—could provide more nuanced insights.

In addition, the study is context-specific to Indonesia, a resource-dependent emerging economy with strong financial inclusion mandates. Cross-country comparative studies across ASEAN or other developing regions would help validate the generalizability of the findings. Finally, as the global financial landscape evolves with fintech, climate-related risks, and post-pandemic recovery dynamics, future research should extend the analysis to examine how these emerging factors interact with traditional bank profitability determinants.

## 6.4 Recommendations

**Academic Recommendations.** Future research should extend the analysis of bank profitability in emerging economies by incorporating additional structural factors such as digital transformation, governance quality, and cost efficiency. The present study highlights MSME-LAR as a forward-looking credit risk measure, but further empirical validation across different countries would strengthen its relevance as an alternative to traditional NPL ratios. Comparative studies within ASEAN and other developing regions are encouraged to test whether ownership-specific heterogeneity—such as the distinct behaviors of BUMN, BUSN, and BPD—also applies across different institutional and regulatory contexts.

**Policy Recommendations.** For regulators, enhancing risk-sharing mechanisms in MSME lending is essential to balance the dual goals of profitability and financial inclusion. OJK should strengthen microprudential supervision, while Bank Indonesia should reinforce macroprudential oversight and monetary policy; both must coordinate to differentiate across ownership structures. BPDs require support in optimizing capital deployment to avoid profitability constraints from overcapitalization, while BUMN and BUSN need safeguards against procyclical exposure to commodity price fluctuations. Monetary policy adjustments, particularly in the BI rate, must be carefully calibrated to avoid eroding banks' net interest margins during tightening cycles. Finally, coordinated policy responses between OJK, Bank Indonesia, and the government are critical to align financial inclusion objectives with prudential standards.

**Practical Recommendations.** For bank management, the findings emphasize the importance of tailoring strategies to ownership-specific vulnerabilities. Regional development banks (BPDs) should focus on optimizing capital utilization and leveraging local government partnerships to strengthen MSME credit programs. State-owned banks (BUMN) must enhance risk assessment frameworks to mitigate the profitability tradeoffs from mandated MSME lending. Private national banks (BUSN) should diversify income sources beyond commodity-linked sectors and strengthen liquidity management to withstand policy rate fluctuations. Across all bank groups, embedding digital banking solutions and adopting advanced credit analytics will be key to sustaining profitability while expanding inclusive finance.

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