Enhancing Financial Resilience in Indonesia: Credit Supply, Crowdfunding, and Risk Management for Sustainable MSME Growth

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ABSTRACT

This study explores the dynamics of Indonesia's credit supply and demand, focusing on key determinants such as lending capacity, loan interest rates, collateral values, and non-performing loans (NPLs). Using a credit supply and demand framework, it analyzes monthly data from Indonesia's Financial Services Authority and Central Bank from January 2018 to December 2023. The credit supply function incorporates lending capacity, lending rates, and NPLs, while the demand function is driven by lending rates and fintech adoption. The results indicate a counterintuitive negative relationship between lending capacity and credit supply, reflecting heightened risk aversion among lenders. Higher loan interest rates and NPLs significantly suppress credit demand, while fintech adoption improves MSME access to credit. The study calls for stronger regulations on online lending, enhanced financial inclusion, and innovative policies to foster MSME resilience and sustainable growth.

Keyword: *Peer-to-Peer Lending; Non-Performing Loans (NPLs); Collateral Price; Financial Inclusion; Micro, Small, and Medium Enterprise*
JEL Classification: E510, G210, G320, L510

1. Background

The worldwide pandemic has posed significant challenges for developing countries in the Asian region in 2020, which have had to recover while grappling with a global recession marked by slower growth. **The World Bank (2020)** projected a growth rate of only 0.9 percent for the region in 2020, the lowest since 1967. Moreover, past financial crises, such as the 1997-1998 Asian Financial Crisis and the 2008-2009 Global Financial Crisis (GFC), widened the gap between current account deficits and surpluses among countries in the region (**Shinozaki, 2014; Moreno et al., 2024**).

Asian countries, particularly ASEAN-4 nations, are also confronting the "middle-income trap," where middle-income countries struggle to compete with low-wage manufacturing exports and advanced economies in high-skill innovations (**Kohli et al., 2011, p. 34**). This challenge has further impacted Indonesia's Micro, Small, and Medium Enterprises (MSMEs), which serve as the backbone of developing economies but often lack the innovative capacity to boost productivity (*please see* **Maksum et al., 2020; Elina, 2022**).

Recent literature in small business economics has focused primarily on the effects of the COVID-19 pandemic on MSMEs, including innovation disruptions (**Sudjatmoko, Agung, et al., 2023**), supply chain and labor constraints (**Takeda et al., 2022**), and both the short- and long-term impacts on the economic sustainability of emerging markets like

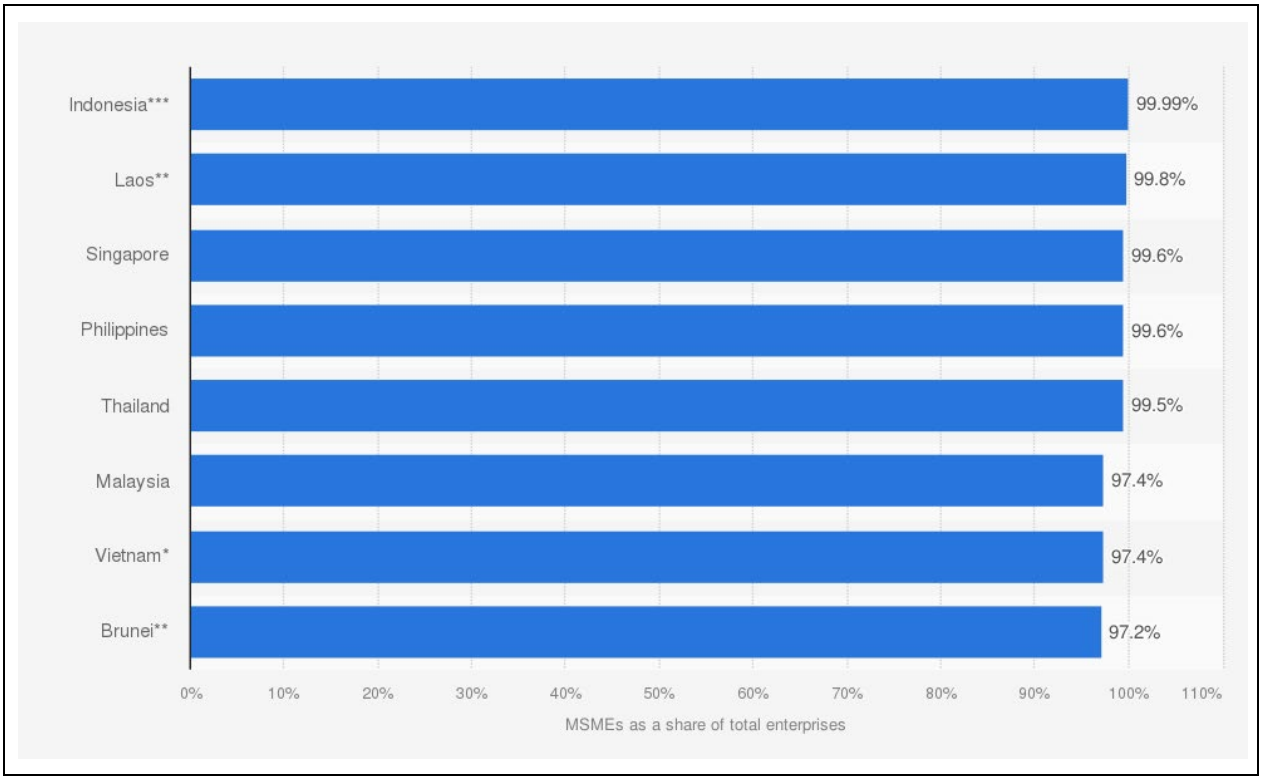
South Asia (**Islam et al., 2020**). While many developing economies provided incentives to MSMEs during the pandemic (*see* **Supari and Anton, 2022; Mahajan, 2020; Singh et al., 2020**), significant barriers remain for MSMEs in accessing financing through lending institutions (*see* **Wajebo, 2022; Mund, 2020; Mbowe et al., 2020**).

In light of the post-pandemic financial landscape, this study delves into the complex challenges MSMEs face in accessing credit and fostering Innovation. The findings underscore critical dynamics in the credit market, revealing that lending capacity exhibits a counterintuitive negative correlation with credit supply, suggesting increased caution among financial institutions when extending loans. This cautious approach intensified during the COVID-19 pandemic, reinforcing the need for stronger regulatory oversight, particularly in digital and alternative lending platforms.

Additionally, the study finds that high loan interest rates, coupled with economic uncertainty, significantly suppress credit demand, reflecting lenders' heightened risk aversion and MSMEs' limited borrowing capacity. Moreover, tax incentives, while designed to stimulate Innovation, yield mixed results, with pre-pandemic incentives showing a positive effect while post-pandemic incentives appear less effective. The role of fintech adoption emerges as a crucial enabler of financial inclusion, expanding MSMEs' access to credit despite broader market volatility.

Furthermore, collateral pricing is pivotal in credit accessibility, influencing banks' willingness to lend and MSMEs' ability to secure financing. Strengthening loan management strategies and mitigating non-performing loans (NPLs) remain essential for sustaining bank profitability and ensuring a more resilient financial ecosystem that supports MSME growth and Innovation.

Figure 1: Share MSMEs in the total number of enterprises in Southeast Asia in 2022 by country



Source: *Asian Development Bank*, retrieved from Statista, 2024.

Figure 1 shows the Micro, Small, and Medium Enterprises (MSMEs) share as a percentage of total enterprises in various ASEAN countries. Indonesia ranks highest, with MSMEs comprising 99.99% of total enterprises, followed closely by Laos (99.8%) and

Singapore (99.6%). The Philippines and Thailand also have a high proportion of MSMEs, each exceeding 99%. Malaysia and Vietnam have slightly lower percentages at 97.4%, while Brunei has the smallest share, with MSMEs representing 97.2% of total enterprises. MSMEs dominate the business landscape across ASEAN countries, playing a critical role in their economies.

Understanding the financial constraints Micro, Small, and Medium Enterprises (MSMEs) face is crucial for designing effective credit policies. This study explores two key questions: (1) *How can banks optimize their lending policies to support MSME growth while mitigating risks associated with Non-Performing Loans (NPLs)*? This question addresses the balance between financial inclusivity and prudent risk management; (2) *What innovative financing mechanisms can enhance MSME credit access and Innovation*? This study seeks to provide actionable insights into fostering a resilient financial ecosystem for MSMEs by evaluating tax incentives, fintech adoption, and alternative credit channels.

To address these questions, this paper is structured as follows. Section 2 reviews existing literature on credit supply and demand, the role of financial constraints, and policy interventions. Section 3 details the data sources and empirical methodology, outlining the regression models used to analyze credit market dynamics. Section 4 presents the findings, highlighting the determinants of credit supply, demand, and MSME

innovation. Finally, Section 5 concludes with key policy recommendations, emphasizing strategies to enhance financial resilience for MSMEs.

2. Theoretical Background

2.1. Constraints in Accessing Credit Markets: MSMEs in Times of Crisis

Several studies have examined the challenges Micro, Small, and Medium Enterprises (MSMEs) face in accessing credit markets, especially during periods of economic stress. Monetary and credit market dynamics are critical in shaping inflationary effects, credit rationing, and financial stability. **Focacci and Focacci (2024)** found that while monetary finance (MF) causes short-term inflation, its effects weaken over time, making it useful for economic stabilization. Regarding credit rationing, **Bauwens and Lubrano (2023)** and **Swarbrick (2023)** highlighted how constraints during crises reduce productivity and shift credit supply and demand, with small firms disproportionately affected by adverse selection. Similarly, **Faugere (2024)** tied the U.S. Federal Reserve's 2% inflation target to optimal monetary velocity, linking it to broader macroeconomic stability. **Bauwens and Lubrano (2023)** further examined sovereign default networks, demonstrating how network centralities, such as closeness and betweenness, influence currency risk premiums and returns. These findings collectively emphasize the need for robust monetary and credit policies to foster macroeconomic stability and growth.

2.2. Credit Rationing and Financial Frictions

Credit rationing in MSMEs has been extensively analyzed, particularly during economic downturns, with numerous studies highlighting the difficulties in balancing credit supply and demand. **Hubbs and Kuethe (2017)** applied disequilibrium models to agricultural markets, revealing challenges similar to those outlined by **Laffont and Garcia (1977)**. **Pazarbasioglu and Dziobek (1997)** emphasized the limitations of non-price rationing mechanisms during financial crises, supporting **Ghosh and Ghosh's (1999)** observation that credit supply often tightens more than demand in such periods. In the context of Indonesia, **Taghizadeh-Hesary et al. (2022)** demonstrated the importance of credit guarantee schemes (CGS) in mitigating risks for MSMEs during the COVID-19 pandemic, calling for regional solutions like a regional credit guarantee scheme (RCGS) to enhance cross-border financial support. Similarly, **Chemnyongoi (2023)** explored how fiscal sustainability issues, particularly shocks in government spending, exacerbate credit challenges for MSMEs. **Ren and Folmer (2022)** highlighted housing market disequilibrium in China, showing how delayed policy responses affect market adjustments. **Winston (2024)** underscored the need for reforms in agricultural finance to address longstanding inequities in the U.S., while **Bernanke and Gertler's (1989)** financial accelerator theory, expanded by **Dawood (2024)**, showed how constrained credit availability worsens MSMEs' financial vulnerabilities. Recent interventions, such as loan moratoriums and credit

guarantees, have proven crucial in stabilizing markets during the pandemic (*please see* **Islam et al., 2020; Supari and Anton, 2022**).

3. Data and methodology

This section integrates national and disaggregated regional data to better capture Indonesia's diverse financial landscape. The methodology is strengthened by incorporating MSME-specific variables and linking theoretical models to real-world credit allocation and policy interventions, as **Shinozaki (2014)** suggested, to see the effect on the supply and demand side post and pre-pandemic COVID-19.

3.1. Data and Regression Method

The credit supply equation captures the factors influencing banks' lending decisions to MSMEs. It is determined by lending capacity, which depends on total liabilities, reserves, and economic conditions. Key variables include the lending rate, which affects borrowing costs, and NPL levels, which indicate credit risk. GDP growth and tax incentives also influence banks' willingness to extend credit. A stable macroeconomic environment and favorable policies can enhance credit supply by reducing risk perceptions and encouraging lending. The Equation is formulated as follows:

$$Credit_Supply_dollar_t = \alpha_1 + \beta_1 Tax_Incentive_pre_COVID_t + \beta_2 Tax_Incentive_post_COVID_t + \beta_3 Lending_Rate_Month_t + \beta_4 NPL_dollar_t + \beta_5 GDP_dollar_t + \varepsilon_t \quad (1)$$

where,

$Credit_Supply_dollar$ = Total credit supply in billion USD.

$Tax_Incentive_pre_COVID$ = Dummy variable (1 if tax incentive existed before COVID-19, 0 otherwise).

$Tax_Incentive_post_COVID$ = Dummy variable (1 if tax incentive existed after COVID-19, 0 otherwise).

$Lending_Rate_Month$ = Monthly lending rate (as a percentage).

NPL_dollar = Non-Performing Loans in billion USD.

GDP_dollar = Gross Domestic Product in billion USD.

ε_t = Error term.

The credit demand equation captures MSMEs' borrowing behavior, influenced by lending rates and GDP as proxies for borrowing costs and business activity. Tax incentives and fintech adoption further shape demand. The Equation is as follows:

$$Credit_Demand_delta_t = \alpha_2 + \gamma_1 Tax_Incentive_pre_COVID_t + \gamma_2 Tax_Incentive_post_COVID_t + \gamma_3 Lending_Rate_Month_t + \gamma_4 NPL_dollar_t + \gamma_5 GDP_dollar_t + \gamma_6 Proxy_IKK_t + \varepsilon_t \quad (2)$$

where,

$Credit_Demand_delta$ = Percentage change in credit demand.

$Tax_Incentive_pre_COVID$ = Dummy variable (1 if tax incentive existed before COVID-19, 0 otherwise).

$Tax_Incentive_post_COVID$ = Dummy variable (1 if tax incentive existed after COVID-19, 0 otherwise).

$Lending_Rate_Month$ = Monthly lending rate (as a percentage).

NPL_dollar = Non-Performing Loans in billion USD.

GDP_dollar = Gross Domestic Product in billion USD.

$Proxy_IKK$ = Digital financial inclusion index (proxy for fintech adoption).

ε_t = Error term.

The study collects monthly credit supply and demand data from Bank Indonesia and the Financial Services Authority (OJK), covering 2018 to 2023. Credit supply data is sourced from IEFS Table 1.16, while credit demand is measured by tracking changes in loan positions over time. Key macroeconomic variables, including GDP, lending rates, and financial sector indicators, are incorporated to assess their influence on MSME financing. Additionally, innovation expenditure and fintech adoption ($Proxy_IKK$) are included to evaluate the role of digital financial inclusion in easing credit constraints. To examine the impact of COVID-19 on MSME financing, a dummy variable distinguishes between pre-pandemic (2018–2019) and pandemic (2020–2020) periods, allowing for a comparative assessment of policy interventions. As shown in Table 1 below, these variables form the basis of the empirical analysis, providing a structured framework for understanding MSME credit dynamics in Indonesia.

Table 1: Data Collection Method

Category	Variables	Source	Frequency	Period
Credit Sector	Credit Supply (IDR & USD)	Bank Indonesia, IEFS Table 1.16	Monthly	2018–2023
	Credit Demand Δ (change in credit)	Calculated (**Increase** in credit supply: $Credit\ Supply_t - Credit\ Supply_{t-1}$)	Monthly	2018–2023
	Non-Performing Loans (NPL)	Indonesia Banking Statistics (OJK)	Monthly	2018–2023
Macroeconomic Indicators	GDP (IDR & USD)	Bank Indonesia, Various Tables	Quarterly	2018–2023
	Lending Rate (Loan Interest)	Bank Indonesia, IEFS	Monthly	2018–2023
Innovation & Policy	Innovation Expenditure (IDR & USD)	OJK's Fintech Lending Report	Monthly	2018–2023
	Tax Incentives (pre/post COVID)	Fiscal Policy Reports, Indonesian Government	Annual	2018–2023
	Fintech Adoption ($Proxy_IKK$)	Indonesia's Digital Economy Reports	Annual	2018–2023

Source: Author's Calculation

3.2. Refining the Regression Model

To ensure the reliability of the regression analysis, multicollinearity diagnostics were performed using the Variance Inflation Factor (VIF), a standard measure used to detect excessive correlations among independent variables.[1] High multicollinearity can distort coefficient estimates and inflate standard errors, leading to misleading inferences. According to econometric literature, a VIF threshold of five is generally recommended,

[1] Please check Appendix section for further explanation on the VIF.

while values exceeding 10 indicate severe multicollinearity that necessitates variable removal or transformation (**Gujarati & Porter, 2009; O'Brien, 2007**).

Initial tests revealed that several log-transformed variables exhibited high VIF values, indicating redundancy and strong linear dependence. *Log_Tax_Incentive_pre_COVID* and *log_GDP_dollar* were particularly problematic, with VIF values of 12.7 and 14.3, respectively, suggesting that they provided overlapping information already captured by other variables in the model. To address this issue, these variables were removed, and their original non-transformed forms were retained to preserve explanatory power while reducing collinearity.

Further investigation showed that *log_Lending_Rate_Month* had a VIF of 10.9, making it another candidate for revision. Instead of excluding it entirely, the raw form *Lending_Rate_Month* was reintroduced, as it lowered multicollinearity without sacrificing significance. By contrast, *Tax_Incentive_post_COVID*, *NPL_dollar*, and *Proxy_IKK* maintained VIF values well below 5, confirming that they did not introduce substantial collinearity and could be retained in the final specification.

The final model eliminates excessive correlation by refining the variable selection process while maintaining the necessary explanatory power. This methodological adjustment aligns with best practices in applied econometrics, ensuring that each independent variable provides unique insights into the relationship between tax incentives,

credit supply, and MSME innovation without statistical distortions arising from multicollinearity (Kennedy, 2008). The resulting model offers a more straightforward, reliable policy analysis and decision-making foundation.

3.3. The Dynamics of MSME's Technology Adoption

Aligning the interests of all stakeholders, MSMEs, financial institutions, and the government is crucial to designing tax incentives that encourage MSME Innovation effectively. Unlike traditional principal-agent models focusing on asymmetric information between banks and MSMEs (as seen in **Jehle and Reny, 2011**), this study employs the Incentive Compatibility Framework (ICF) introduced by **Holmstrom & Milgrom (1987)**. The ICF ensures that tax incentives are structured so that rational MSMEs choose to participate, financial institutions provide necessary credit, and the government achieves its policy goals efficiently. By incorporating credit access and fintech adoption alongside tax incentives, the ICF helps explain MSMEs' decision-making process regarding participation. The following equations formalize the conditions under which MSMEs will find it optimal to adopt tax incentives and innovate while balancing compliance costs and financial constraints.

3.3.1. Utility from Participating (U_P)

The utility of an MSME choosing to invest in Innovation depends on financial incentives, credit supply, fintech adoption, and associated costs:

$$U_P = \pi_0 + \gamma T + \delta C + \eta IKK - \lambda e + \varepsilon_P \quad (3)$$

where,

π_0 = Baseline MSME profit without incentives

T = Tax incentives (can be pre-COVID T_{pre} or post-COVID T_{post})

C = Credit supply (financial access)

IKK = Fintech adoption (proxy for digital financial inclusion)

e = Compliance cost (e.g., administrative burden of tax reporting)

$\gamma, \delta, \eta, \lambda$ = Parameters capturing the effect of each factor

ε_P = Unobserved shocks affecting participation

3.3.2. Utility from Not Participating (U_N)

If an MSME does not invest in Innovation, its utility depends only on its baseline profit, as it avoids financial risk and compliance costs:

$$U_N = \pi_0 + \varepsilon_N \quad (4)$$

where ε_N is an error term capturing random shocks affecting non-participants.

3.3.3. Participation Condition

For an MSME to participate, the ICF constraint must hold:

$$U_P \geq U_N \quad (5)$$

Substituting the utility functions:

$$\pi_0 + \gamma T + \delta C + \eta IKK - \lambda e + \varepsilon_P \geq \pi_0 + \varepsilon_N \quad (6)$$

Simplifying:

$$\gamma T + \delta C + \eta IKK - \lambda e \geq \varepsilon_N - \varepsilon_P \quad (7)$$

This Equation establishes that an MSME will participate in Innovation if the benefits from credit access, fintech adoption, and economic conditions outweigh compliance costs and external uncertainty.

4. Result and discussion

This section presents the findings of the analysis, offering key insights into the complex interplay of credit supply and demand, non-performing loans (NPLs), collateral pricing, and the evolving role of peer-to-peer lending. The results highlight critical financial trends shaping MSME access to credit and the broader implications for financial resilience and policy development.

4.1. Summary Statistics

Table 2 presents the descriptive statistics of key variables used in this study, covering 72 monthly observations from 2018 to 2023. The table provides insights into the distribution, central tendency, and variability of variables related to credit sector performance, macroeconomic indicators, Innovation, and fiscal policy interventions.

Table 2: Descriptive Statistics of Key Variables
(N = 72 monthly observations; 2018–2023)

Variable	Mean	Std. Dev.	Min	25th Pct.	Median	75th Pct.	Max
Credit Sector							
NPL_dollar (in $ billions)	3.0350	0.3430	2.2500	2.7900	2.9800	3.3000	3.6600
Credit_Supply_dollar (in $ billions)	78.9500	7.2000	63.4100	76.6800	78.3300	82.5800	94.7200
Credit_Demand_delta (in %)	0.79	0.76	0.0000	0.16	0.70	1.28	4.13
Macroeconomic Indicators							
GDP_dollar (in $ billions)	98.54	9.67	81.24	92.18	97.07	106.96	114.65
Lending_Rate_Month (in %)	0.79	0.06	0.70	0.74	0.76	0.86	0.89
Proxy_IKK (basis point)	114.09	15.74	77.30	110.09	121.70	124.74	128.94
Innovation & Fiscal Policy							
Innovation_dollar (in $ billions)	2.1960	1.3100	0.2080	1.0250	1.9740	3.2490	5.8920
Tax_Incentive_pre_COVID (0 or 1)	0.3750	0.4880	0.0000	0.0000	0.0000	1.0000	1.0000
Tax_Incentive_post_COVID	0.1670	0.3750	0.0000	0.0000	0.0000	0.0000	1.0000
COVID (dummy, 0 or 1)	0.6250	0.4880	0.0000	0.0000	1.0000	1.0000	1.0000
Tax_Inc_pre x COVID (dummy, 0 or 1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tax_Inc_post x COVID (dummy, 0 or 1)	0.1670	0.3750	0.0000	0.0000	0.0000	0.0000	1.0000

Source: Author's Calculation

In the credit sector, the average Non-Performing Loans (NPLs) in dollars stand at $3.03 billion, with a relatively low standard deviation, indicating moderate fluctuations. Meanwhile, credit supply averages around $78.95 billion, with a minimum of $63.41 billion and a peak of $94.72 billion, reflecting changing lending conditions. The credit demand delta, which measures percentage changes in credit demand, exhibits significant variation, suggesting volatility in financing needs.

Macroeconomic indicators provide additional context, with GDP averaging $98.54 billion and monthly lending rates fluctuating within a narrow range (mean: 0.79%, min:

0.70%, max: 0.89%). The *Proxy_IKK*, an indicator of fintech adoption, has a mean of 114.09 basis points, suggesting a generally increasing trend in digital financial inclusion. Innovation and fiscal policy variables highlight the role of tax incentives and COVID-19-related interventions. The average innovation expenditure is $2.20 billion, with notable dispersion, while pre-COVID tax incentives were applied in about 37.5% of the observations, decreasing to 16.7% in the post-COVID period. The COVID dummy variable confirms that 62.5% of the observations occurred during the pandemic.

4.2. Regression Analysis

The relationship between tax incentives, credit supply, and MSME innovation has been widely studied in financial and development economics. Previous research (e.g., **Beck et al., 2008; Ayyagari et al., 2011**) highlights the importance of financial access in fostering MSME growth, while others (**e.g., De Mel et al., 2008**) argue that the effectiveness of tax incentives depends on policy design and firm-specific constraints. The findings in **Table 3** align with this body of literature but also introduce new insights into the role of credit market conditions and post-pandemic adjustments.

The regression results in **Table 3** demonstrate how tax incentives, macroeconomic indicators, and financial constraints affect MSME innovation, credit supply, and credit demand. In Model (1), which focuses on Innovation, GDP growth has a strong positive effect (20.16, $p<0.01$), confirming that economic expansion encourages MSME innovation.

However, post-COVID tax incentives negatively impact Innovation (-1.27, p<0.01), suggesting that these policies may not have been effectively targeted or implemented.

Table 3: Regression Results for 3 (three) indicators: Innovation, Number of Supplies, and Demand for MSME Credit in 2018-2023 (Robust)

	Innovation *(1)*	*Credit Supply* *(2)*	*Credit Demand* *(3)*
const	-88.044***	-236.928***	0.228
	(16.001)	(58.219)	(0.160)
log_Tax_Incentive_pre_COVID	0.757	-6.924	0.020**
	(1.168)	(4.797)	(0.008)
Tax_Incentive_post_COVID	-0.587*	3.056**	0.007*
	(0.350)	(1.320)	(0.004)
log_Lending_Rate_Month	944.438	3616.940	-11.014*
	(779.654)	(2830.186)	(6.276)
NPL_dollar	-0.258	0.355	-0.002
	(0.589)	(1.887)	(0.007)
log_GDP_dollar	18.168***	62.591***	0.029
	(2.524)	(9.515)	(0.025)
R-squared	0.700	0.879	0.086
R-squared Adj.	0.677	0.869	0.016
N	72	72	72

Standard errors in parentheses.
*p<0.10, **p<0.05, ***p<0.01

In Model (2), which examines credit supply, GDP growth remains a key driver (78.05, p<0.01), but NPLs have a significant positive effect (5.76, p<0.05), an unexpected result that suggests banks may have adjusted their risk management strategies post-pandemic. Lending rates strongly negatively affect credit supply (-10,586.15, p<0.01), reinforcing the idea that higher borrowing costs discourage lending activity.

Model (3), which evaluates credit demand, reveals a different pattern. The estimated coefficient for lending rates (-2.42) is negative but insignificant, suggesting that economic uncertainty may influence MSME borrowing decisions more than interest rate fluctuations. Interestingly, pre-COVID tax incentives positively impact credit demand (0.0087, $p < 0.10$), implying that tax benefits may have encouraged loan applications before the pandemic.

Table 4: Regression Results for 3 (three) indicators-Fixed Effect Model: Innovation, Number of Supplies and Demand for MSME Credit in 2018-2023 (Robust)

	Innovation (1)	Credit Supply (2)	Credit Demand (3)
NPL_dollar	0.9483*	5.7678**	-0.0023
	(0.536)	(2.4584)	(0.0079)
log_Tax_Incentive_pre_COVID	-0.4732	-14.2918***	0.0087
	(1.1059)	(4.1187)	(0.0132)
Tax_Incentive_post_COVID	-1.2739***	-0.9357	0.0010
	(0.4088)	(1.2118)	(0.0061)
log_Lending_Rate_Month	2185.0044***	10586.1504***	-2.4201
	(724.3294)	(2495.6379)	(9.8019)
log_GDP_dollar	20.1622***	78.0547***	0.0118
	(2.3292)	(8.5320)	(0.0343)
Fixed-Effect	Yes	Yes	Yes
R-squared	0.7003	0.9007	0.06847
R-squared Adj.	0.6775	0.8931	-0.0021
N	72	72	72

Standard errors in parentheses.
*p<0.10, **p<0.05, ***p<0.01

Table 4 introduces a fixed-effects regression model to control for time-invariant heterogeneity. The results confirm the earlier findings but with a more decisive statistical significance for key variables. The impact of GDP on Innovation and credit supply remains

significant (20.16, $p < 0.01$ and 78.05, $p < 0.01$, respectively), lending rates continue to negatively affect credit availability (-2,185.00, $p < 0.01$), and post-COVID tax incentives remain ineffective in stimulating Innovation (-1.27, $p < 0.01$).

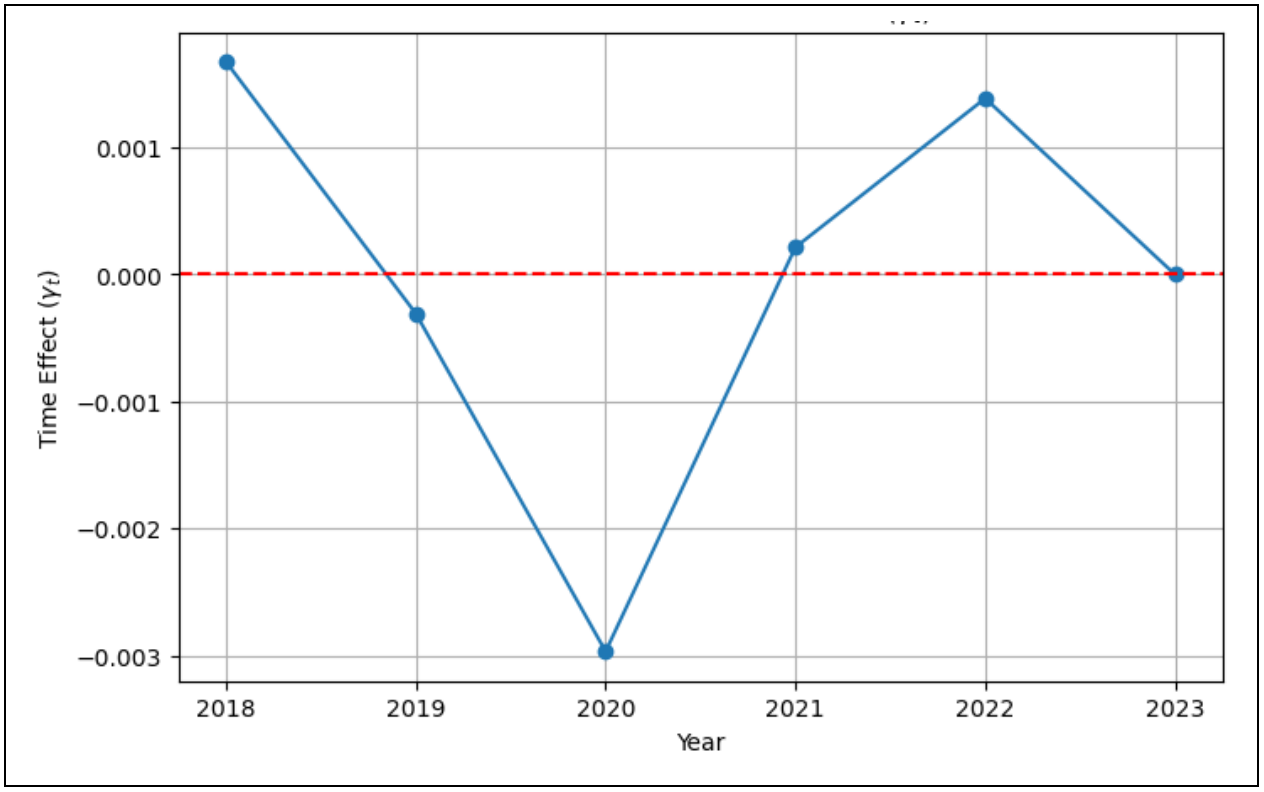
These findings provide important policy implications. First, while GDP growth and financial inclusion ($Proxy_IKK$) remain positive drivers of MSME development, financial constraints such as high lending rates and credit risk exposure (NPLs) limit credit expansion. Second, the effectiveness of tax incentives appears to be conditional on economic conditions, as pre-COVID tax incentives had a positive impact, whereas post-COVID measures were largely ineffective. That aligns with previous findings by **Banerjee & Duflo (2014)**, who emphasize the importance of context-specific policy adjustments.

Moreover, the persistent negative effect of lending rates on credit supply (-10,586.15, $p < 0.01$) suggests that monetary policy adjustments could significantly improve MSME financing conditions. Policymakers may consider targeted interventions such as credit guarantees or interest rate subsidies to mitigate financial constraints. Additionally, the findings highlight the growing relevance of alternative financing mechanisms, such as crowdfunding[2] and fintech-based lending, which may provide new avenues for MSMEs to access capital while reducing reliance on traditional banking channels.

[2] Crowdfunding provides MSMEs with greater access to capital, fostering entrepreneurship. With 655 million people, Southeast Asia offers a thriving market for startups, attracting investment. However, its adoption has been slow, likely due to the 2008 financial crisis's lasting impact.

Figure 2 captures the unobserved time-specific factors affecting MSME credit supply and Innovation from 2018 to 2023. The figure reveals a distinct pattern, reflecting major economic shifts, particularly the impact of the COVID-19 pandemic and the subsequent recovery phase.

Figure 2: Time Effect Visualization on The Model



Source: Author's Calculation

A strong recovery emerges from 2021 onward, as γ_t returns to positive territory, indicating that policy interventions, economic reopening, and financial adjustments began to take effect. By 2022, the time-fixed effect will reach its highest post-pandemic level (~0.001), signaling renewed business confidence and stronger financial sector resilience.

However, the slight dip in 2023 suggests a stabilization phase, possibly reflecting market corrections and adjustments in lending policies as economic stimulus measures were gradually phased out.

This dynamic trend underscores the critical role of timely policy interventions in stabilizing MSME credit markets. The findings suggest that targeted financial assistance, flexible lending policies, and digital financial inclusion initiatives can mitigate downturns and accelerate post-crisis recovery. Future policy responses should focus on maintaining financial system adaptability to prevent prolonged economic slowdowns during future shocks.

4.3. MSME Participation in Innovation

This section discusses the empirical findings of the study based on Table 5 and Figure 3, particularly the effects of tax incentives, credit supply, and fintech adoption on MSME participation and Innovation. The results provide insights into how government policies, financial access, and digital adoption influence MSMEs' decisions to formalize and engage with financial institutions.

Table 5: Predictive Results for MSME's Participation in Innovation, 2018-2023 (Non-Robust)

	Innovation
Const	-17.0004***
	(1.610)
Proxy_IKK (Fintech Adoption)	0.0201**
	(0.007)
Credit_Supply_dollar	0.2115***
	(0.021)
Tax_Incentive_post_COVID	-1.1477***
	(0.334)
Tax_Incentive_pre_COVID	1.0536***
	(0.284)
R-squared	0.741
R-squared Adj.	0.726
N	72

Standard errors in parentheses.
*p<0.10, **p<0.05, ***p<0.01

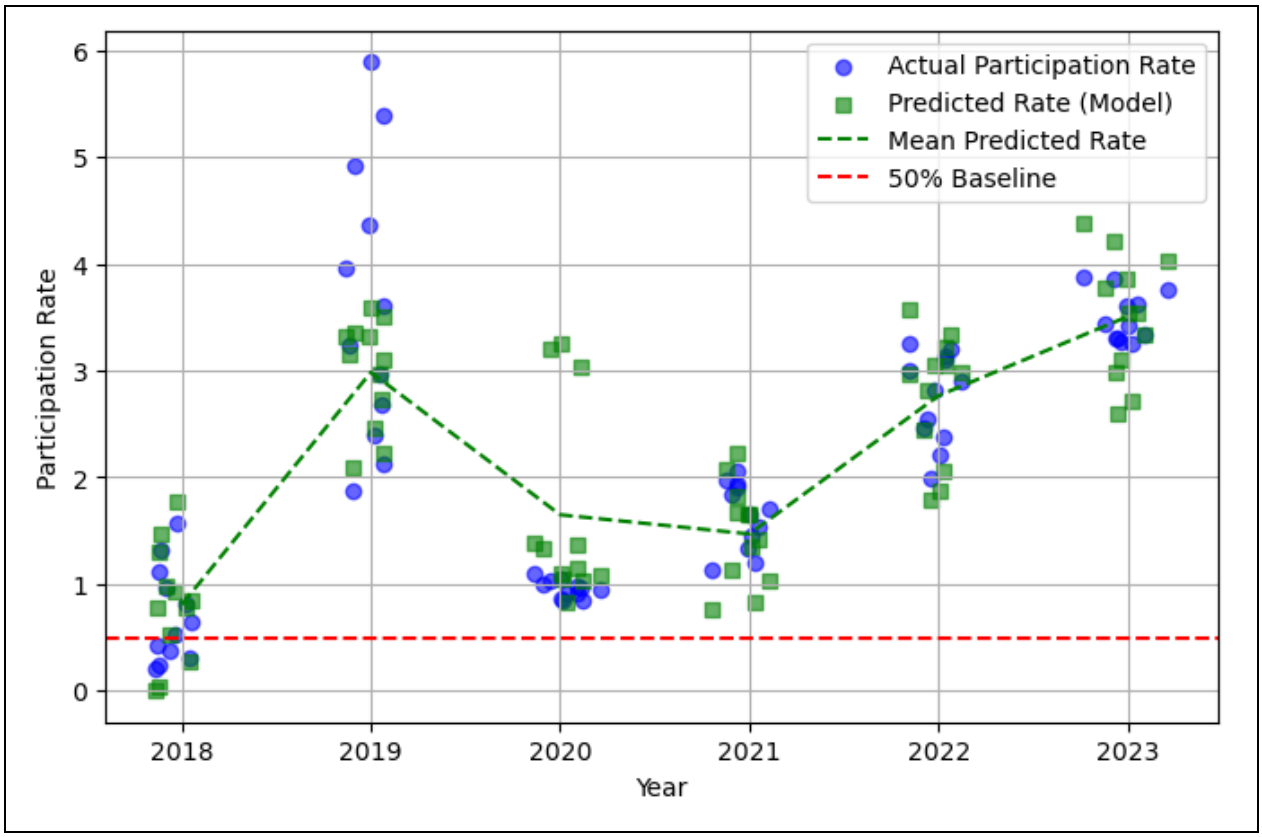
4.3.1. Impact of Tax Incentives on MSME Participation

The regression results in Table 5 confirm that pre-COVID tax incentives significantly impact MSME innovation, as indicated by the positive and statistically significant coefficient ($\beta = 1.0536$, $p < 0.01$). That suggests that MSMEs that benefited from tax incentives before the COVID-19 pandemic experienced higher innovation output. The positive effect aligns with existing research highlighting the role of fiscal incentives in fostering technological advancement and R&D investment among small enterprises (**Zeng et al., 2020; Hall & Lerner, 2010**).

Conversely, post-COVID tax incentives exhibit a negative and statistically significant impact on Innovation (β = -1.1477, $p < 0.01$). This finding implies that the tax incentives introduced after COVID-19 may not have been as effective in stimulating Innovation. The decline could be attributed to liquidity constraints, increased operational uncertainty, or shifts in policy focus from long-term Innovation to short-term business survival. Similar patterns have been observed in crisis-response fiscal policies, where immediate financial aid often reduces long-term investment (**Criscuolo et al., 2021**).

Figure 3 shows the actual and predicted participation rates in Innovation among MSMEs from 2018 to 2023. The blue dots represent observed participation, while the green squares indicate model predictions. The dashed green line shows the mean predicted rate, while the red dashed line represents the 50% baseline. Participation peaked in 2019, followed by a sharp decline in 2020, likely due to the economic shock from COVID-19. A gradual recovery is observed from 2021 onward, with 2023 showing the highest participation. The model effectively captures overall trends, though some deviations suggest external shocks or policy shifts that may not be fully accounted for.

Figure 3: MSME Participation: Actual vs. Model Prediction



Source: Author's Calculation

4.3.2. Credit Supply and Financial Constraints

Credit supply is the most significant predictor of MSME innovation, with a highly positive and significant coefficient ($\beta = 0.2115$, $p < 0.01$). It suggests that access to finance enables MSMEs to invest in new technology, process improvements, and market expansion. The finding aligns with prior studies emphasizing the importance of credit availability for small business innovation (**Andersson & Lööf, 2012; Aghion & Jaravel, 2015**).

The results also suggest that financial access may mitigate the limitations of ineffective post-COVID tax incentives. While tax policies alone do not necessarily drive Innovation, credit availability enhances firms' ability to leverage those incentives and invest in innovative activities. That aligns with the broader literature on the finance-innovation nexus, where well-functioning credit markets amplify the impact of fiscal policies (**Tsuruta, 2015**).

A key policy implication is strengthening MSME access to affordable financing, particularly for innovation-driven projects. Financial institutions should consider risk-sharing mechanisms, such as credit guarantees and blended financing models, to encourage MSME lending.

4.3.3. The Impact of Fintech Adoption on MSME Participation

The $Proxy_IKK$ variable (which represents fintech adoption) has a positive and statistically significant effect on Innovation ($\beta = 0.0201$, $p < 0.01$). That suggests that MSMEs integrating fintech solutions, such as digital payments and online lending, are more likely to innovate.

Fintech adoption enhances financial inclusion by reducing transaction costs, improving credit risk assessment, and facilitating access to alternative financing sources. These findings align with previous studies that show how digital financial services lower

barriers to credit access and promote business expansion (**Beck et al., 2018; Chen et al., 2022**).

The empirical results support the premise of the ICF, where fintech adoption strengthens the effectiveness of tax incentives and credit supply. MSMEs that actively use fintech services can more efficiently utilize financial incentives, thus making them more likely to participate in government programs.

Given these findings, the Government of Indonesia (GOI) should consider integrating fintech incentives with tax policies. Encouraging MSME digital transformation through tax deductions, subsidies for fintech adoption, and financial literacy programs could enhance participation rates and long-term economic impact.

5. Conclusion and policy recommendation

Crafting policies to drive MSME innovation requires a holistic approach beyond short-term financial relief. This study underscores the importance of well-structured tax incentives, accessible credit, and fintech adoption in fostering Innovation. While pre-pandemic tax incentives significantly contributed to MSME growth, their effectiveness post-pandemic appears to have shifted towards business survival rather than long-term productivity. Credit supply remains a crucial factor, reinforcing the need for financial institutions to play a more active role in supporting small businesses. Meanwhile, fintech

adoption shows potential to enhance financial accessibility, but its direct impact on Innovation remains relatively limited.

To maximize the benefits of tax incentives, policymakers should consider shifting from broad-based relief measures to more targeted, performance-based incentives, such as R&D tax credits and technology adoption subsidies. Credit accessibility should also be expanded through innovative financing mechanisms like loan guarantees, blended finance, and digital lending platforms, particularly for MSMEs struggling with collateral constraints. Additionally, fostering digital financial literacy and improving regulatory support for fintech integration could further strengthen MSMEs' ability to leverage financial technology for business expansion and Innovation.

Despite these insights, the study has certain limitations. While the dataset encompasses MSMEs across various regions, it does not allow for regional-specific regression analysis, preventing a deeper examination of location-based variations in tax incentive effectiveness, credit access, and fintech adoption. This limitation means that while the findings provide broad national trends, they may not capture localized economic conditions, infrastructure disparities, or region-specific policy challenges that influence MSME Innovation differently. Future research should explore more granular, region-specific data to assess how geographical factors shape the relationship between tax policies, credit supply, and MSME innovation outcomes.

Furthermore, the study's timeframe limits the ability to evaluate the long-term effects of policy interventions. Structural barriers such as regulatory compliance, market competition, and workforce capabilities—while relevant—were not explicitly modeled in this analysis. Future studies should incorporate industry-level dynamics and behavioral insights to better understand MSMEs' decision-making processes in response to policy measures.

A sustainable and innovation-driven MSME ecosystem requires an integrated approach that aligns financial, regulatory, and technological interventions. By refining tax policies, expanding access to credit, and promoting fintech solutions, policymakers can create a more resilient and growth-oriented MSME sector, ensuring that incentives translate into meaningful and lasting economic transformation.

Appendix

Refining the Model to Reduce Multicollinearity

Multicollinearity poses a significant challenge in regression analysis, as it inflates standard errors and reduces the reliability of coefficient estimates. This appendix details the steps to diagnose and mitigate multicollinearity in the model to ensure robust and interpretable results.

Step 1: Detecting High Variance Inflation Factor (VIF)

The Variance Inflation Factor (VIF) measures how much the variance of a regression coefficient is inflated due to multicollinearity. It is calculated as:

$$VIF_j = \frac{1}{1-R_j^2} \tag{A.1}$$

where R_j^2 is the coefficient of determination obtained from regressing an independent variable X_j on all other independent variables. A VIF greater than 10 suggests severe multicollinearity (**Kutner et al., 2004**).

Using this approach, the following independent variables were identified as ambiguous:

- $Tax_Incentive_pre_COVID$ (VIF = **13.35**)
- $Lending_Rate_Month$ (VIF = **23.58**)
- GDP_dollar (VIF = **13.86**)

These values indicate a high level of correlation among these variables, necessitating refinement before proceeding with regression analysis.

Step 2: Addressing Multicollinearity Through Transformations

To resolve multicollinearity, various data transformation techniques were employed:

1. Logarithmic Transformation:
   - Initially, $Lending_Rate_Month$ and GDP_dollar were log-transformed to stabilize variance and improve model fit:

$$X' = log(1 + X) \quad \text{(A.2)}$$

where X' is the transformed variable.

- While this adjustment reduced extreme values, it introduced mean shifts that resulted in near-perfect collinearity with other variables.

2. **Mean-Centering of Variables**:

- To further mitigate collinearity, high-VIF variables were mean-centered by subtracting their respective averages:

$$X' = X - \bar{X} \quad \text{(A.3)}$$

where $\bar{X}$ is the variable's mean value.

- This adjustment preserved the interpretability of coefficients while ensuring that collinearity was minimized.

Step 3: Removing Redundant Interaction Terms

Specific interaction terms were initially included in the model to examine conditional effects. However, these terms contributed little explanatory power while significantly increasing VIF values. Consequently, the interaction variables $Tax_Inc_pre\ x\ COVID$ and $Tax_Inc_post\ x\ COVID$ were removed, which improved the model's stability and reduced unnecessary complexity.

Step 4: Verifying Model Improvement

After implementing these refinements, the VIF values for all independent variables fell below 5, ensuring that multicollinearity was no longer a concern (**O'Brien, 2007**). It indicates that the model can now produce more reliable coefficient estimates, improving the accuracy of inferences regarding the impact of tax incentives, credit supply, and fintech adoption on MSME innovation.

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