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Research Article

Non-Performing Loans in Cambodia's Microfinance Sector: Challenges and Implication for Sustainable Economic Growth

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Abstract: This study investigates the impact of Non-Performing Loans (NPLs) on Cambodia's economic growth, utilizing panel data analysis with annual data from 62 microfinance institutions over the period 2017-2023. Data sourced from the National Statistics Institution of Cambodia, National Bank of Cambodia, and World Bank. The results show that NPLs have a significant negative effect on Gross Domestic Product (GDP) growth. In contrast, inflation is found to have a positive relationship with GDP growth, suggesting that moderate inflation may stimulate economic activity. Furthermore, government regulations are shown to have a positive influence on GDP growth, highlighting the importance of a well-structured regulatory environment. These findings emphasize the need to strengthen financial sector stability, carefully manage inflation, enhance regulatory frameworks, and encourage sectoral diversification to ensure sustainable economic growth in Cambodia. The study also underscores the importance of further research to better understand the mechanisms underlying the relationship between these variables and economic performance.

Keywords: financial sector stability; regulatory frameworks; inflation management

1. Introduction

The microfinance sector in Cambodia has been a cornerstone of financial inclusion, providing critical access to credit for underserved populations, small businesses, and entrepreneurs. This sector has significantly contributed to Cambodia's economic growth, supporting key sectors such as agriculture, trade, industry, and household financing. However, recent trends indicate growing challenges, particularly in the form of rising Non-Performing Loans (NPLs), which pose a threat to the microfinance institutions (MFIs) sector's stability and long-term sustainability. According to the National Bank of Cambodia (NBC) 2023 annual report, the MFIs sector's total assets decreased by 40.9%, amounting to KHR 26.2 trillion (USD 6.4 billion), a more significant decline than the previous year's 19.8%. Similarly, microfinance credit contracted by 42.6%, reaching KHR 22.4 trillion (USD 5.4 billion), affecting 1.6 million accounts. This contraction marks a troubling trend for the sector's capacity to provide financial support across Cambodia's economy.

A closer look at sectoral allocations reveals the severe impact of these declines across various industries. The household sector saw a 49.2% drop in microfinance credit, while agriculture experienced a 32% decline. Other sectors such as trade and commerce, services, and transportation were equally affected, with declines ranging from 52.4% to 64.6%. Conversely, a slight increase of 3.7% was observed in the "other" category, which includes smaller sectors. The microfinance sector also saw a decrease in liquidity, as microfinance deposit-taking institutions reported deposits amounting to KHR 9.2 trillion (USD 2.2 billion) from 1.9 million accounts. Despite the drop in credit allocations, interest rates on both deposits and loans increased in 2023, with KHR and USD deposit rates rising to 8.39% and 8.25%, respectively, and loan rates increasing to 17.44% and 16.2% (NBC, 2023).

The rise in NPLs, exacerbated by these financial strains, poses significant challenges to the microfinance sector's ability to meet the growing credit demands of borrowers. Existing literature on the subject has highlighted several potential causes for the growth in NPLs, including economic shocks, inflation, government regulation, and borrower defaults. The impact of the COVID-19 pandemic on borrowers' ability to repay loans has been significant,

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particularly in the microfinance sector in developing countries like Cambodia (Evans & Ntim Adjei, 2014). The pandemic disrupted income sources and exacerbated defaults in the microfinance sector in several developing countries, including Cambodia. Similarly, inflationary pressures and economic instability often lead to an increase in default rates as borrowers face higher costs of living and reduced financial capacity. The influence of government regulation, particularly in areas of loan terms and interest rates, on NPLs in MFIs has been extensively studied (Hassan et al., 2022). However, there is limited research focused specifically on Cambodia's microfinance sector in the context of current economic environment and recent disruptions. While previous studies have established the link between broader economic instability and rising NPLs, the unique challenges faced by Cambodian MFIs – such as the post-pandemic recovery and shifting geopolitical dynamics – have not been fully explored.

This research seeks to address this gap by examining the factors contributing to the increasing NPLs in Cambodia's microfinance sector and the broader implications for sustainable economic growth. The rising NPL rate threatens not only the financial health of MFIs but also the broader economic stability of Cambodia. Given the pivotal role that MFIs play in driving financial inclusion and economic development, understanding the root causes of rising NPLs and their economic implications is critical for safeguarding the sector's long-term sustainability. By exploring these challenges, this study aims to provide actionable recommendations to enhance the resilience of Cambodia's microfinance sector and mitigate the risks associated with rising NPLs, thus contributing to the country's economic goals, including achieving upper-middle-income status by 2030 and high-income status by 2050.

1.1. Objective of Study

The primary objective of this study is to examine the impact of NPLs on Cambodia's economic growth. Specifically, the study seeks to explore how increasing NPL levels in the microfinance sector affect the country's overall economic performance, particularly in terms of whether rising NPLs constrain the sector's capacity to provide essential credit, thus hindering the development of key industries driving economic growth. Additionally, the study will investigate how inflation influences consumers' purchasing power and borrowers' financial stability, potentially exacerbating the slowdown in economic expansion. The research will also assess the role of government regulation, with a focus on loan terms, interest rates, and microfinance stability, to understand how these policies shape the broader economic landscape. By analyzing the combined challenges posed by rising NPLs, inflation, and government regulation, this study aims to provide valuable insights and offer actionable policy recommendations to foster sustainable eco-nomic growth in Cambodia.

1.2. Hypothesis development

In the context of this study, the relationship between NPLs, inflation, government regulation, and economic growth in Cambodia's micro-finance sector can be examined through several key hypotheses. These hypotheses are designed to assess the direct and indirect impacts of rising NPLs, inflationary pressures, and regulatory factors on Cambodia's broader economic performance:

H1: Increasing levels of NPLs in Cambodia's microfinance sector negatively impact economic growth.

H2: Inflation has a negative effect on Cambodia's economic growth by diminishing consumers' purchasing power and borrowers' financial stability.

H3: Government regulation, specifically in terms of loan terms, and microfinance stability, significantly influences Cambodia's economic growth.

2. Literature Review

2.1. Theoretical Review

The relationship between microfinance, NPLs, inflation, government regulation, and economic growth has been widely explored within the frameworks of financial intermediation theory, the credit channel of monetary policy, and regulatory theory. This review examines relevant theoretical perspectives to better understand how NPLs and related factors affect economic growth in Cambodia. According to financial intermediation theory, MFIs play a critical role in facilitating credit flow in an economy, particularly in underserved markets. However, as NPLs rise, these institutions face increased risk, which hampers their ability to provide loans and support economic activity (Saliba et al., 2023). This process, in turn, restricts credit availability, which can impede the growth of key industries and economic

development.

The credit channel theory further elaborates that inflation, which drives up interest rates, can worsen borrower defaults by eroding the real income and purchasing power of borrowers, thereby increasing NPLs and reducing the flow of credit to essential sectors (Deng & Yao, 2020). In this context, rising NPLs become a barrier to economic growth, especially in critical sectors such as agriculture, trade, and small businesses, which rely heavily on accessible credit.

Regulatory theory emphasizes the importance of government regulation in maintaining the stability of financial institutions (Loomans & Kaika, 2021). Effective regulation helps prevent risky lending practices, ensures appropriate capitalization of financial institutions, and protects the broader economy from financial instability. On the other hand, ineffective regulation can exacerbate the problem of rising NPLs, leading to financial crises and stunted economic growth (Nguyen et al., 2022). Furthermore, inflation undermines consumer purchasing power, further aggravating financial strains on borrowers and contributing to higher NPL rates.

As highlighted by Abaidoo and Agyapong (2023), inflationary pressures decrease consumers' and businesses' ability to repay loans, amplifying the risk of defaults and slowing economic growth. Previous studies consistently find that rising NPLs are closely linked to slowed economic performance as they limit the flow of credit (Bocean & Vărzaru, 2023). In Cambodia, where the microfinance sector plays a vital role in economic development, understanding these theoretical perspectives is crucial for identifying the challenges in managing rising NPLs and fostering long-term, sustainable growth.

2.2. Empirical Review

The effect of NPLs on economic growth has been widely re-searched, with studies consistently showing that high NPL levels adversely affect lending capacity, economic stability, and growth potential. Goyal, Singhal, and Mishra (2023) found that elevated NPL levels lead banks to hold more reserves to cover potential loan defaults, limiting their capacity to extend new credit. This reduced lending capacity is especially harmful to economic growth in developing countries, where credit is essential for investment and expansion. Similarly, Hassan, Sheikh, and Rahman (2022) highlighted that NPLs in the microfinance sector hinder access to affordable credit, which is crucial for small businesses and rural households, thereby stalling poverty reduction and economic growth.

Inflation, a key macroeconomic variable, is another factor influencing economic performance, particularly in economies with high levels of microfinance. Cieslak and Pflueger (2022) highlight that inflation erodes consumers' purchasing power, which, in turn, reduces consumption and economic growth. Government regulation plays a significant role in shaping the microfinance sector's stability, particularly in ensuring that MFIs can manage risks associated with NPLs (Masengi et al., 2023). A study by An and Pivo (2020), Blanchard (2019), and Naoaj (2023) argue that effective regulation, including the monitoring of loan terms, interest rates, and capital adequacy, can mitigate the adverse impacts of NPLs on financial stability.

The relationship between NPLs and economic growth has been explored extensively within the banking sector. The high levels of NPLs have been found to create a negative feedback loop where impaired bank balance sheets reduce lending capacity, ultimately limiting economic growth (Pavković et al., 2018). The study emphasizes that rising NPLs weaken bank profitability and capital adequacy, leading banks to tighten credit standards and hold more reserves, which restricts funds available for productive investment.

High NPLs impact the availability of credit for SMEs, which are critical drivers of economic growth, particularly in emerging markets. The study by Khan, Ali, Hossain, and Bairagi (2023) found that countries with elevated NPL ratios experienced lower SME lending. The study highlights that SMEs face greater challenges in accessing credit, especially in developing countries, where banks view them as higher-risk borrowers due to economic volatility and underdeveloped financial markets. Reduced access to financing for SMEs directly hampers employment and growth in these economies (Frey & Osborne, 2017).

MFIs are particularly vulnerable to the effects of NPLs, which can significantly impact their ability to support low-income populations and small-scale businesses. The high NPLs in MFIs led to higher interest rates on loans, as institutions attempted to offset losses from bad debts (Hassan et al., 2022). This increase in interest rates further discouraged borrowing among low-income individuals and micro-entrepreneurs, limiting the poverty reduction impact and potential economic contributions of the microfinance sector.

NPLs are also influenced by macroeconomic variables such as Gross Domestic Product

(GDP) growth, inflation, and exchange rates. The study of the Greek banking system revealed that macroeconomic factors, particularly unemployment and GDP growth, had significant predictive power for NPL levels (Kyriazopoulos, 2023). During economic downturns, high unemployment rates and reduced GDP growth led to increased NPLs, reinforcing the cyclical relationship between economic performance and credit risk in the banking sector.

Effective government regulation plays a crucial role in mitigating the impact of NPLs on financial stability. The robust regulatory frameworks, such as stricter capital requirements and more rigorous oversight, were effective in reducing the adverse effects of NPLs in Eastern European countries (Malovaná & Ehrenbergerová, 2022). The research suggests that government intervention through policy measures that address NPL accumulation, such as credit risk assessment standards and capital adequacy requirements, can help protect the banking sector from systemic risk and enhance financial stability.

Economic recessions often exacerbate NPL issues, as economic stress reduces borrowers' ability to repay loans. During the 1990s recession, Verho (2020) examined the impact of economic crises on unemployment persistence, shedding light on the effects of recessionary pressures on various economic indicators. Specifically, Verho's study provides insights into the repercussions of the 1990s recession on different sectors, including the U.S. banking sector. The findings of the study are relevant to the observed increase in NPL ratios and the resulting lending constraints in the U.S. banking sector during the 1990s recession. The study highlighted that bank with high NPLs had to divert resources towards loss provisions, which further limited credit availability for productive investments and contributed to slower economic recovery.

The 2008 global financial crisis underscored the impact of NPLs on economic resilience. A study by Reinhart and Rogoff (2010) reviewed financial crises across history and showed that rising NPLs were a common precursor to banking crises. They found that once NPL levels surpassed a certain threshold, banks faced liquidity constraints and credit markets contracted sharply, precipitating prolonged economic downturns. Their analysis indicates that NPLs not only affect individual institutions but also pose systemic risks that can de-stabilize the entire financial sector.

3. Materials and Methods

3.1. Research Design

The primary objective of this study is to examine the impact of NPLs on Cambodia's economic growth. To achieve this, the study employs an explanatory approach using panel data analysis. Panel data offers significant advantages, including the ability to control for individual heterogeneity, minimize collinearity among variables, and observe trends over time, which are limitations of simple time-series and cross-sectional data (Wooldridge, 2022).

3.2. Data

This study utilizes annual panel data spanning from 2017 to 2023, collected from 62 MFIs in Cambodia. GDP growth, defined as the annual percentage change in a country's GDP, and the inflation rate, also measured as a percentage, are both sourced from the National Institute of Statistics of Cambodia. Inflation refers to the rate at which the general level of prices for goods and services rises, eroding purchasing power (Özsoy & Tasinato, 2023). NPLs, measured as a percentage, are sourced from the National Bank of Cambodia. NPLs represent the portion of loans in a financial institution's portfolio that are in default or close to being in default (Wang et al., 2023). Government Regulation is measured as an index, with data sourced from the World Bank. This index represents the set of rules, guidelines, and oversight mechanisms that govern the operations of MFIs in a country. It reflects the extent and effectiveness of government policies regulating the financial sector, including interest rates, loan terms, and capital requirements (Akhmaddhian et al., 2023). These data enable an analysis of the relationship between NPLs, inflation, government regulation, and Cambodia's economic growth over the study period.

3.3. Econometrics Model

To assess the influence of NPLs, Inflation Rate, and Government Regulation on GDP growth in Cambodia, this study employs a panel regression model. Panel data analysis offers significant advantages by enabling the control of unobserved heterogeneity at both the cross-sectional (MFIs) and temporal (over time) dimensions. This methodological approach accounts for individual-specific effects, thus enhancing the robustness of the results and

mitigating potential biases associated with omitted variable bias or endogeneity that may arise in simpler regression models (Baltagi, 2021). Panel regression analysis, particularly with fixed or random effects, allows for greater precision in estimating the effects of these variables on economic growth, thus offering valuable insights for policymakers, financial regulators, and stakeholders in the microfinance sector (Jiang & Ye, 2022).

The dependent variable in this analysis is GDP growth, which serves as a critical measure of economic performance and reflects the aggregate output growth of the Cambodian economy (Lianos et al., 2023). The independent variables consist of key macroeconomic and financial indicators, including the level of NPLs in MFIs, the prevailing inflation rate, and the regulatory framework governing the financial sector. By incorporating both time-series and cross-sectional data, the model allows for an in-depth exploration of the dynamic relationships between these variables, offering insights into how fluctuations in NPLs, inflation, and government regulation influence the trajectory of GDP growth over the study period (Liu et al., 2023). This approach enables a comprehensive understanding of the factors that shape economic growth in Cambodia, providing actionable insights for policymakers and stakeholders in the financial sector. The empirical model proposed in this study is specified as follows:

$$GDPgr_{it} = \gamma_0 + \gamma_1 NPLs_{it} + \gamma_2 InflRate_{it} + \gamma_3 GortReg_{it} + \varphi_i + \varepsilon_{it} \quad (1)$$

In the model (1), $GDPgr_{it}$ denotes the GDP growth rate for microfinance institution i at time t. $NPLs_{it}$ stands for Non-Performing Loans for microfinance institution i at time t, which indicates the level of bad loans within the institution. $InflRate_{it}$ refers to the Inflation Rate for microfinance institution i at time t, capturing the percentage change in the general price level of goods and services. $GortReg_{it}$ is the Government Regulation at time t, reflecting the influence of government policies, laws, and regulations on the economy. γ_0 is the intercept term in the model, representing the baseline GDP growth rate when all the independent variables (NPLs, inflation, and government regulation) are zero. $\gamma_1, \gamma_2, \gamma_3$ are the coefficients for the independent variables NPLs, inflation rate, and government regulation, respectively. φ_i captures MFI-specific effects, accounting for unobserved heterogeneity across MFIs, such as institutional characteristics that remain constant over time. Finally, ε_{it} is the error term, which accounts for all other unobserved factors that affect GDP growth but are not included in the model.

To ensure the robustness and validity of the panel regression models employed in this study, several diagnostic tests are performed. These tests include the unit root test to assess the stationarity of the data, which is important because non-stationary data can lead to spurious regression results (Cai & Omay, 2022). The Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) Fisher test are used for this purpose. The multicollinearity test is conducted using both a correlation matrix and the Variance Inflation Factors (VIF) to detect any potential correlations among the independent variables. High correlations between variables can distort regression coefficients, and the VIF quantifies how much a variable's variance is inflated due to collinearity with other variables (Juarto,2023). The heteroskedasticity test checks for non-constant variance of the error terms, as heteroskedasticity can lead to inefficient estimates. Tools such as the Breusch-Pagan or White test are commonly used for this purpose (Raza et al., 2023). Additionally, the Ramsey RESET test is used to verify the functional form of the model, ensuring that no relevant non-linear relationships are omitted (Christodoulou-Volos & Tserkezos, 2023). The Jarque-Bera (JB) normality test is conducted to examine whether the residuals follow a normal distribution, which is a key assumption in many statistical tests (Desgagné & Micheaux, 2018). The Hausman test is performed to determine whether fixed or random effects should be used, based on whether individual effects are correlated with the regressors (Stater & Hoag, 2023). These tests collectively help ensure that the regression model is specified correctly, that the assumptions hold, and that the estimates are reliable for drawing meaningful conclusions from the panel data. The formulas for the diagnostic tests used in panel regression analysis:

The ADF test checks for a unit root in the time series data and tests the null hypothesis that a series has a unit root (i.e., is non-stationary). The ADF equation is:

$$\Delta y_t = \alpha + \beta_t + \theta y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta y_{t-1} + \varepsilon_t \quad (2)$$

y_t is the time series data, and Δy_t represents the first difference of the data. α is the constant term, β_t is a deterministic trend, and $\theta y_{t-1}$is the lag of the series. The sum of

lagged first differences (with coefficients δ_i) is included to account for autocorrelation. ε_t represents the error term. The test essentially assesses if the series is stationary, which is a key assumption in many econometric models.

The PP test is similar but corrects for autocorrelation and heteroskedasticity in the error terms. The test is based on the regression:

$$\Delta y_t = \alpha + \theta y_{t-1} + \varepsilon_t \quad (3)$$

This model is simpler as it does not include lagged differences of the dependent variable, unlike the ADF test. The main difference lies in the correction for autocorrelation and heteroskedasticity, which makes the PP test more robust under these conditions.

A simple correlation matrix calculates pairwise correlations between the independent variables to check for multicollinearity. If the correlation between two variables is very high (typically above 0.8 or 0.9), multicollinearity may be a concern.

$$\text{Corr}(X_i, X_j) = \frac{\sum(X_i-\bar{X}_i)(X_j-\bar{X}_j)}{\sqrt{\sum X_i-\bar{X}_i)^2(X_j-\bar{X}_j)^2}} \quad (4)$$

To investigate multicollinearity among the independent variables, VIFs are calculated using the formula:

$$VIF_j = \frac{1}{1-R_j^2} \quad (5)$$

Where R_i^2 is the coefficient of determination from the regression of the j^{th} variable on all other independent variables. Typically, a VIF value greater than 10 indicates high multicollinearity.

The Breusch-Pagan test is used to detect heteroskedasticity in the error terms. The null hypothesis is that the variance of the error term is constant (homoskedasticity). This involves estimating an auxiliary regression where the squared residuals e_i^2 from the original model are regressed on the independent variables

$$e_i^2 = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots\ldots + \beta_k X_{ki} + \mu_i \quad (6)$$

The test statistic is calculated as:

$$\text{LM} = \frac{n.R^2}{2} \quad (7)$$

Furthermore, specification tests, including the Ramsey RESET test, are conducted to confirm the appropriateness of the model's functional form (Sapra, 2018). This test estimates the following model:

$$Y_i = \alpha + \delta_1 X_{1i} + \delta_2 X_{2i} + \delta_3 X_{3i} + \ldots\ldots + \delta_k X_{ki} + \emptyset_1 \hat{Y}^2 + \emptyset_2 \hat{Y}^3 + \mu_i \quad (8)$$

The F-statistic for this test is calculated as:

$$F = \frac{(SSR_{restricted} - SSR_{unstricted})/m}{SSR_{unstricted}/(n-k-m)} \quad (9)$$

To assess the normality of the residuals, the Jarque-Bera (JB) test statistic is calculated as follows (Upendra et al., 2023):

$$JB = \frac{n}{6}(S^2 + \frac{(k-3)^2}{4}) \quad (10)$$

n is the sample size, S^2 is the skewness, and k is the kurtosis of the residuals. A significant result (high JB statistic) suggests non-normality in the residuals.

Finally, the Hausman test is used to determine whether fixed or random effects are more appropriate for the panel data model. The test compares the estimates from both models. The test statistic is:

$$\text{H} = (\hat{\beta}_{FE} - \hat{\beta}_{RE})'[Var(\hat{\beta}_{FE}) - Var(\hat{\beta}_{FE})]^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{RE}) \quad (11)$$

$\hat{\beta}_{FE}$ and $\hat{\beta}_{RE}$ are the coefficients from the fixed effects and random effects models, respectively. The test helps decide whether to use fixed effects (if the coefficients are significantly different) or random effects (if there is no significant difference).

Collectively, these diagnostic evaluations reinforce the reliability and integrity of the regression analysis.

4. Results and Discussion

The section examines the impact of NPLs on Cambodia's economic growth, focusing on the reliability and validity of the regression models used. The analysis begins with descriptive statistics, which offer an overview of the data's central tendencies (mean, median) and its variability (standard deviation, range). Descriptive statistics play a crucial role in understanding the data before further analysis, and this preliminary step is essential (Bren & Tchetgen, 2022). Next, the unit root test is performed to assess the stationarity of the data, as non-stationary data could lead to spurious results. Following this, the multicollinearity test is conducted to detect any correlations among the independent variables that could distort the regression coefficients. Finally, a series of diagnostic tests are carried out to confirm the robustness of the regression results.

4.1. Statistical Summary

Descriptive statistics are essential for summarizing data on GDP growth, NPLs, the inflation rate, and government regulation. Emphasizing central tendency measures like the mean and median, as well as dispersion indicators such as the standard deviation, descriptive statistics offer a clear view of typical values and data variability. Additionally, observing maximum and minimum values, we gain insights into the range, enhancing our understanding of the extremes within these economic indicators. This approach establishes a foundation for interpreting trends, identifying anomalies, and supporting further statistical analysis

Table 1. Statistical summary.

Variable	Obs	Mean	Std. Dev.	Min	Max
GDPgr	434	.046	.0345569	-.031	.075
NPLs	434	.11135	.16618	0	.89732
InflRate	434	.02345	.0147	-.006718	.03970
GovtRegs	434	-.54857	.19126	-.71	-.11

The dataset contains 434 observations, providing insights into key variables related to Cambodia's economic growth. The GDP growth rate has a mean of 4.6%, with a standard deviation of approximately 3.46%. The minimum observed GDP growth rate is -3.1%, while the maximum is 7.5%, indicating significant variability in economic performance over the study period.

The NPLs variable has an average value of 11.14%, with a standard deviation of 16.62%. The values range from 0% to 89.73%, reflecting varying levels of financial sector health across institutions and time. The Inflation Rate has a mean of 2.35%, with relatively low variability (standard deviation of 1.47%). The minimum inflation rate recorded is -0.67%, while the maximum is 3.97%, showing a relatively stable inflation environment during the study period.

Lastly, the Government Regulations variable, represented as an index, has a mean of -0.54857 and a standard deviation of 0.19126. The values range from -0.71 to -0.11, indicating differences in the stringency or effectiveness of regulatory frameworks over time and across institutions.

4.2. Unit Root Test

To ensure the validity of the econometric analysis, the stationarity of the panel data is examined using unit root tests, specifically the Augmented Dickey-Fuller (ADF) test and the PP-Fisher test. As shown in Table 2, the variables GDP growth (GDPgr), inflation rate (InflRate), and government regulation (GovtRegs) are stationary at the level in both tests. However, NPLs is stationary only after first differencing, indicating that this variable needs to be differenced to achieve stationarity. Ensuring stationarity is essential for reliable model estimation and inference in panel data analysis.

Table 2. Unit root test results for panel data variables.

Variable	Level	Fist difference

	ADF-Fisher chi-square	PP-Fisher chi-square	ADF-Fisher chi-square	PP-Fisher chi-square
	P-value	P-value	P-value	P-value
GDPgr	0.0001*	0.0001		
NPLs	0.9974	0.9974	0.0000*	0.0000*
InflRate	0.0000*	0.0000*		
GovtRegs	0.0000*	0.0000*		

Note: * Statistical significance at the 1% level; ** Statistical significance at the 5% level.

4.3. Multicollinearity Test

In econometric regression analysis, multicollinearity occurs when independent variables are highly correlated, resulting in unreliable estimates of regression coefficients (Kyriazos & Poga, 2023). To diagnose this issue, the correlation matrix and VIF are commonly used. VIF measures the extent to which the variance of a regression coefficient is inflated due to multicollinearity. A high VIF value indicates significant multicollinearity, suggesting that the respective independent variable may be redundant (Thompson et al., 2017). This section examines the use of the correlation matrix and VIF to identify and mitigate multicollinearity, thereby enhancing the reliability and precision of the regression model. Table 3 presents the correlation matrix and VIF estimates for the independent variables. Notably, none of the variables have a VIF value exceeding the conventional threshold of 10, indicating no substantial multicollinearity among the independent variables in the model.

Table 3. Correlation matrix and VIF estimation.

Variable	VIF	d.NPLs	InflRate	GovtRegs
d.NPLs	1.05	1.0000		
InflRate	1.03	-0.1615	1.0000	
GovtRegs	1.02	0.1238	0.0422	1.0000

4.4. Parameter Estimation

Based on the Model Estimation Results for GDP growth in Table 4, the findings offer critical insights into the factors that drive GDP growth within Cambodia's economic framework. The regression results indicate that a 1 percentage point increase in NPLs is associated with a 0.0109 percentage point decrease in GDP growth, suggesting that higher NPL levels hinder economic performance. This relationship is marginally significant (p-value = 0.064), which supports Hypothesis 1 (H1), positing that increasing levels of NPLs in Cambodia's microfinance sector have a negative impact on economic growth. Theoretically, this result aligns with credit channel theory, which posits that higher levels of NPLs constrain lending capabilities, limiting investment and economic growth. Empirically, studies by Goyal, Singhal, and Mishra (2023) and Hassan, Sheikh, and Rahman (2022) support this view, showing that high NPL ratios can stymie credit flow and thereby impede economic expansion.

The analysis further shows that a 1 percentage point increase in inflation is linked to a 2.086 percentage point increase in GDP growth, with this relationship being highly statistically significant (p-value = 0.000). This finding contradicts Hypothesis 2 (H2), which expected a negative relationship between inflation and GDP growth. Instead, the positive effect of inflation suggests that under specific economic conditions, inflation may stimulate growth by lowering real interest rates, which can increase spending and investment. This result contrasts with the views highlighted by Abaidoo and Agyapong (2023), who emphasize that inflationary pressures decrease consumers' and businesses' ability to repay loans, amplifying the risk of defaults and slowing economic growth. Additionally, it diverges from the empirical findings of Cieslak and Pflueger (2022), who highlight that inflation erodes consumers' purchasing power, thereby reducing consumption and hampering economic growth.

Additionally, government regulations exhibit a positive and significant association with GDP growth; a 1-unit increase in the government regulation index results in a 0.0406 percentage point increase in GDP growth (p-value = 0.000). This result confirms Hypothesis 3 (H3), which asserts that government regulations significantly influence Cambodia's economic growth. This finding aligns with Regulatory Theory, which underscores the role of government regulation in stabilizing financial institutions by preventing risky lending, ensuring

adequate capitalization, and safeguarding the broader economy, thereby fostering sustainable economic growth. Empirical evidence from Malovaná and Ehrenbergerová (2022) highlights the critical role of effective government regulation in mitigating the impact of NPLs on financial stability, thereby fostering economic stability.

Table 4. Model estimation results for GDP growth.

Variable	Coef.	Std. Err.	Z-stat.	P-value	Conf. Interval
d.NPLs	-0.0109	0.0059	-1.86	0.064	-0.0226 to 0 .0006
InflRate	2.0860	0.0423	49.27	0.000	2.0031 to 2.1691
GovtRegs	0.0406	0.0031	12.95	0.000	0.03446 to 0.0468
Constant	0.0192	0.0021	8.98	0.000	0.01502 to 0.0234
Overall R-square	0.882				
Number of obs	434				
Number of group	62				
Prob > chi2	0.0000				
Heteroskedasticity Test	1.0000				
Ramsey RESET Test	0.1301				
Hauman Test	P-value=0.9830		Random effect		

Note: * Statistical significance at the 1% level; ** Statistical significance at the 5% level, and *** Statistical significance at the 10% level.

Overall, the model exhibits strong explanatory power, with an R-square value of 0.882, indicating that 88.2% of the variance in GDP growth is explained by the model's independent variables. Diagnostic tests further confirm that the model is well-specified, with no evidence of heteroskedasticity (p-value = 1.0000) and no indication of model misspecification (Ramsey RESET test p-value = 0.1301). Furthermore, the Hausman test (p-value = 0.9830) suggests that the random effects model is appropriate for this analysis, indicating that the random effects estimates are consistent and efficient. These findings collectively substantiate the hypotheses and significance levels within the model, supported by both theoretical frameworks and empirical literature, thereby reinforcing the robustness of the analysis.

5. Conclusions and Recommendation

The primary objective of this study is to examine the impact of NPLs on Cambodia's economic growth. First, the analysis shows that NPLs significantly affect GDP growth, supporting Hypothesis 1 (H1). Specifically, a 1 percentage point increase in NPLs is associated with a 0.0109 percentage point decrease in GDP growth, with a marginal significance at the 0.1 level (p-value = 0.064). This result is consistent with both theoretical and empirical literature, which suggests that higher levels of NPLs can negatively influence economic performance by increasing financial instability and reducing the availability of credit for productive investments. Second, inflation, which was expected to have a negative effect on economic growth as outlined in Hypothesis 2 (H2), shows a significant positive relationship with GDP growth instead. A 1 percentage point increase in inflation leads to a 2.086 percentage point increase in GDP growth, with high statistical significance (p-value = 0.000). This result contradicts the expected negative impact of inflation, suggesting that under certain conditions, inflation may stimulate economic activity. However, it contrasts with the view that inflationary pressures reduce the capacity of consumers and businesses to repay loans, increase default risks, and hinder economic growth. Similarly, it diverges from the perspective that inflation erodes purchasing power, thereby reducing consumption and impeding economic growth. Lastly, government regulations are found to significantly positively influence GDP growth, as supported by Hypothesis 3 (H3). The results indicate that a 1-unit increase in the government regulation index corresponds to a 0.0406 percentage point increase in GDP growth, with high statistical significance (p-value = 0.000). This aligns with Regulatory Theory, which emphasizes the role of regulation in stabilizing financial institutions and fostering sustainable economic growth. Empirical evidence further underscores the importance of effective regulation in mitigating NPLs and promoting economic stability.

The findings of this study suggest several key recommendations to support sustainable

economic growth in Cambodia. Strengthening the stability of the financial sector is crucial in light of the negative impact of NPLs on GDP growth. Policymakers and regulatory bodies should collaborate closely with banks and financial institutions to monitor and manage NPL levels. This may involve implementing stricter credit assessment standards, focusing on high-risk lending areas, and encouraging timely loan repayment to reduce the adverse effects of NPLs on economic performance.

Another important recommendation is to manage inflation carefully. The study indicates that inflation has a positive relationship with GDP growth, suggesting that a controlled level of inflation can stimulate economic activity. Therefore, it is important for policymakers to maintain inflation within a moderate range, allowing it to encourage spending and investment while avoiding negative consequences for purchasing power and economic stability. This could be achieved through regular adjustments to monetary policy, which would balance inflationary pressures with the goal of fostering long-term growth.

The results also highlight the significant role of government regulations in driving GDP growth. A stable and transparent regulatory environment is essential to creating a favorable business climate that attracts investment. Continued efforts to enhance regulatory frameworks, ensuring that they remain effective and relevant in a changing economy, will support economic growth. Regular updates and fair enforcement of regulations can contribute to a predictable business environment that encourages both domestic and foreign investment.

Encouraging diversification within Cambodia's economic sectors is another critical strategy. By promoting growth in sectors less vulnerable to financial instability, such as technology, renewable energy, and manufacturing, the country can reduce risks associated with NPLs and inflation. This will foster economic resilience and ensure more balanced, sustainable development in the long run.

Finally, further research is essential to deepen the understanding of the mechanisms through which inflation and government regulation influence economic growth. Future studies could explore additional factors such as interest rates, investment levels, and sector-specific regulations to better inform policy decisions and improve Cambodia's economic performance.

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