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The Impact of CAMELS on Banks' Credit in Cambodia: A Two-Step GMM Method

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Abstract

The aim of this research was to examine the components of the CAMELS framework, which encompasses capital adequacy, asset quality, management quality, earnings quality, liquidity, and sensitivity to market risk, as utilized by the central bank to assess the health of banks. To address this objective, a research question was formulated: Do all components of CAMELS significantly influence the credit growth of banks? To answer this question, a dynamic panel data model was employed, utilizing a two-step GMM approach. This model not only included the CAMELS variables but also integrated three macroeconomic indicators: the growth rate of real GDP, money supply, and government spending. The empirical results indicated that capital adequacy and earnings quality significantly affected credit growth, while asset quality, management quality, and sensitivity to market risk negatively impacted banks' credit. Additionally, the findings revealed that the growth of real GDP and money supply positively contributed to credit growth, whereas the relationship between government spending growth and banks' credit was found to be insignificant.

Keywords: *Banks' Credit, CAMELS, Dynamic Panel Data Model, Two-Step GMM Method.*

Introduction

Banks play a crucial role in the economy by providing credit to the public, which is essential for economic growth and stability. Credit allows individuals and businesses to borrow money for various purposes, such as purchasing homes, starting or expanding businesses, and investing in education. By offering loans, banks act as intermediaries between savers, who deposit their funds, and borrowers, who need capital. This flow of credit supports economic activity by encouraging consumption, investment, and innovation (Losifidi et al., 2021). For businesses, access to credit is particularly important as it enables them to finance operations, purchase inventory, and expand their workforce. Without the availability of loans, many businesses would struggle to grow or even survive, limiting job creation and overall economic development (Nippani et al., 2024). For individuals, credit provides opportunities for major life events like buying a home or financing education, which can lead to long-term financial security and prosperity. Additionally, banks help regulate the money supply by managing how credit is distributed and ensuring financial stability. Through responsible lending practices, they prevent excessive borrowing that could lead to inflation or financial crises. Overall, the provision of credit by banks fosters economic growth, supports entrepreneurship, and enhances the financial well-being of the public (Xie and Hu, 2024).

The CAMELS rating system is a crucial tool used by regulators to assess the financial health and stability of banks. It evaluates banks based on six key components: Capital adequacy, Asset quality, Management quality, Earnings, Liquidity, and Sensitivity to market risk (Wang et al., 2024). This assessment impacts a bank's credit growth, as it directly influences its ability to lend and attract investors. Banks with strong CAMELS ratings generally enjoy better access to capital markets, enabling them to offer more credit to the public. A high rating in capital adequacy ensures that banks have sufficient capital to absorb potential losses, which supports lending activities. Good asset quality indicates that a bank's loan portfolio is relatively risk-free, making it more willing to extend credit to borrowers. Additionally, a bank with strong management and earnings is better equipped to handle economic challenges and provide stable credit growth (Sifrain, 2024). Conversely, poor ratings in any of the CAMELS components can lead to restrictions on lending, as regulators may impose limits on riskier loans or require additional capital reserves. In this way, CAMELS ratings provide a balance between promoting credit growth and ensuring that banks maintain financial stability, ultimately contributing to the health of the broader economy (Gopalan, 2022). Poor ratings in any

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of the CAMELS components, such as low capital reserves or weak asset quality, may lead to reduced credit growth. Regulatory bodies may impose restrictions on lending or require additional capital, curbing a bank's ability to offer loans. Thus, the CAMELS rating system ensures that banks grow credit responsibly while maintaining financial stability (Citterio, 2024).

The objective of this study is to investigate the impact of CAMELS rating on credit growth of commercial bank in Cambodia. This study is also trying to find an answer to the following research question: Does all element of CAMELS have significant influence on banks' credit in Cambodia banking industry. The analysis of data relying on dynamic panel data model through the two-step generalized method of moment (GMM) technique. This research has been classified into five sections include introduction, literature review, research methodology, empirical results, and conclusion.

Literature Review

There exist two categories of theories regarding the impact of capital on bank lending. In accordance with the financial fragility-crowding out hypothesis, Berger and Bouwman (2021) contend that shareholders display greater hesitancy in providing loans when they allocate larger sums of money into their respective banks. Moreover, they exhibit increased prudence when making investment choices. Consequently, banks with higher capitalization may offer a reduced number of loans compared to banks with lower capitalization. Conversely, the risk absorption theory suggests that capital has a positive effect on bank lending. In line with this, maintaining a larger capital buffer enhances the ability to bear risks and safeguards banks from potential losses (Coval & Thakor, 2005). Consequently, financial institutions will be motivated to embrace a more expedited approach towards expanding their loan portfolio. Extensive research has been conducted to examine the impact of capital on bank lending. In initial investigations, numerous scholars have demonstrated that augmenting bank capital can lead to varying degrees of accelerated loan growth (Repullo, 2014).

In recent studies, Carlson et al., (2020), Louhichi and Boujelbene (2017), and Košak et al., (2015) have examined the relationship between bank capital and lending behavior using data from the US, Europe, and the global context. Their findings consistently indicate a positive correlation between bank capital and lending activity. However, there are also some conflicting conclusions. According to Kim and Sohn (2017), US banks with higher capital levels tend to expand their lending aggressively only after they have accumulated sufficient liquidity. On the other hand, Roulet (2022) focuses on banks in the euro area and discovers that capital ratios have a negative impact on retail lending during the post-2008 financial crisis period.

Asset quality is widely recognized in the literature as a crucial factor that influences bank lending. When a bank faces a high level of credit risk, it tends to prioritize strengthening its risk supervision rather than increasing its loan portfolio (Altunbas et al., 2020). Lenders become more cautious when they observe higher ratios of bad debt and loan loss provisions, which can result in stricter lending standards and a reduction in lending activities (O'Brien & Browne, 1992). Consequently, banks may become reluctant to disburse loans due to the deterioration in loan quality, leading to a decline in lending segments, as highlighted by Heid and Krüger (2011). This decline in lending can have adverse effects on bank profitability, capital adequacy, and the overall capacity of banks to support the economy (Ben Naceur et al., 2018).

Several studies have examined the relationship between asset quality and loan creation, but few have directly measured its impact. Delis et al., (2014) conducted a study using bank-level data and found that lending by US banks decreases when customers are anxious, particularly when banks face high credit risk. Adesina (2019) analyzed loan loss provisions as a measure of bank loan quality and concluded that poor asset performance hinders banks' ability to provide loans. Tracey and Leon (2011) took a different approach and discovered that banks respond differently to the non-performing loan ratio, with risky banks significantly reducing their lending when the ratio exceeds a certain threshold. However, Aysan and Disli (2019) present contrasting findings for Turkey, stating that an increase in non-performing loans does not affect bank

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lending activities. They argue that diversified funding can help banks withstand the reduced returns from deteriorated investments.

Jeitschko and Jeung (2005) propose that the main indicator of inadequate management systems is low cost efficiency. This suggests that managers who lack experience and expertise in credit scoring may easily approve a large number of loans. Additionally, the "moral hazard" hypothesis suggests that bank managers may be incentivized to pursue riskier investments, particularly when banks are less efficient. Consequently, poorly managed banks with greater moral hazard incentives are more inclined to adopt an aggressive lending approach. On the other hand, Berger and DeYoung (1997) present an alternative hypothesis stating that well-managed banks can sustain the same loan volume with fewer operating expenses. Therefore, banks may be motivated to enhance their revenues by accelerating the pace of loan growth, thanks to their ample resources. This implies that banks with efficient management systems can achieve the desired loan volume without incurring excessive costs. In summary, low cost efficiency serves as a primary signal of poor management systems. This can lead to managers with limited experience in credit scoring approving a high number of loans. Moreover, the "moral hazard" hypothesis suggests that poorly managed banks with greater incentives for risky investments are more likely to adopt an aggressive lending schedule. However, well-managed banks can sustain the same loan volume with fewer operating expenses, motivating them to increase loan growth speed to improve revenues.

Furthermore, the issue at hand is closely connected to the segment that delves into the pass-through mechanism of cost efficiency to interest rates on loans. Scholarly research conducted earlier has provided evidence that banks with higher levels of efficiency tend to impose lower markups, thus alleviating the burden of lending rates for their clientele (Gambacorta, 2008; Havranek et al., 2016). Consequently, the reduction in borrowing expenses may serve as an incentive for an upsurge in the demand for loans (Ben Naceur et al., 2018).

The relationship between bank profitability and lending remains uncertain in theoretical terms. Certain theoretical models propose that higher profits for banks might serve as a solution to the problem of asymmetric information (Holmstrom & Tirole, 1997). The ability of banks to effectively utilize their competitive advantages allows them to attract funding from depositors and shareholders, thereby leading to a substantial increase in their lending activities. High-profit banks, in particular, are well-positioned with a wide array of loanable funds to meet the growing demand for loans. Furthermore, Dell'Ariccia and Marquez (2006) argue that banks can enhance their lending segments by capitalizing on their superior comparative advantages, potentially resulting in relaxed lending standards or even lower lending rates. Conversely, the profitability of banks has a direct impact on their risk appetite and overall business strategies.

Rajan (2006) suggests that banks are less inclined to offer loans when they experience higher returns, as this discourages them from actively seeking out higher yields. Additionally, Laidroo (2010) argues that in a highly competitive banking sector, lower interest margins may lead to an increase in loan growth. However, it is important to note that there is a limited amount of empirical analysis conducted on the relationship between bank earnings and loan growth, and further research is needed to expand our understanding in this area. Nier and Zicchino (2023) utilize a large sample of 600 listed banks globally to establish a positive correlation between bank return (measured by return on equity) and loan growth. This finding is subsequently confirmed by Bustamante et al., (2019) in their study on the banking system in Peru. Adesina (2019) challenges the previous results by examining the relationship between bank profits (proxied by return on assets) and loan growth. Interestingly, Adesina (2019) reveals a contrasting pattern, indicating a negative linkage between bank profits and loan growth. The author interprets this as a potential consequence of banks reducing loan supply in pursuit of higher returns. However, it is important to note that the primary focus of these prior works is not on bank earnings.

The lending activity of highly liquid banks can be rationalized by the precautionary motive. Gennaioli et al., (2020) propose a model that demonstrates how banks strategically opt to acquire liquid assets as a means to secure liquidity for future investments. Additionally, due to the challenges associated with immediately disbursing funds after their collection from depositors, banks may temporarily invest in liquid asset sources

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that can later be replaced by loans (Broner et al., 2014). Nonetheless, the findings of Cornett et al., (2011) indicate that banks have proactively enhanced their liquidity positions in order to mitigate liquidity risk during times of stress, resulting in a decrease in investments towards new loans. Previous studies have typically employed assets and liabilities ratios to examine the relationship between liquidity positions and the growth of bank loans (Berrospide & Edge, 2010; Roulet, 2022). The results highlight the significance of maintaining higher levels of liquidity as a driving force for banks to expand their lending operations.

Methodology

This study utilizes a technique employed by the central bank for evaluating the banking system, known as the CAMELS approach. The primary objective of the assessment conducted by the central bank is to gain insights into the overall health of the banking system. Banks play a crucial role as financial intermediaries, accepting deposits from investors with surplus funds and providing loans to those in need of additional capital. Such activities can only be effectively carried out when banks maintain a sound financial condition. Each component of the CAMELS framework serves as an indicator of the bank's health status. Consequently, a model has been developed to assess the significant impact of CAMELS on the creditworthiness of banks.

$$CREDIT_{it} = \varphi_0 + \varphi_1 CREDIT_{it-1} + \varphi_2 C_{it} + \varphi_3 A_{it} + \varphi_4 M_{it} + \varphi_5 E_{it} + \varphi_6 L_{it} + \varphi_7 S_{it} + \varphi_8 GDP_{it} + \varphi_9 M2_{it} + \varphi_{10} G_{it} + \epsilon_{it}$$

To analyze the dynamic fluctuations in bank credit, a dynamic panel data model is utilized, where CREDIT signifies the growth rate of loans or credit extended by banks. The variable C represents capital adequacy, defined as the ratio of equity to total assets, while A denotes asset quality, assessed through the measure of non-performing loans. M reflects management quality, calculated as the ratio of operating expenses to total assets, and E illustrates earning quality, evaluated by the return on assets. Liquidity, represented by L, is quantified as the ratio of liquid assets to total assets, and S indicates the sensitivity of banks to market risk, measured as the percentage of an individual bank's assets relative to the total assets of all banks in the industry for a given year. Additionally, the model incorporates three macroeconomic indicators: the real growth rate of gross domestic product (GDP), the growth rate of money supply (M2), and the growth rate of government expenditure (G). It is important to note that all variables are expressed as percentages.

One of the crucial aspects of econometric model analysis is the method utilized for estimating all parameters, represented in vector form as $\boldsymbol{\varphi} = [\varphi_0, \varphi_2, \ldots, \varphi_{10}]$, with ϵ denoting the residual term. Given the inclusion of the lagged dependent variable as an independent variable, the appropriate estimation technique employed is the two-step generalized method of moments (GMM) model, as developed by Arellano and Bond in 1991. This research spans the period from 2012 to 2023 and encompasses a dataset from 22 banks that have complete information. Data on bank credit and all components of the CAMELS framework have been gathered, and it is important to highlight that this study utilizes balanced panel data.

Empirical Analyses

The examination of the data commenced with an interpretation of descriptive statistics, followed by a comprehensive discussion and analysis of the empirical findings derived from the dynamic panel data model. Panel data represents a combination of time series and cross-sectional data. The dataset encompasses twelve years and includes twenty-two commercial banks, resulting in a total of 242 observations. The average annual credit growth is approximately 24.93%, with a minimum growth rate of -49.21% and a maximum of 756.05%. The volatility of the growth rate, as measured by the standard deviation, is around 53.60%. The average equity to asset ratio, utilized as an indicator of capital adequacy, is determined to be 24.59%. Additionally, the average values for asset quality, management quality, earnings quality, and sensitivity to market risk are recorded at 2.92%, 2.05%, 1.39%, 40.83%, and 3.56%, respectively. Throughout the duration of this study, the mean growth rates for real GDP, broad money, and government spending are estimated to be 3.06%, 8.19%, and -6.73%, respectively.

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Table 1. Descriptive Statistics

Variables	Observation	Mean	Standard deviation	Minimum	Maximum
CREDIT	242	24.93	53.60	-49.21	756.05
C	242	24.59	14.85	9.22	91.20
A	242	2.92	3.33	0.00	19.20
M	242	2.05	1.11	0.34	6.15
E	242	1.39	1.26	-7.92	4.08
L	242	40.83	13.59	13.94	85.61
S	242	3.56	4.47	0.22	19.70
GDP	242	5.67	3.06	-3.14	7.50
M2	242	21.68	8.12	8.19	39.41
G	242	11.96	9.47	-6.73	31.99

It is essential to evaluate whether there exists a problem of multicollinearity among the independent variables included in the model. To identify multicollinearity, one can utilize correlation matrices to analyze the pairwise correlation coefficients of the independent variables. Correlation values that are significantly high, generally exceeding 0.8 or 0.9, indicate a robust linear relationship among two or more variables, which may imply the presence of multicollinearity that could skew the estimates of the regression model. When independent variables exhibit high correlation, it complicates the assessment of their individual impacts on the dependent variable. A correlation matrix serves as a useful tool for visualizing these interrelationships, thereby facilitating the identification of problematic variables that might require removal or consolidation to enhance the model's accuracy and interpretability. As indicated in Table 2, the correlation coefficients for all variable pairs are below 0.8, suggesting that multicollinearity is not present.

Table 2. Correlation Matrix

Variables	C	A	M	E	L	S	GDP	M2	G
C	1								
A	0.071	1							
M	0.252	0.001	1						
E	-0.131	-0.069	-0.347	1					
L	0.230	0.016	-0.116	-0.172	1				
S	-0.193	-0.106	-0.005	0.348	-0.069	1			
GDP	0.012	-0.081	-0.048	0.040	0.043	0.031	1		
M2	0.073	-0.087	-0.041	0.074	0.101	0.043	0.436	1	
G	0.002	-0.049	-0.016	0.031	0.032	0.022	0.673	0.403	1

The empirical results obtained through the two-step GMM technique, as illustrated in Table 3, indicate a persistent growth in credit, evidenced by a sample parameter of 0.118, which is statistically significant at the 1% level. Furthermore, an increase in capital adequacy is associated with a growth in bank credit, as reflected by its positive coefficient, also significant at the 1% level. Capital adequacy is recognized as a crucial indicator in evaluating the health of a bank. In scenarios where a bank requires emergency funds, it is imperative that sufficient capital is available to prevent the risk of a bank run, which could ultimately lead to bankruptcy. Additionally, the quality of management plays a vital role; any reluctance or negligence in managing operational expenses can adversely impact profitability and, consequently, bank lending. This research aligns with this viewpoint, as the estimated coefficient for management quality is negative, albeit weakly significant, suggesting that an increase in operational expenses relative to assets may hinder credit growth. Moreover, a strong positive correlation between earning quality and credit growth has been identified, with an estimated coefficient of 6.715, which is highly significant at the 1% level, indicating that banks are likely to extend more credit when they perceive it to be profitable. It has found that the credit growth will be reduced in the case that banks face with high sensitivity to market risk since the estimated coefficient is -0.858 which is negative, even though it has weakly significant. In addition to CAMELS indicators, there are three macroeconomics variables incorporated in the model as control variables namely

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growth rate of real GDP, money supply, and government expenditure. Among the three indicators, it has only government spending that has statistically insignificant, where the growth rate of real GDP and growth rate of broad money present positive influence on credit growth given that the slope coefficients of both indicators are estimated to be positive; more importantly, each slope indicate 1% significant level. According to the Wald Chi-square test of 72.27 and its associated p-value of 0.000 which less than significant level of 1% suggested that all variables are collectively explain banks' credit growth.

Table 3. Two-Step GMM Estimated Result

Independent variables	Coefficient
CREDIT(1)	0.118***
	[2.832]
C	0.563***
	[2.658]
A	-1.030***
	[-3.288]
M	-19.036*
	[-1.913]
E	6.715***
	[2.964]
L	-1.242***
	[-3.951]
S	-0.858*
	[-1.943]
GDP	1.209***
	2.739]
M	0.200***
	[2.165]
G	0.039
	[0.070]
Constant	100.229*
	[1.900]

***, **, * significant at 1%, 5%, 10%, respectively. Z-statistics are in parenthesis.

Conclusion

The empirical findings of this research can be demonstrated that all elements of CAMELS have statistical impact on banks' credit growth which can be interpreted and described in the following contexts. Commercial banks' capital adequacy directly impacts their lending capability, as higher capital reserves reduce financial risk and enhance stability. Adequate capital enables banks to absorb losses without jeopardizing solvency, fostering increased confidence among borrowers. This, in turn, encourages more lending, promoting economic growth and stability in the financial system. Non-performing loans negatively affect commercial banks' lending capability by tying up capital and increasing credit risk. High NPL levels reduce available funds for new loans, lower profitability, and erode investor confidence. This discourages lending activity, impeding economic growth as banks become more cautious in their credit offerings.High operational expenses reduce commercial banks' profitability, limiting the funds available for lending. Increased costs may also divert resources away from loan generation and risk management. As a result, banks may become more conservative in their lending practices, reducing credit availability and hindering economic growth and development.

Higher return on assets reflects strong earning quality, enhancing a bank's profitability and financial stability. This improves capital availability, enabling increased lending capacity. Strong earnings boost investor confidence and provide a buffer against economic shocks, fostering more credit extension, which ultimately

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supports business growth and economic expansion. Excessive liquidity, measured by high liquid assets, can negatively impact commercial banks' lending capability. Banks holding large reserves in liquid assets may prioritize safety over lending, reducing credit supply. This conservative approach limits loan growth, potentially stalling economic activity, as banks hesitate to allocate funds for higher-yielding loans. Banks with high sensitivity to market risk face increased vulnerability to economic fluctuations, reducing their lending capability. Greater exposure to market volatility may lead to capital erosion, limiting available funds for loans. Consequently, banks become more risk-averse, curbing credit issuance and restricting economic growth through reduced loan availability.

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