# UNPACKING THE EFFECTS OF FINANCIAL INCLUSION ON BANK EFFICIENCY: A CROSS-COUNTRY ANALYSIS OF THE ASEAN 5+1 BANKING SECTORS

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**Abstract:**

The impact of financial inclusion on the well-being of economic development and the stability of the financial system has been widely documented in previous literature. However, the empirical evidence of the financial inclusion effect on bank efficiency remains unclear. It seems surprising because when a country is financially exclusive, it can dampen economic growth, thus inhibiting inclusion, especially for the unbanked population in ASEAN 5+1 countries. This paper investigates the relationship between financial inclusion and bank efficiency within the ASEAN 5+1 banking sectors, focusing on the country's income levels. For this purpose, a dataset of 1,500 observations spanning from 2013 to 2021 was used. We utilize Data Envelopment Analysis (DEA) and Ordinary Least Squares (OLS) regressions to analyse the relationship between financial inclusion indicators and bank efficiency. Our empirical findings reveal that the pattern varies across countries with different income levels. This study suggests that financial inclusion in high- and middle-income countries positively affects bank efficiency, while in low-income countries, it unfavourably influences bank efficiency. This implies the need to draw attention to the side effects of bank inefficiency on increasing financial inclusion and achieving inclusion goals.

**Keywords:**

Bank Efficiency, Financial Inclusion, ASEAN 5+1, Country's Income Level.

## Introduction

The banking sectors plays an important role for both developed and developing countries. Since the banking industry is the main channel for monetary transmission and the main source of funds for households and businesses in developing countries (Fase & Abma, 2003), an efficient banking system is the key to overall financial development and economic growth (Andersen & Tarp, 2003). In recent years, financial inclusion has become a crucial goal for policymakers, economists, and banking institutions worldwide. The underlying concept seems simple yet profound; ensuring that individuals and businesses have access to affordable financial services is fundamental for fostering economic growth, reducing poverty, and promoting social development, especially in developing countries (Joshi & Nalawade, 2021).

Furthermore, banking sectors can provide extensive economic advantages, however to achieve it long-term and sustainably, the financial system must be inclusive. Within the dynamic landscape of the Association of Southeast Asian Nations (ASEAN), there is a growing recognition that financial inclusion can enhance bank efficiency. Despite the rapid intensification of technology-based financial activities, approximately 470 million adults do not have a bank account in this region (World Bank, 2022). Efficient banks can lower the cost of providing financial services, making them more accessible to underserved populations (Demirguc-Kunt & Klapper, 2012). Besides, efficient banks are better positioned to innovate and adapt to changing market dynamics, potentially expanding the range and quality of services available to customers, which was not the case in this region (Nguyen, 2020). It is uncertain if financial inclusion has led to an increase in bank efficiency in ASEAN, and this question requires empirical evidence to be answered because of the huge gap in financial inclusion between developing and advanced economies (Demirguc-kunt et al. 2018).

Triki and Faye (2013) defined financial inclusion as the introduction of formal financial services that are accessible and affordable to all individuals in an economy. Sarma and Pais (2010) also defined financial inclusion as a multi-dimensional concept that comprises the accessibility, availability, and usage of formal financial products and services. This multi-dimensional aspect of financial inclusion considered is extremely crucial, whereby most of the previous literature only focused on definition, determinants, and measurement (Kumar et al. 2021). The multi-dimensional aspects consist of demand-side aspects, which include the accessibility and usage of mainstream financial products, and supply-side aspects which refer to the availability of these instruments (Anand & Chhikara, 2013). Increasing both demand and supply-side variables significantly contributes to improving financial inclusion. A significant number of individuals from the lower-income group who previously did not have access to banking services are now being integrated into the regulated financial system. Furthermore, increased savings assure appropriate liquidity of cash in the financial system and enable significant accumulation of capital, thus contributing to bank performance (Park & Mercado, 2015; Kim et al. 2018).

Moreover, previous studies have largely overlooked the issue of bank efficiency, particularly within the ASEAN 5+1 banking sectors. This group of countries consists of Singapore, Malaysia, Indonesia, Thailand, the Philippines, and Vietnam which represents a diverse range of income levels and financial development stages. Examining this region provides a unique opportunity to understand how financial inclusion influences bank efficiency across different economic contexts. To address this research gap, the study applies the Data Envelopment Analysis (DEA) method to measure bank efficiency, using a robust dataset comprising 1,500

observations from 200 banks over the period 2013 to 2021. The analysis is complemented by the inclusion of several control variables, both bank-specific and macroeconomic such as return on assets, bank size, diversification, cost, liquidity, capitalization, risk, GDP growth, market concentration (CR3), inflation, and unemployment. These variables help account for factors that may also influence bank efficiency. Additionally, Ordinary Least Squares (OLS) regression is used as a second-stage estimation technique to address potential multicollinearity and to provide consistent results.

In contrast to most prior studies, which typically use cross-country or single-country designs and focus solely on the relationship between financial inclusion and bank performance (Sarma, 2008; Kondo, 2010; Shihadeh et al. 2018), this study takes a more comprehensive and comparative approach. The inclusion of Vietnam as the "plus one" offers an opportunity to explore transitional dynamics in a rapidly developing financial system alongside more established economies such as Singapore. This comparative framework enhances the understanding of how income level differences shape the impact of financial inclusion.

The motivation for focusing on the ASEAN 5+1 stem from the region's growing economic integration, its active pursuit of inclusive financial policies, and the contrasting capacities of its banking systems to implement them. This heterogeneity enables a nuanced investigation into whether financial inclusion contributes to bank efficiency in a uniform manner or produces varied outcomes depending on a country's structural and developmental characteristics. The findings aim to inform policymakers seeking to design inclusive growth strategies without compromising banking sector performance. The rest of this paper is structured as follows: Section 2 provides a review of the literature on financial inclusion and bank performance. Section 3 describes the methodology and data sources. Section 4 presents the empirical results and findings. Section 5 concludes with key implications and recommendations.

**Literature Review**
The studies on financial inclusion indicators are relatively new and growing rapidly. Mehrotra and Yetman (2015) indicated that increased financial inclusion may provide households with improved access to saving and borrowing, leading to more consistent consumption behaviours. Banks find it easier to maintain price stability when production volatility is no longer a primary concern (Le et al. 2019). According to Shihadeh (2018), this estimation has many deficiencies since several important aspects of financial inclusion are being ignored, including availability, affordability, and usage of financial services (Sarma, 2015). Furthermore, the previous literature has shown that single dimensions may not be sufficient to imply financial inclusion. Allen et al. (2016) found that lower banking costs, greater proximity to financial intermediaries, stronger legal rights, and a politically stable environment can lead to greater financial inclusion. Sharma (2016) also investigated the relationship between three financial inclusion dimensions (banking penetration, availability, and usage) and economic development in India. He discovered a direct correlation between economic growth and several dimensions of financial inclusion.

Similarly, Kim et al. (2018) conducted a study on the correlation between financial inclusion and economic development and found mutual causality between five financial inclusion indicators: the number of ATMs, the number of bank branches, the number of deposit accounts, and the life insurance premium volume to GDP. Gupte et al. (2012) examined the number of bank accounts per 1,000 adults and found that this indicator is directly proportional to Indian

banks. Similarly, Sarma (2008) investigated the number of bank accounts in developed and developing countries between 2004 and 2015 and found that the number of bank accounts had a positive relationship with bank performance.

Arora (2010) found that the East Asian countries with higher per capita incomes have higher bank branches per 1,000 km$^2$ compared to countries in the South Asia region, which have low incomes per capita and lower access to bank branches. For the accessibility dimension, the result shows that the higher weight to outreach is the number of ATMs per 1,000 km$^2$. The correlation coefficient between the two variables turns out to be strong and positive. Similarly, Chakrabarty and Pal (2010) discovered that each of the six indicators of the outreach of banking have a positive impact on bank performance. Meanwhile, Akhisar et al. (2015) analysed the impact of banking services on bank performance in 23 countries. Cards (credit, debit, and other cards) were discovered to have a positive correlation with bank performance. Similarly, Vo et al. (2021) showed a positive effect of financial inclusion (the number of ATMs, the number of bank branches, the number of credit cards, and the number of debit cards) on bank performance in the emerging markets in the Asian region.

In addition to that, Shihadeh et al. (2018) also investigated the impact of financial inclusion on the performance of banks in Jordan between 2009 and 2014. The research examined financial inclusion using credit for SMEs, ATM services, deposits by SMEs, credit cards, the number of ATM services, and the number of ATMs. Bank performance was measured by return on assets (ROA) and gross income. The specific components of financial inclusion had diverse outcomes. The research discovered a positive correlation between financial inclusion and bank performance in Jordan. It also revealed that the introduction of new services in the banking industry, seen as innovation, has a beneficial impact on the profitability of banks.

Shihadeh et al. (2018) also found that the use of ATMs affected the performance of banks by using a dataset of 161 banks from 1991 to 1992. The research determined that the adoption of ATMs can make transactions more convenient for clients. However, it is also noted that the associated costs of ATM usage can be relatively high. In a study of Olajide et al. (2011) which examined the effect of the financial sector on the performance of banks in Nigeria showed that bank-specific characteristics and government policies aimed at promoting financial inclusion. The findings indicated a positive impact on banks' profitability, particularly in their net interest margin (NIM).

Alfonse & Florence (2012) investigated the impact of credit card usage on the performance of Kenyan banks. The research highlighted that using credit cards boosts bank profits. Akhisar et al. (2015) also explored how electronic banking services would affect bank performance. The research used banks' return on assets (ROA) and return on equity (ROE) as performance indicators. The study's findings indicated that using credit and debit cards positively affects bank performance. Ikram & Lohdi (2015) studied the effect of financial inclusion on banks' profitability in Pakistan. The authors gathered data from 149 participants and conducted correlation and regression analysis to determine the relationship between financial inclusion indicators (cost, access, and usage of financial services) and banks' profitability. The findings indicated that financial inclusion does not have a statistically significant effect on banks' profitability. However, all three financial inclusion indicators were positively correlated with banks' profitability.

Mutinda et al. (2018) examined the impact of technology services like ATMs, internet banking, and mobile banking on the financial performance of 42 Kenyan commercial banks. The data spanning from 2010 to 2016 found a significant positive correlation between financial inclusion and bank performance using multiple regression and correlation analysis. The preceding literature reviewed in this study indicates a notable lack of consensus on how financial inclusion affects bank efficiency, including both bank-specific and macroeconomic variables. It is also evident that the empirical research mostly evaluated is single-country research and focuses on single dimensions of financial inclusion, whereby the findings cannot be generalized. In response to these gaps, this research aims to investigate how financial inclusion influences the efficiency of the ASEAN 5+1 banking sectors and provides new insights into the relationship between financial inclusion and bank efficiency within the ASEAN 5+1 context.

**Methodology and Data Sources**

The dataset used in this research is a panel dataset consisting of 1500 bank-year observations from the six (6) ASEAN countries: Singapore, Malaysia, Thailand, Vietnam, Indonesia, and the Philippines (known as ASEAN 5+1 countries). The "plus one" country belongs to Vietnam since this country has been experiencing rapid economic growth and has emerged as one of the fastest growing economies in the ASEAN countries. The observations span from 2013 to 2021. To measure bank efficiency, this study employs Data Envelopment Analysis (DEA) method to measure bank efficiency due to its non-parametric nature and flexibility in handling multiple inputs and outputs without assuming a predefined functional form. DEA is particularly suited for banking efficiency studies, where banks utilize multiple resources (e.g. labour, capital, deposits) to produce multiple outputs (e.g. loans, interest income, investments). Unlike parametric methods such as Stochastic Frontier Analysis (SFA), DEA allows for greater adaptability across heterogeneous environments which is critical in cross-country studies where banking structures vary significantly.

Furthermore, DEA has been extensively validated in prior literature as an effective tool for measuring relative efficiency in the banking sector using intermediation approach (Sealey & Lindley, 1977; Banker et al. 1984; Sufian & Habibullah, 2010). The use of DEA is complemented by a second-stage OLS regression to explore the impact of financial inclusion variables on DEA-derived efficiency scores, ensuring statistical robustness (Banker & Natarajan, 2008; McDonald, 2009). Moreover, the criteria used to determine financial inclusion include accessibility, availability, and usage aspects. This study proposes five (5) indicators to measure accessibility and availability: the number of bank branches per 1,000 adults, the number of ATMs per 1,000 adults, the number of bank branches per 1,000 $km^2$, the number of ATMs per 1,000 $km^2$, and the number of bank accounts per 1,000 adults (Sarma, 2008; Chakravarty & Pal, 2010; Arora, 2010; Gupte et al. 2012; Amidzic et al. 2014; Park & Mercado, 2015; Kim et al. 2018; Shihadeh et al. 2018; Le et al. 2019; Zeqiraj et al. 2021; Vo et al. 2021; Kumar et al. 2021).

Regarding the usage aspect, four (4) indicators are employed: the number of credit cards, the number of debit cards, outstanding deposits with banks, and outstanding loans with banks (Sarma, 2008; Chakravarty & Pal, 2010; Gupte et al. 2012; Amidzic et al. 2014; Park & Mercado, 2015; Kim et al. 2018; Shihadeh et al. 2018; Le et al. 2019; Zeqiraj et al. 2021; Vo et al. 2021; Kumar et al. 2021). All financial inclusion variables were extracted from the Financial Access Survey (FAS) IMF database. In addition, we obtained explanatory factors,

bank-specific features, and macroeconomic variables from the World Development Indicator (WDI) database. The total sample comprises almost 70% of the total assets of the banking industries in Singapore, Malaysia, Thailand, Vietnam, Indonesia, and the Philippines. The research used the ordinary least squares (OLS) regression approach to examine the correlation between financial inclusion and bank efficiency. According to Banker & Natarajan (2008) and McDonald (2009) provide proof that the use of a 2-stage procedure involving DEA followed by OLS regression yields consistent estimators for a 2-stage regression model involving DEA as the dependent variable. Moreover, to classify countries' income levels, we introduce an interaction variable to see how the combination of different factors affects overall performance more accurately.

## Results and Discussions

The findings show that the various dimensions of financial inclusion have a substantial impact on bank efficiency in the ASEAN 5+1 banking sectors. Hence, in this analysis, we control the potential variation in bank efficiency across countries with varying income levels. We specifically examine the interaction of the three different elements of financial inclusion, which are categorised based on the classification of banks operating in high-income, middle-income, and low-income countries. In high-income countries, the number of ATMs per 100,000 adults and per 1,000 km² demonstrates a positive relationship with bank efficiency, as they enhance accessibility and convenience for customers. Despite the rise of digital and mobile banking, ATMs continue to play a crucial role in complementing modern financial services and supporting customer needs (Narteh, 2013; Arango et al. 2018; Batiz-Lazo et al. 2014). Likewise, the number of bank branches per 100,000 adults and per 1,000 km² is positively associated with bank efficiency, serving as important physical access points for financial services.

While digital transformation has reshaped banking behaviour, branches remain valuable for offering personalized services, supporting complex transactions, and maintaining customer trust (DeYoung et al. 2007; Casu & Molyneux, 2003; Berger et al. 1997). The supportive presence of physical infrastructure, together with technological innovation and widespread ATM deployment, collectively contributes to enhancing overall banking efficiency in high-income economies (Beck et al. 2010; Karjaluoto et al. 2002; Fungacova & Weill, 2015; Usman et al. 2020). In contrast, the number of bank accounts shows a positive relationship with bank efficiency, as increased account penetration enables banks to benefit from economies of scale, lower transaction costs, and enhanced resource allocation, particularly when supported by technological advancements (Beck et al. 2007; Goddard et al. 2007). The number of credit cards also has a positive impact on efficiency, highlighting how credit cards promote financial inclusion, broaden the customer base, and contribute to non-interest income, thereby improving profitability (Demirguç-Kunt et al. 2018; Shihadeh et al. 2018).

Similarly, although the efficiency gains from debit cards may be less pronounced in saturated markets, the relationship remains positive, as debit cards still contribute to customer convenience, reduce reliance on cash, and support the transition toward cashless banking (Beck & Demirguç-Kunt, 2008; Kumar et al. 2020).However, the benefits of debit cards diminish in saturated markets, as additional issuance may increase operational costs without significant efficiency gains, a trend observed in mature banking systems where newer payment technologies emerge (Beck & Demirguç-Kunt, 2008; Kumar et al. 2020). The number of outstanding loans and deposits plays a crucial role in enhancing efficiency by providing banks

with a stable deposit base, reducing funding costs, and enabling more efficient loan provisioning, ultimately supporting bank profitability and operational performance (Shukur & Sufian, 2024; Berger & Bouwman, 2009; Diamond & Rajan, 2001).

In middle-income countries, the number of ATMs per 100,000 adults is positively associated with bank efficiency. ATMs improve access to banking services in areas with fewer branches, reduce operational costs, and enhance financial inclusion by offering self-service options like withdrawals, deposits, and transfers (Akhisar et al. 2015). The proliferation of ATMs allows banks to serve more customers at a lower cost, particularly in remote areas (Valverde & Humphrey, 2009), which improves operational efficiency (Nigatu et al. 2023). As ATMs reduce the reliance on physical branches, they enhance convenience, lower transaction costs, and expand banking services, contributing to higher bank efficiency (Al-Zyood, 2018; Le et al. 2020). The number of bank branches per 100,000 adults is also positively related to bank efficiency, as expanded branch networks increase financial inclusion, customer loyalty, and operational efficiency (Beck et al. 2007; Saha et al. 2018). Similarly, ATM density per 1,000 km² positively correlates with bank efficiency by reducing operational burdens on branches and promoting greater financial inclusion and customer access (Arora, 2010; Zeqiraj et al. 2021).

The expansion of financial inclusion through increased bank accounts, credit cards, and debit cards in middle-income countries shows a positive relationship with bank efficiency. A higher number of bank accounts contributes to greater deposit mobilization and lending capacity, supporting improved operational efficiency. The adoption of credit and debit cards enhances transaction volumes and broadens the customer base, which can streamline banking operations and boost profitability. Similarly, a rise in the number of outstanding loans supports efficiency gains through economies of scale and better resource utilization. These findings highlight the beneficial impact of financial inclusion in strengthening the performance and efficiency of the banking sectors in middle-income economies (Ghosh, 2016; Florence, 2021; Frączek, 2019; Berger & DeYoung, 1997; Dell'Ariccia et al. 2012).

In low-income countries, the expansion of traditional banking infrastructure particularly ATMs has been found to negatively impact bank efficiency due to several interconnected challenges. The deployment of ATMs per 100,000 adults and per 1,000 km² is associated with higher operational costs, underutilization, and limited reach in rural areas, which reduces their cost-effectiveness (Jungo et al. 2024; Shaikh et al. 2023; Florence, 2021; Demirgüç-Kunt et al. 2017). Similarly, increasing bank branch density, both per capita and geographically, imposes heavy infrastructure and staffing costs that often outweigh revenue in regions with low financial activity and literacy (Beck et al. 2007; Allen et al. 2016; World Bank, 2023). Studies have shown that such expansions, while aimed at improving financial access, do not necessarily result in better financial inclusion or efficiency, as the services are frequently underutilized or poorly aligned with local demand (Nguyen & Du, 2022; Park & Mercado, 2018; Bernini & Brighi, 2018). Moreover, limited digital infrastructure, institutional weaknesses, and regulatory hurdles further exacerbate inefficiencies, making digital alternatives such as mobile or agent banking more viable and cost-effective solutions (Le et al. 2019; Arora, 2010; Zeqiraj et al. 2021). Therefore, the conventional approach of expanding physical banking networks in low-income regions may hinder rather than enhance bank efficiency.

The regression results reveal that the number of bank branches per 1,000 adults and per 1,000 km² are negatively associated with bank efficiency. This finding supports the view that branch expansion, beyond a certain threshold, can become economically inefficient (Harimaya & Kondo, 2016). The negative impact may be attributed to rising levels of bad debt, increased cost pressures, the proliferation of self-service branches, and a significant shift of customers towards digital banking platforms (Kumar et al. 2021). These results diverge from previous studies, such as Chen et al. (2018) and Shihadeh & Liu (2019), which suggest that branch expansion fosters a larger client base, increased deposits and loan portfolios, and improved risk diversification. Nonetheless, Kumar et al. (2021) argue that strategic branch placement in underserved areas may still enhance profitability and reduce risk, indicating that the efficiency impact of branch expansion is highly context-dependent.

The number of bank accounts also exhibits a negative relationship with bank efficiency. This may reflect the challenges faced by poor and rural populations who are unable to maintain the minimum balance required to keep accounts active, or who remain excluded due to cultural and religious factors (Banna & Alam, 2021). Moreover, the application of uniform financial inclusion policies may be ineffective in less developed countries, where localized needs and constraints vary significantly (Banerjee et al. 2020). The volume of outstanding loans is likewise negatively associated with efficiency, potentially due to the increased risk of non-performing loans and higher operational costs, particularly among smaller banks lacking scale advantages (Petersen & Rajan, 1995; Berger et al. 2010; Sufian, 2012). Additionally, high levels of outstanding deposits may result from relaxed lending standards aimed at improving financial access, which in turn increases credit risk and reduces efficiency (Khan, 2011). Lastly, the number of credit cards and debit cards does not appear to improve bank efficiency, likely due to increased transaction and overhead costs, as well as the operational complexities involved in collaborating with FinTech firms (Shihadeh & Liu, 2019; Forcadell et al. 2020; Ozili, 2021; Buchak et al. 2018; Klus et al. 2019).

**Conclusions and Policy Implications**
This study fills a significant gap in the literature by empirically examining the relationship between financial inclusion and bank efficiency across ASEAN 5+1 countries from 2013 to 2021. By incorporating DEA and OLS models, and controlling for bank-specific effects and macroeconomic variables, the study offers nuanced insights. Results reveal that financial inclusion positively and significantly enhance bank efficiency in high- and middle-income countries, with the strongest effects observed in middle-income countries where all inclusion indicators show a statistically significant impact. These findings align with previous literature emphasizing the role of financial inclusion in expanding the formal financial sector, increasing deposit mobilization, and improving monetary transmission (Cull et al. 2012; Sethy & Goyari, 2022). However, in low-income countries, financial inclusion has a statistically significant negative effect on efficiency. This support concerns that extending services to low-income, rural populations may raise transaction costs and exacerbate information asymmetries, leading to inefficiencies (Jose & Garcia, 2016; Le et al. 2019). High credit risks, weak recovery systems, and limited financial infrastructure further contribute to this adverse outcome.

To address these disparities, policymakers should adopt differentiated financial inclusion strategies. In high- and middle-income countries, policies should focus on sustaining inclusive growth through digital innovation and promoting healthy competition among banks. For low-income countries, strengthening governance, improving financial regulation and supervision,

and promoting the development of cost-efficient technologies such as mobile banking and agent networks are crucial. Banks should invest in financial literacy programs to increase usage and reduce default risk, and enhance risk diversification strategies to mitigate credit and operational risks. Collaboration among governments, financial institutions, and international organizations is essential to build inclusive and resilient banking systems tailored to each country's structural context. Recognizing the heterogeneity of income levels and banking maturity within ASEAN 5+1 is key to crafting effective, country-specific policies that maximize the efficiency gains from financial inclusion.

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**Appendices**

### Table 1: Descriptive Statistics of Explanatory Variables

| Explanatory Variables | Mean | Minimum | Maximum | Standard Deviation | No of Observation |
|---|---|---|---|---|---|
| **Bank-Specific Characteristics** | | | | | |
| LN (LLP/TL) | -5.041 | -11.358 | 0.975 | 1.3796 | 1500 |
| LN (ROA) | -4.794 | -11.211 | 0.679 | 1.0826 | 1500 |
| LN (NII/TA) | -4.938 | -11.362 | -1.641 | 0.9458 | 1500 |
| LN (NIE/TA) | -3.914 | -8.113 | -1.361 | 0.6107 | 1500 |
| LN (EQASS) | -2.043 | -6.854 | -0.010 | 0.6072 | 1500 |
| LN (TA) | 15.086 | 6.027 | 21.269 | 3.2998 | 1500 |
| LN (TL/TA) | -0.624 | -5.785 | 3.642 | 0.5952 | 1500 |
| **Macroeconomic Conditions** | | | | | |
| LN (INF) | 0.802 | -4.013 | 1.886 | 0.9412 | 1500 |
| LN (CR3) | 3.940 | 3.863 | 3.980 | 0.0363 | 1500 |
| LN (UNEMP) | 1.221 | 1.058 | 1.513 | 0.1222 | 1500 |
| LN (GDP) | -5.037 | -11.358 | 0.975 | 1.3798 | 1500 |
| **Financial Inclusion Indicators** | | | | | |
| LN (ATM_ADULTS) | 4.203 | 3.572 | 8.413 | 0.7459 | 1500 |
| LN (BRANCH_ADULTS) | 2.360 | 1.069 | 2.867 | 0.5293 | 1500 |
| LN (ATM_KM2) | 3.865 | 3.085 | 4.769 | 0.4705 | 1500 |
| LN (BRANCH_KM2) | 2.682 | 1.896 | 6.415 | 0.6941 | 1500 |
| LN (BANK_ACC) | 5.921 | 4.715 | 7.832 | 0.8045 | 1500 |
| LN (CRE_CARD) | 4.915 | 3.509 | 7.621 | 0.8256 | 1500 |
| LN (DEB_CARD) | 6.826 | 6.129 | 7.753 | 0.4098 | 1500 |
| LN (OUT_LOAN) | 4.006 | 3.071 | 5.450 | 0.5442 | 1500 |
| LN (OUT_DEPO) | 19.532 | 13.195 | 23.179 | 3.6084 | 1500 |

Note: Bank risk can be calculated as LLP/TL = total loan loss provision over total loans. Capitalization can be calculated as EQASS= book value of shareholders equity as a fraction of total assets. Costs can be calculated as NIE/TA = non-interest

expenses over total assets. Bank profitability can be calculated as ROA = profit after tax over total assets. Bank size can be calculated as TA = natural logarithm of total assets. Diversification can be calculated as NII/TA = non-interest income over total assets. Liquidity risk can be calculated as TL/TA = total loans over total assets. GDP = natural log of gross domestic products. INF = the rate of inflation. CR3= the three largest banks asset concentration ratio. UNEMP = unemployment rate. ATM_ADULTS = the number of ATM per 1,000 adults. BRANCH_ADULTS = the number of branches per 1,000 adults. ATM_KM2 = the number of ATM per 1,000 $km^2$ .BRANCH_KM2 = the number of branches per 1,000 $km^2$. BANK_ACC = the number of bank account. CRE_CARD = the number of credit card. DEB_CARD = the number of debit card. OUT_LOAN = the number of outstanding loans. OUT_DEPO = the number outstanding deposits.

***, ** and * indicate significance at 1, 5 and 10 % levels

## Table 2: Regression Results for High-Income Countries

| High-Income Countries | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Explanatory Variables** | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 5** | **Model 6** | **Model 7** | **Model 8** | **Model 9** |
| Constant | -11.410*** | -11.395*** | -11.409*** | 11.407*** | 11.411*** | -11.405*** | -11.407*** | -11.3938*** | -10.0951*** |
| | (1.197) | (1.199) | (1.197) | (1.1975) | (1.197) | (1.198) | (1.197) | (1.197) | (0.011) |
| **Bank-Specific Characteristics** | | | | | | | | | |
| LN (LLP/TL) | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 | -0.006 |
| | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) |
| LN (ROA) | 0.023* | 0.022* | 0.022* | 0.022* | 0.023* | 0.023* | 0.023* | 0.023* | 0.023* |
| | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.012673) | (0.012673) | (0.12615) |
| LN (NII/TA) | 0.054*** | 0.054*** | 0.054*** | 0.054** | 0.054*** | 0.054*** | 0.054*** | 0.054*** | 0.054*** |
| | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) |
| LN (NIE/TA) | -0.241*** | -0.241*** | -0.241*** | -0.241*** | -0.241*** | -0.241*** | -0.241*** | -0.241*** | -0.240*** |
| | (0.038) | (0.039) | (0.389) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) |
| LN (EQASS) | 0.069** | 0.069** | 0.069** | 0.069** | 0.069** | 0.069** | 0.069** | 0.069** | 0.106*** |
| | (0.034) | (0.348) | (0.349) | (0.349) | (0.349) | (0.035) | (0.035) | (0.035) | (0.039) |
| LN (TA) | -0.034*** | -0.034*** | -0.034*** | -0.034*** | -0.034*** | -0.034*** | -0.034*** | -0.034*** | -0.037*** |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.033) |
| LN (LOANS/TA) | -0.025 | -0.025 | -0.025 | -0.025 | -0.025 | -0.025 | -0.025 | -0.025 | N/A |
| | (0.032) | (0.0321) | (0.0321) | (0.0321) | (0.0321) | (0.321) | (0.0321) | (0.321) | |
| **Macroeconomic Conditions** | | | | | | | | | |
| LN (INF) | 0.047*** | 0.047*** | 0.047*** | 0.047*** | 0.047*** | 0.0467*** | 0.047*** | 0.047*** | 0.039*** |
| | (0.012) | (0.112) | (0.115) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.011) |
| LN (CR3) | 1.647*** | 1.646*** | 1.647*** | 1.647*** | 1.647*** | 1.647*** | 1.647*** | 1.645*** | 1.391*** |
| | (0.288) | (0.288) | (0.288) | (0.288) | (0.288) | (0.288) | (0.288) | (0.288) | (0.287) |
| LN (UNEMP) | -0.127*** | -0.126*** | -0.127*** | -0.126*** | -0.127*** | -0.126*** | -0.126*** | -0.126*** | 0.126*** |
| | (0.030) | (0.307) | (0.304) | (0.0305) | (0.304) | (0.306) | (0.0305) | (0.305) | (0.0315) |
| LN (GDP) | 0.155*** | 0.154*** | 0.155*** | 0.155*** | 0.155*** | 0.154*** | 0.155*** | 0.155*** | 0.126*** |
| | (0.025) | (0.249) | (0.025) | (0.249) | (0.025) | (0.025) | (0.025) | (0.249) | (0.025) |
| **Financial Inclusion Indicators** | | | | | | | | | |
| LN(HIGH*ATM_ADULTS) | 0.022 | - | - | - | - | - | - | - | - |
| | (0.015) | | | | | | | | |
| LN(HIGH*BRANCH_A | - | 0.067 | - | - | - | - | - | - | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DULTS) | | (0.058) | | | | | | | |
| LN (HIGH*ATM_KM2) | - | - | 0.045 (0.031) | - | - | - | - | - | - |
| LN(HIGH*BRANCH_KM2) | - | - | - | 0.0266 (0.198) | - | - | - | - | - |
| LN(HIGH*BANK_ACC) | - | - | - | - | 0.024 (0.016) | - | - | - | - |
| LN(HIGH*CRE_CARD) | - | - | - | - | - | 0.023 (0.017) | - | - | - |
| LN(HIGH*DEB_CARD) | - | - | - | - | - | - | 0.023 (0.164) | - | - |
| LN(HIGH*OUT_LOAN) | - | - | - | - | - | - | - | 0.035 (0.254) | - |
| LN(HIGH*OUT_DEPO) | - | - | - | - | - | - | - | - | 0.022** (0.011) |

Note: Bank risk can be calculated as LLP/TL = total loan loss provision over total loans. Capitalization can be calculated as EQASS= book value of shareholders equity as a fraction of total assets. Costs can be calculated as NIE/TA = non-interest expenses over total assets. Bank profitability can be calculated as ROA = profit after tax over total assets. Bank size can be calculated as TA = natural logarithm of total assets. Diversification can be calculated as NII/TA = non-interest income over total assets. Liquidity risk can be calculated as TL/TA = total loans over total assets. GDP = natural log of gross domestic products. INF = the rate of inflation. CR3= the three largest banks asset concentration ratio. UNEMP = unemployment rate. ATM_ADULTS = the number of ATM per 1,000 adults. BRANCH_ADULTS = the number of branches per 1,000 adults. ATM_KM2 = the number of ATM per 1,000 $km^2$ .BRANCH_KM2 = the number of branches per 1,000 $km^2$. BANK_ACC = the number of bank account. CRE_CARD = the number of credit card. DEB_CARD = the number of debit card. OUT_LOAN = the number of outstanding loans. OUT_DEPO = the number outstanding deposits.

***, ** and * indicate significance at 1, 5 and 10 levels.

## Table 3: Regression Results for Middle-Income Countries

| Middle-Income Countries | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Explanatory Variables** | **Model 10** | **Model 11** | **Model 12** | **Model 13** | **Model 14** | **Model 15** | **Model 16** | **Model 17** | **Model 18** |
| Constant | -10.989*** | -11.170*** | -11.051*** | -11.051*** | -11.0499*** | -11.023*** | -11.053*** | -11.108*** | -10.409*** |
| | (1.222) | (1.211) | (1.217) | (1.219) | (1.215) | (1.213) | (1.212) | (1.209) | (1.224) |
| **Bank-Specific Characteristics** | | | | | | | | | |
| LN (LLP/TL) | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 |
| | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) |
| LN (ROA) | 0.021* | 0.021* | 0.021* | 0.021* | 0.021* | 0.021* | 0.021* | 0.021* | 0.019* |
| | (0.013) | (0.013) | (0.013) | (0.127) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) |
| LN (NII/TA) | 0.051*** | 0.051*** | 0.051*** | 0.051*** | 0.051*** | 0.050*** | 0.050*** | 0.050*** | 0.049*** |
| | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) |
| LN (NIE/TA) | -0.228*** | -0.229*** | -0.228*** | -0.229*** | -0.227*** | -0.225*** | -0.225*** | -0.226*** | -0.218*** |
| | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.398) | (0.039) | (0.039) | (0.039) |
| LN (EQASS) | 0.072** | 0.073** | 0.073** | 0.073** | 0.073** | 0.074** | 0.074** | 0.074** | 0.087** |
| | (0.035) | (0.035) | (0.035) | (0.035) | (0.035) | (0.035) | (0.035) | (0.035) | (0.037) |
| LN (TA) | -0.020* | -0.022* | -0.020* | -0.021* | -0.019* | -0.018* | -0.018* | -0.018* | N/A |
| | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) | |
| LN (LOANS/TA) | -0.027 | -0.027 | -0.027 | -0.028 | -0.028 | -0.028 | -0.028 | -0.028 | -0.033 |
| | (0.032) | (0.033) | (0.324) | (0.032) | (0.325) | (0.324) | (0.325) | (0.033) | (0.033) |
| **Macroeconomic Conditions** | | | | | | | | | |
| LN (INF) | 0.053*** | 0.053*** | 0.053*** | 0.053*** | 0.053*** | 0.053*** | 0.052*** | 0.052*** | 0.053*** |
| | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) | (0.012) | (0.011) | (0.012) |
| LN (CR3) | 1.542*** | 1.578*** | 1.551*** | 1.564*** | 1.538*** | 1.519*** | 1.521*** | 1.537*** | 1.391*** |
| | (0.292) | (0.290) | (0.291) | (0.291) | (0.292) | (0.292) | (0.292) | (0.291) | (0.284) |
| LN (UNEMP) | -0.077*** | -0.086*** | -0.082*** | -0.077*** | -0.856*** | -0.086*** | -0.091*** | -0.092*** | -0.059** |
| | (0.031) | (0.031) | (0.031) | (0.327) | (0.031) | (0.307) | (0.304) | (0.031) | (0.313) |
| LN (GDP) | 0.143*** | 0.146*** | 0.145193*** | 0.143395*** | 0.147*** | 0.1479*** | 0.149*** | 0.149*** | 0.133*** |
| | (0.025) | (0.025) | (0.025) | (0.025) | (0.025) | (0.025) | (0.025) | (0.025) | (0.025) |
| **Financial Inclusion Indicators** | | | | | | | | | |
| LN(HIGH*ATM_ADULTS) | 0.048*** | - | - | - | - | - | - | - | - |
| | (0.019) | | | | | | | | |
| LN(HIGH*BRANCH_A | - | 0.076** | - | - | - | - | - | - | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DULTS) | | (0.357) | | | | | | | |
| LN(HIGH*ATM_KM2) | - | - | 0.046** (0.019) | - | - | - | - | - | - |
| LN(HIGH*BRANCH_KM2) | - | - | - | 0.085** (0.037) | - | - | - | - | - |
| LN(HIGH*BANK_ACC) | - | - | - | - | 0.029** (0.012) | - | - | - | - |
| LN(HIGH*CRE_CARD) | - | - | - | - | - | 0.037*** (0.014) | - | - | - |
| LN(HIGH*DEB_CARD) | - | - | - | - | - | - | 0.301*** (0.012) | - | - |
| LN(HIGH*OUT_LOAN) | - | - | - | - | - | - | - | 0.046** (0.019) | - |
| LN(HIGH*OUT_DEPO) | - | - | - | - | - | - | - | - | 0.021*** (0.004) |

Note: Bank risk can be calculated as LLP/TL = total loan loss provision over total loans. Capitalization can be calculated as EQASS= book value of shareholders equity as a fraction of total assets. Costs can be calculated as NIE/TA = non-interest expenses over total assets. Bank profitability can be calculated as ROA = profit after tax over total assets. Bank size can be calculated as TA = natural logarithm of total assets. Diversification can be calculated as NII/TA = non-interest income over total assets. Liquidity risk can be calculated as TL/TA = total loans over total assets. GDP = natural log of gross domestic products. INF = the rate of inflation. CR3= the three largest banks asset concentration ratio. UNEMP = unemployment rate. ATM_ADULTS = the number of ATM per 1,000 adults. BRANCH_ADULTS = the number of branches per 1,000 adults. ATM_KM2 = the number of ATM per 1,000 $km^2$ .BRANCH_KM2 = the number of branches per 1,000 $km^2$. BANK_ACC = the number of bank account. CRE_CARD = the number of credit card. DEB_CARD = the number of debit card. OUT_LOAN = the number of outstanding loans. OUT_DEPO = the number outstanding deposits.

***, ** and * indicate significance at 1, 5 and 10 % levels.

**Table 4: Regression Results for Low-Income Countries**

| **Low-Income Countries** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Explanatory Variables** | **Model 19** | **Model 20** | **Model 21** | **Model 22** | **Model 23** | **Model 24** | **Model 25** | **Model 26** | **Model 27** |
| Constant | -11.489*** (1.194) | -11.366*** (1.196) | -11.646*** (1.191) | -11.260*** (1.1992) | -11.444*** (1.194) | -11.401*** (1.188) | -11.408*** (1.195) | -11.192*** (1.203) | -11.029*** (1.196) |
| **Bank-Specific Characteristics** | | | | | | | | | |
| LN (LLP/TL) | -0.005 (0.006) | -0.003 (0.006) | -0.003 (0.006) | -0.004 (0.006) | -0.004 (0.006) | -0.005 (0.006) | -0.005 (0.006) | -0.005 (0.006) | -0.005 (0.006) |
| LN (ROA) | 0.021* (0.013) | 0.022* (0.012) | 0.021* (0.013) | 0.021* (0.012) | 0.021* (0.012) | 0.022* (0.013) | 0.020* (0.013) | -0.021* (0.013) | 0.019 (0.013) |
| LN (NII/TA) | 0.048*** | 0.044*** | 0.046*** | 0.046*** | 0.048*** | 0.049*** | 0.049*** | 0.051*** | 0.046*** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) |
| LN (NIE/TA) | -0.217*** | -0.191*** | -0.206*** | -0.203*** | -0.214*** | -0.217*** | -0.219*** | -0.232*** | -0.214*** |
| | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) |
| LN (EQASS) | 0.077*** | 0.091*** | 0.085*** | 0.080*** | 0.078*** | 0.074** | 0.079** | 0.073** | 0.089** |
| | (0.036) | (0.039) | (0.038) | (0.037) | (0.035) | (0.035) | (0.035) | (0.035) | (0.037) |
| LN (TA) | -0.012 | -0.006 | -0.004 | -0.009 | -0.012 | -0.0142 | -0.012 | -0.021 | N/A |
| | (0.011) | (0.009) | (0.012) | (0.009) | (0.009) | (0.010) | (0.121) | (0.013) | |
| LN (LOANS/TA) | -0.029 | -0.026 | -0.029 | -0.028 | -0.029 | -0.027 | -0.031 | -0.027 | -0.032 |
| | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) |
| **Macroeconomic Conditions** | | | | | | | | | |
| LN (INF) | 0.058*** | 0.068*** | 0.063*** | 0.064*** | 0.055*** | 0.059*** | 0.054*** | 0.052*** | 0.058*** |
| | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) |
| LN (CR3) | 1.679*** | 1.309*** | 1.609*** | 1.524*** | 1.594*** | 1.623*** | 1.635*** | 1.636*** | 1.497*** |
| | (0.285) | (0.294) | (0.287) | (0.288) | (0.287) | (0.286) | (0.286) | (0.287) | (0.283) |
| LN (UNEMP) | -0.087*** | -0.029 | -0.065** | -0.061** | -0.076*** | -0.078** | -0.089*** | -0.106*** | -0.075*** |
| | (0.032) | (0.032) | (0.033) | (0.032) | (0.032) | (0.033) | (0.033) | (0.032) | (0.032) |
| LN (GDP) | 0.149*** | 0.202*** | 0.164*** | 0.165*** | 0.160*** | 0.154*** | 0.152*** | 0.145*** | 0.154*** |
| | (0.025) | (0.024) | (0.024) | (0.024) | (0.024) | (0.024) | (0.025) | (0.025) | (0.025) |
| **Financial Inclusion Indicators** | | | | | | | | | |
| LN(HIGH*ATM_ADULTS) | -0.068*** | - | - | - | - | - | - | - | - |
| | (0.021) | | | | | | | | |
| LN(HIGH*BRANCH_ADULTS) | - | -0.188*** | - | - | - | - | - | - | - |
| | | (0.033) | | | | | | | |
| LN (HIGH*ATM_KM2) | - | - | -0.102*** | - | - | - | - | - | - |
| | | | (0.026) | | | | | | |
| LN(HIGH*BRANCH_KM2) | - | - | - | -0.138*** | - | - | - | - | - |
| | | | | (0.027) | | | | | |
| LN(HIGH*BANK_ACC) | - | - | - | - | -0.055*** | - | - | - | - |
| | | | | | (0.013) | | | | |
| LN(HIGH*CRE_CARD) | - | - | - | - | - | -0.062*** | - | - | - |
| | | | | | | (0.017) | | | |
| LN(HIGH*DEB_CAR | - | - | - | - | - | - | -0.039*** | - | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| D) | | | | | | | | (0.014) | |
| LN(HIGH*OUT_LOAN) | - | - | - | - | - | - | - | -0.039 (0.025) | - |
| LN (HIGH*OUT_DEPO) | - | - | - | - | - | - | - | - | -0.016*** (0.002) |

Note: Bank risk can be calculated as LLP/TL = total loan loss provision over total loans. Capitalization can be calculated as EQASS= book value of shareholders equity as a fraction of total assets. Costs can be calculated as NIE/TA = non-interest expenses over total assets. Bank profitability can be calculated as ROA = profit after tax over total assets. Bank size can be calculated as TA = natural logarithm of total assets. Diversification can be calculated as NII/TA = non-interest income over total assets. Liquidity risk can be calculated as TL/TA = total loans over total assets. GDP = natural log of gross domestic products. INF = the rate of inflation. CR3= the three largest banks asset concentration ratio. UNEMP = unemployment rate. ATM_ADULTS = the number of ATM per 1,000 adults. BRANCH_ADULTS = the number of branches per 1,000 adults. ATM_KM2 = the number of ATM per 1,000 km$^2$ .BRANCH_KM2 = the number of branches per 1,000 km$^2$. BANK_ACC = the number of bank account. CRE_CARD = the number of credit card. DEB_CARD = the number of debit card. OUT_LOAN = the number of outstanding loans. OUT_DEPO = the number outstanding deposits.