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Examining the Nexus Between Financial Inclusion (FI) and Economic Growth (EG) in The Lower-Middle Income (LMI) Africa Countries (2004-2023)

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Abstract: *This study examined the impact of financial inclusion using proxies like automated teller machines (ATMs) and outstanding loans from commercial bank on economic growth in selected ten selected LMI Africa countries covering the duration from 2004 to 2023. Panel data sourced from the World Bank's World Development Indicators as well as Central Bank of Nigeria statistical database were used. Using an ex-post facto research design, and using descriptive statistics and panel regression techniques for data analysis of 10 lower-middle income Africa countries. The empirical results show that the number of ATMs per 100,000 adults has a negative and statistically significant effect on economic growth, suggesting that the financial infrastructure expansion only does not necessarily translate into better economic growth. In comparison, number of outstanding loans from commercial banks per 1000 adults show a positive and significant relationship with economic growth, showing that access to credit plays an important role in thrilling investment and economic activities. In conclusion, financial inclusion contributes to the growth of economy via financial depth instead of financial accessibility in the ten selected countries. The study recommends promotion of financial illiteracy for improved financial inclusion policies effectiveness, strengthening credit delivery systems, and enhancing financial infrastructure efficiency.*

Keywords: financial inclusion, automated teller machines, outstanding loans from commercial banks, real gross domestic product (rGDP), lower-middle income Africa countries.

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INTRODUCTION

The relationship between real GDP and the number of Automated Teller Machine (ATMs) per 100,000 adults is typically studied within the broader framework of financial inclusion and economic development. The advantages are indirect and multidimensional rather than purely one-way (Hasan et. al., 2024). Economic growth bring about increases in bank profitability, investment capacity which hitheto leads to the deployment of more ATM per population. Burkul and Patil (2024) ATMs' facilitate cash withdrawals and deposits 24/7, with seamless integration via bank-issued cards. In developing economies such lower-middle income Africa countries, the growth in the economy is driven by ATM expansion. The advantages of real GDP growth on ATMs are financial infrastructure expansion, promotes financial inclusion, strengthens payment systems and banking access (Hasan et al.,2024). More bank loans increase access to credit for businesses and households. A 1% increase in private bank lending can raise real GDP by about 0.37% in some economies. A higher number of loans per 1000 adults reflect greater financial inclusion and depth. Most commercial banks branches in Africa have been confronted with large number of loans which has led to increasing in bad loans (banks non-performing loans) in many Africa countries, though significant to total gross loans increases. Loans increase spending (consumption + investment), which feeds into GDP through the multiplier effect, boosts short-run economic activity and demand. Long-term studies show that economies with deeper banking systems tend to grow faster. A developed loan market improves the effectiveness of monetary policy. Central banks influence GDP partly through credit channels (Naula et al., 2025; MDPI, 2021; Botev et al., 2019).

Many communities and villages, today, are faced with inadequate numbers of functional ATMs' to provide financial services to the people in LMI Africa communities which has resulted in the reduction of gross domestic product of such communities (Rastogi et.al., 2023). Security of data from unauthorized access, data collection and fraud investigation, shortage of knowledge concerning the access point where ATMs frauds are committed, unauthorized biometric modules, authentication unauthorized modification and destruction of data most especially in ATMs systems are challenges facing ATMs' (Ukah et.al., 2024; Onyesolu et al., 2019). However, constant disappointment often arisen via the usage of these ATMs' devices. Where these ATMs' are visibly present, they are not functional optimally most especially in our rural settlements and dwellers which has considerably denied them access to financial services. These days, in many communities and villages especially of 10 lower-middle income Africa countries, there are inadequate numbers of functional ATMs' to provide financial services to the people which has resulted in the reduction of GDP of these communities (Rastogi, Sharma, Mukherji, Kaliyar and Baghel, 2023). High levels of outstanding loans often lead to non-performing loans profitability reduction and stability of banks (International

Monetary Fund, 2020). Commercial banks experiences liquidity problems in situations of unpaid loans by customers because such fund are held up. Ability to finance new loan by banks may be difficult. Excessive outstanding credit affects banks' cash flow and financial operations as research shown (World Bank, 2025). Banking sector instability, limiting financial intermediation and slowing economic activity are challenges of widespread loan defaults. Historical financial crises have shown that poor loan recovery and excessive bad loans can destabilize banking systems (Bank for International Settlements, 2025). Large volumes of outstanding loans can cause banks to increase interest rates to compensate for default risk. Excessive outstanding loans can create systemic risk within the financial system, especially when many loans are concentrated in risky sectors. High levels of outstanding loans lead banks to prioritize loan recovery rather than issuing new credit (Mishkin, 2016).

Adults in LMI Africa countries are 'unbanked' due to unaffordability and inaccessibility of financial services, or choice. Small business are affected by a substantial and growing financing gap amounting to $5.7 trillion which implies 19% of GDP due to inadequate ATMs, which hitherto affect the growth of economy in the LMI region greatly. However, limited finance accessibility impede expansion operations by the enterpreneurs to invest in new technologies, and enhance productivity. Ibrahim & Olasunkanmi (2019) itemizes overall low-level of financial literacy, double-digit inflation in the economy, increasing poverty, and uncompetitive wage levels as challenges of financial inclusion. Nevertheless, 65% of adults which constitute low income and lower-middle income Africa countries in the poorest developing nations still lack access to a transaction account and only 20% save through a formal financial institution (Pazarbasioglu et al., 2020). Remarkably, the exclusiveness of the majority in LMI Africa region has caused a hindrance to economic development and growth, social exclusion, and inequality that pose significant challenges for governments and policymakers (Adedokun & Ağa, 2021). Nations in the developing economies are relatively poorer with some countries having as high as 70.0 per cent financial exclusion rate (Eze & Markjackson, 2020).

The main objective of this study is to evaluate the effect of financial inclusion on the economic growth while the objectives are: to examine the effect of number of ATMs per 100,000 adults on the real GDP growth rate of selected lower-middle income Africa countries; and assess the effect of outstanding loans from commercial banks on the real GDP of selected lower-middle income in ten Africa countries. The hypothesis of the study are: (i) Number of ATMs per 100,000 adults have no significant effect on the real GDP growth rate of lower-middle income African countries; (ii) Outstanding loans from commercial banks have no significant effect on the real GDP of lower-middle income African countries. It's therefore understandably that the study provide answers to the following research questions: to what extent does number of ATMs per adult affect real GDP growth rate of selected lower-middle income African countries? Does outstanding loans from Commercial banks affect the real GDP growth rate of selected

lower-middle income African countries? Which are seen as crucial, because the outcomes will be useful to researchers, public affairs analysts, investors, debtors, creditors, corporate finance managers, policy makers, and lenders worldwide. In addition, the uniqueness of transacting financial services in these LMI business environment of African countries will give a further need for research to generate valuable knowledge and literature on the effect of financial inclusion on economic growth of these countries. The factors considered for analysis include rGDP as a dependent variable and number of Automated Teller Machines per 100,000 adults, and outstanding loans from commercial bank used as independent variables. The paper is break thus: Section 1, 2, 3, 4, 5 and 6.

Research Questions

The following research questions are developed:

(i) To what extent does number of ATMs per 100,000 adults affect real GDP of selected Lower-Middle Income African countries?

(ii) Does outstanding loans from Commercial banks per 1,000 adults affect the real GDP of selected Lower-Middle Income African countries?

Research Hypotheses

The following research hypotheses are formulated in null forms:

H_1 Number of Automated Teller Machines per 100,000 adults have no significant effect on the real GDP of Lower-Middle Income African countries;

H_2 Outstanding loans from Commercial banks per 1,000 adults have no significant effect on the real GDP of Lower-Middle Income African countries.

LITERATURE REVIEW

Conceptual Review

The primary focus of this study is to examine the relationship between selected proxies of financial inclusion such as the number of automated teller machines (ATMs) per 100,000 adults, and outstanding loans from commercial banks and economic growth in ten lower-middle income (LMI) African countries. The World Bank (2020) defines financial inclusion as the long-term provision of affordable financial services to low-income individuals. One of its most significant contributions is its ability to stimulate economic growth through increased investment in education and improved access to entrepreneurial capital (Kumari, 2017). Financial inclusion contributes to overall economic growth, narrows income inequality gaps, and supports poverty reduction (Adedokun & Ağa, 2021).

As at 2023, about 3.45million ATMs were said to be in operation worldwide, even though their distribution remains irregular worldwide. As a result of financial technology innovations,

mobile payments, and digital banking speedy expansion, ATMs deployment growth has slowed recently. The number of ATMs density on average globally as at 2024, is about 52.8 ATMs per 100,000 adults. In comparing, ATM penetration is said to remains low and uneven in LMI African countries, frequently decreasing below 20 ATMs per 100,000 adults. For instance, approximate 16,714 ATMs are operated in Nigeria, meaning roughly 14 ATMs per 100,000 adults (Central Bank of Nigeria, 2025). Ghana and Kenya report about 2,500 and 3,000 ATMs respectively, with densities of approximately 11 and 8 ATMs per 100,000 adults (Bank of Ghana, 2023; Central Bank of Kenya, 2023). Other countries operating at lower levels include: Zambia and Uganda each have less than 500 ATMs, meaning 5 ATMs per 100,000 adults in ratios, Senegal has 700 ATMs while Cameroon also has 1,500 ATMs (African Development Bank, 2023; Bank of Zambia, 2023; Bank of Uganda, 2023). These figures underscore a momentous infrastructural gap in access to formal banking across the region. ATMs means an important financial infrastructure indicator, reflecting physical access to banking services, financial intermediation depth, and formal financial inclusion level. ATMs are electronic banking terminals that enable customers to carry out financial transaction like bill payments, balance inquiries, cash withdrawals, fund transfers without need of going to any bank branch. ATMs are designed to provide 24/7 services, improve financial access aim at reducing congestion in banking halls being part of self-service banking systems. The deployment of ATMs are said to be significantly constricted in some African countries like Uganda, Cameroon, Zambia, Kenya, Côte d'Ivoire, Nigeria, Senegal, and Ghana comprises of lower-middle income (LMI) compared to high-income economies (Nairametrics, 2026; Central Bank of Nigeria, 2025; RadarR Africa, 2025).

Moreover, ATMs are not equally distributed in LMI Africa countries as it was seen to be concentrated in commercial and urban areas hence leaving rural areas underserved (African Development Bank, 2023). Those in Rural areas and low-income often rely solely on physical cash usage while this urban bias exacerbates financial exclusion, most especially among low-income and rural populations that rely heavily on physical cash access points. Today, agent banking and mobile money have all emerged as an important substitutes for traditional ATMs infrastructure. Mobile financial services have significantly reduced dependence on ATMs by offering availability, accessible and cost-effective transaction platforms in countries like Uganda and Kenya (Central Bank of Kenya, 2023; Bank of Uganda, 2023). Likewise, countries in West African have experienced rapid growth agent banking networks, and point-of-sale (POS) systems which frequently exceed ATMs in accessibility and transaction volume (African Development Bank, 2023). In spite of these developments, ATMs remain necessary in cash-based economies. For example, Nigeria still continue to rely mostly on cash while ATMs transactions still account for a considerable share of total transaction value (Central Bank of Nigeria, 2025). A structural duality in financial systems occurs in Nigeria, traditional banking

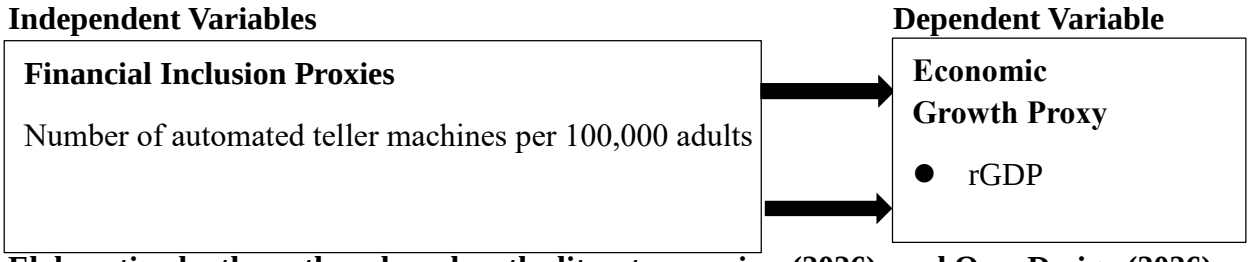
infrastructure remains lacking, while digital financial services are expanding rapidly (Business Tech., 2014).

Outstanding loans from commercial banks which is another financial inclusion proxy means a total credit extended by commercial banks to persons and businesses in LMI African economies. This implies extent the banking sector consumption, investment, private sector activities support loans. Access to bank credit is the major driver of economic growth in developing economies. Nevertheless, lending levels remain relatively low compared to global standards in LMI African countries. Commercial banks in LMI African countries tend to adopt conservative lending practices as a result of high default risks, weak legal enforcement systems, and information asymmetry between lenders and borrowers (African Development Bank, 2023). While relatively limited financing are seen in an essential productive sectors like manufacturing, and agriculture sector, huge bank lending often noticeable in trade, oil and gas, and government-led activities sectors. Outstanding loans from commercial banks have gone up considerably over a period of time due to sound regulatory policies and targeted credit interventions put in place in Nigeria (Central Bank of Nigeria, 2025). Likewise, as at 2023, about $25 billion was recorded as total outstanding loans in Kenya (Central Bank of Kenya, 2023). In spite of this growth, credit access remains constrained, most especially for small and medium-sized enterprises, due to stringent collateral requirements as well as high interest rates. The study Leave some gaps despite extensive literature review on financial inclusion and economic growth. First, each country or broad regional analyses, paid little attention to LMI African countries as a distinct group as seen in most studies. Second, composite indices or digital financial proxies, with inadequate emphasis on infrastructure-based measures like ATMs density while outstanding loans use credit-based indicators as largely reviewed by existing studies. Third, continued relevance of traditional banking infrastructure has been overshadowed by digital financial services growing dominance, thereby creating a gap in understanding the role of ATMs in modern financial systems. Furthermore, prior studies often examine financial inclusion variables in isolation, neglecting their joint effects on economic growth. There is also limited recent empirical evidence incorporating post-2020 financial developments in the region. This study addresses these gaps by providing a panel analysis of selected LMI in ten African countries, using the number of ATMs per 100,000 adults and outstanding loans from commercial bank as complementary proxies for financial inclusion and examining their individual and combined effects on economic growth.

Conceptual Framework

Provide explanation on the relationship between proxies of financial inclusion which include ATMs, outstanding loans from commercial banks, and proxy of economic growth which is real gross domestic product. Based on the literature review, two proxies of financial inclusion are identified as well as a proxy of economic growth (see Table 2.1).

Table 2.1. Conceptual Framework



Elaboration by the authors based on the literature review (2026); and Own Design (2026)

Theoretical Review

The selected theories provide strong justification for the inclusion of ATM density and outstanding loans as proxies for financial inclusion. The Schumpeterian and supply-leading theories support the role of these variables in driving economic growth through improved access to financial services and credit provision (Schumpeter, 1911). Emphasizes was placed on financial institutions roles in channeling funds to productive investments by the Schumpeterian theory, which is associated to Joseph Schumpeter. Outstanding Loans and number of ATMs per 100,000 adults reflect how financial systems enable economic growth through access and intermediation (Schumpeter, 1911). In contrast, enhanced demand for financial services are led by economic growth as stated by the demand-following financial development theory. Outstanding loans mean economic activities increase, individuals and firms demand more credit for consumption and investment. ATM Density growth in income and transactions can increase demand for ATM services, but this is less direct.

Furthermore, Community Echelon Theory developed by Phyllis A. Mason and Donald C. Hambrick, this theory emphasizes the role of community leadership in influencing financial behavior. Community leaders can encourage the adoption and use of financial infrastructure such as ATMs. the theory highlights the role of social structures in facilitating the adoption of financial services, Outstanding Loans means leaders may influence trust in financial institutions, thereby encouraging borrowing. Social structures help determine whether financial infrastructure and credit services are actually utilized (Mason & Hambrick, 1984). While financial literacy theory emphasizes the importance of knowledge in determining effective utilization. Financial Literacy Theory focuses on how financial knowledge influences participation in the financial system. ATM Density Availability of ATMs alone is insufficient users must understand how to use them. Financial literacy affects individuals willingness and ability to access and manage credit.

Financial literacy acts as an enabling factor, determining whether ATM access and loan availability translate into real economic benefits (Samson & Ndefru, 2024). Supply leading financial development theory argues that financial development precedes and drives economic

growth (Ghosh & Chaudhury, 2024). ATMs indicate financial infrastructure expansion, increasing access to banking services, especially for underserved populations. Outstanding Loans means investment is stimulated by credit availability, productivity, and business expansion. The model is driven by economic growth as both financial service usage, and loans volumes increase, thus showing possible reverse causality. Above variables showing a crucial supply-side instruments that promote financial inclusion and economic growth. Together, these theories give a broad framework linking financial access (ATM density) and financial depth (outstanding loans) to economic growth (Aydin & Demiroz, 2023).

Theoretical Framework

Financial Literacy Theory and the Schumpeterian Finance-Growth Nexus Theory are key theories this study is anchored on. The strong connexion in providing explaination between financial inclusion and economic growth in LMI African countries responsible for their choice of selection. The combination of these theories provide all-encompassing framework for this study. Schumpeterian theory gives explaination on how economic growth via financial intermediation as well as credit provision is driven financial systems while Financial Literacy Theory explains the importance of individuals access and efficient utilization of these financial services. Schumpeterian Finance-Growth Nexus Theory builds on earlier ideas by Adam Smith (1776), who argued that economic growth is facilitated by specialization and capital accumulation enabled through access to financial resources. According to Schumpeter, financial intermediaries such as banks lay a vital role in promoting innovation and economic development by mobilizing savings, managing risk, evaluating investment projects, allocating credit efficiently, and facilitating transactions. These functions make sure that resources are channeled toward productive investments, thereby fostering sustained economic growth (Levine, 1992).

Efficiency of financial infrastructure (ATM density) and financial depth (outstanding loans) depends largely on the financial literacy level among the population and these are crucial for growth as suggested by the theories (Aydin & Demiroz, 2023). Financial literacy, particularly the awareness and relevance of financial education regarding financial products and services, plays a crucial role in enabling persons to make informed financial decisions (Henderson et al., 2020; Bianchi, 2018). Importance of individuals knowledge and understanding of financial products, services, and concepts in improving formal financial system participation as emphasized by financial literacy theory. A major barrier to financial inclusion is financial illiteracy as identified by empirical studies. Persons ability to access and efficiently utilizing financial services like credit facilities, savings accounts, and electronic banking systems is often limited by low levels of financial knowledge (Hasan et al., 2020a; Koomson et al., 2020; Lyons et al., 2020; Kodongo, 2018; Mogilevskii & Asadov, 2018). Annamaria Lusardi et al. (2017) develop a augmented stochastic life-cycle model which further explains how financial

knowledge is acquired over an individual lifetime and how it influences wealth accumulation and inequality. The model is of the view that persons with higher financial literacy are more likely to get involve in formal financial systems and accumulate wealth over a period of time. The efficient usage of ATMs services and other banking technologies by individuals implies financial literacy. Persons ability to access, manage, and repay credit responsibly is affected by Financial knowledge influences. Low financial literacy can be limited by their impact on economic growth, when credits and financial infrastructure are available.

Therefore, the impact of financial inclusion proxies such as ATM density and outstanding loans on economic growth depends not only on their availability but also on the level of financial literacy within the economy. Together, these theories suggest that: Financial infrastructure (ATM density) and financial depth (outstanding loans) are essential for growth. Their effectiveness depends on the level of financial literacy among the population. The theoretical framework of this study integrates financial literacy theory and the Schumpeterian Finance-Growth Nexus Theory to explain the relationship between financial inclusion and economic growth. Therefore, the impact of financial inclusion proxies such as ATM density and outstanding loans on economic growth depends not only on their availability but also on the level of financial literacy within the economy.

Empirical Review

Several researchers (Saranu, Yusuf, Gambo and Maitala, 2024; Samson and Ndefru, 2024; Yakubi et.al., 2023; Kamalu and Ibrahim, 2023; Yisa and Onyia, 2022; Ifediora et.al., 2022; Ifediora, Offor, Eze, Takon, Ageme, Ibe, & Onwumere, 2022; Noha and Ayah, 2021; Chima et.al., 2021; Bello and Oladunjoye, 2020; Chinoda and Kwenda, 2019 ; and Van and Lihn, 2019) have carefully looked into the impact of financial inclusivity and growth in the economy. The outcomes of their studies indicated positive relationship, negative relationship, and mixed relationship among the variables.

Studies indicating positive effect of financial inclusivity on growth of economic

Saranu, Yusuf, Gambo and Maitala (2024) determine the impact of financial inclusion on economic growth in Nigeria using ex-post facto research design. Using time series statistics data from Central Bank of Nigeria comprising of 21years from 2001 to 2021. The data were examined using Ordinary Least Square (OLS) approach. The research investigated variables like credit to the private sector (CPS), ATM transactions (ATM), and gross domestic product (GDP) as indicator variables for financial inclusion and economic growth. Credit to the private sector is positively related to economic growth and is statistically significant. While ATMs transactions is positive and statistically insignificant with economic growth in Nigeria. Monetary authorities implement measures to promote economic growth as well as increase the availability of credit to the private sector increament via interest rates reduction to conducive

levels to growth objectives as this will favor economic development.

Also, Yakubi et. al. (2023), influence Access, Usage, and Quality which are financial inclusion elements on Socio-Economic development in 77 low income countries using multiple regression analysis. A significant positive impact on socio-economic development exhibited by all financial inclusion components at different levels. This was consistent with the findings of Van and Lihn (2019) who found that a correlations exist between the indicators of financial inclusion (namely, large numbers of bank branches, ATMs, domestic credit in the private sector), and the increased rate of development in the economy.

In another study carried out by Kamalu and Ibrahim (2023), impact of financial access on human development, found that number of ATMs per 100,000 people, number of commercial bank branches and domestic credit to private sector as proxies for access to finance promote long run human development in developing countries. Of the three proxies, the number of ATMs per 100,000 people had the highest effect on human development.

Furthermore, Chuka, Kenechukwu, Eze, Samuel, Anthony and Godwin (2022) using panel data comprising of 22 sub-Sahara African (SSA) countries from 2012 to 2018 in examining the financial inclusion effect on economic growth. Using the system Generalized Method of Moments (GMM), financial inclusion composite index and individual financial inclusion indicators. Availability dimension of financial inclusion, penetration dimension of financial inclusion and composite financial inclusion significantly and positively affect economic growth while the usage dimension of financial inclusion enhances economic growth insignificantly.

In addition, Noha and Ayah (2021) investigates the relationship between financial inclusion, governance, and economic growth in the MENA region. Using system general method of moments technique on annual data for 44 emerging markets and MENA from 1990 to 2018. Quite number of financial inclusion measures covering the households and the firms' access to finance were used. Financial inclusion positively impacts GDP per capita growth in the selected countries as shown by the results. However, future studies could consider increasing the study's areas to include more regions.

Also, Bello and Oladunjoye (2020) Using secondary data sourced from the World Development Indicators (WDI) of the World from 2004-2018 to investigate the effect of access to finance and poverty level in SSA using variables such as automated teller machines (ATMs) per one hundred thousand adults, number of borrowers from commercial banks per one thousand adults, among others. A number of commercial bank branches per 100,000 adults, number of ATMs per 100,000 adults and number of depositors account per 1,000 adults had

positive and significant impact on poverty level. Whereas, borrowers from banks per 1,000 adults had positive but insignificant impact on poverty level. Overall access to finance positively impacted poverty level in SSA as concluded by the study. Analysed collected data using econometric method of panel ordinary least squares.

Chinoda and Kwenda (2019) studied the impact of mobile phones, economic growth, bank competition and stability on financial inclusion. Using data from 2004 to 2016 for 49 countries, using a five variable panel structural vector autoregressive model to analyze the study. Financial inclusion is significant and positively related to shocks emanating from banking competition, mobile phones, economic growth and bank stability as study revealed.

Studies of negative relationship between financial inclusivity on growth of economy

Also, Chima et.al.(2021) examine inclusive financial access and economic growth using system GMM method in 48 sub-Saharan African countries from 1995 to 2017, the outcome reveals moderates negative relationship between income inequality and economic growth. Also, credit from banks and loan issuance costs apply a negative association with growth.

Studies of mixed outcomes on the effect of financial inclusivity on growth of economy

Furthermore, Saranu, Yusuf, Gambo and Maitala (2024) Using secondary annual time series statistics data from the Central Bank of Nigeria from 2001 to 2021. Using the ordinary least square (OLS) approach, to determining the impact of financial inclusion on economic growth in Nigeria. Using ex-post facto research design to examining variables like credit to the private sector (CPS), ATM transactions (ATM), and gross domestic product (GDP). The study established credit to the private sector is positively related to economic growth and is statistically significant. However, ATMs transactions have a positive and statistically insignificant relationship with economic growth in Nigeria.

Yisa and Onyia (2022) studied the effect of financial inclusion on economic growth in Nigeria. The main objective is to look into the effect of commercial bank's loans to small scale enterprises on GDP in Nigeria. Using ex-post facto research design in the study, the results revealed that deposit and loans of commercial bank rural branches had positive and significant effect on GDP and commercial bank's loans to small scale enterprises had positive and significant effect on Gross Domestic Product.

Ifediora et.al. (2022) examine the relationship in sub-Saharan African from 2012 to 2018 using panel data from 22 sub-Saharan African countries. Branches of commercial banks and ATMs have positive and significant impact on economic growth, deposit accounts and outstanding loans enhance economic growth insignificantly, while outstanding deposits has a negative

impact on economic growth. The sample size is considered small while the period is considered too short and could affect the credibility of its findings.

METHODOLOGY

Research Design

This study adopts an ex-post facto research design, which is appropriate because it relies on already existing data and does not involve manipulation of variables. The design is suitable for examining the relationship between financial inclusion proxies and economic growth using historical data (Kerlinger, 1973).

Data Source and Type

The study utilizes secondary data, which are obtained from the World Bank's World Development Indicators (WDI) database. Secondary data are considered reliable and appropriate for macroeconomic analysis, as they are systematically collected and widely used in empirical research (World Bank, 2026).

Variables Measurement

The study consists of the following variables:

Dependent Variable

Economic Growth (GDP) measured using real Gross Domestic Product (GDP), which serves as a proxy for economic growth.

Independent Variables (Financial Inclusion Proxies)

ATM Density (ATMs) measured as the number of automated teller machines per 100,000 adults, representing financial access. Outstanding Loans (OUTSLO) measured as commercial bank loans per 1,000 adults, representing financial depth.

Measurement of Variables

Table 3.1. Present how each of the variables for the models were measured

S	Variables	Notation	Role	Source	Unit of Measure	Outcome
1	Real Gross Domestic Product	RGDP	Dependent Variable	World Development Indicator	A nations real gross domestic product from year to year	
2	Automated Teller Machines	ATMs	Independent Variable	WDI, IMF, & CBN	(number of ATMs) * 100,000/ adult population	Negative
3	Outstanding loan from Commercial Bank	OLCB	Independent Variable	WDI, IMF, &CBN	(number of borrowers) *1,000/ adult population	Positive

Source: Author's Compilation, 2023 extracted from WDI of World Bank

Model Specification

In this study, the model specification of (Ratnawati, 2020) who recently examined the effect of financial inclusion proxies on macroeconomic outcomes like economic growth, poverty, income inequality, and financial stability using a panel data regression framework was adapted from their formulated model below to independently explain the functions of the dependent variable, Real Gross Domestic Product which is chosen to measure economic growth. Ratnawati (2020) specifies a panel regression model estimated with Generalized Method of Moments (GMM):

$Y_{it} = \beta_0 + \beta_1 COM_{it} + \beta_2 BRANCH_{it} + \beta_3 ATM_{it} + \beta_4 DEP_{it} + \beta_5 LOAN_{it} + \beta_6 NPL_{it} + \varepsilon_{it}$.....(3.0)

Where:

-Y_{it} = Economic outcome variable (economic growth, poverty, inequality, or financial stability)

for country $_i$ at time $_t$

-β_0 = Constant term

-β_1- β_6 = Estimated coefficients

-it = Error term

Financial Inclusion Variables

The study measures financial inclusion using indicators such as:

COM = Number of commercial bank accounts

BRANCH = Number of commercial bank branches

ATM = Number of ATMs
DEP = Outstanding deposits in commercial banks
LOAN = Outstanding loans from commercial banks
NPL = Non-performing loans to total loans ratio
These variables capture the three main dimensions of financial inclusion:
Banking penetration (e.g., bank accounts)
Access to financial services (e.g., bank branches, ATMs)
Usage of financial services (e.g., loans and deposits)
Some studies referencing Ratnawati (2020) express the model as:

Economic Growth Equation

$$lnGDP_{it} = \beta_0 + \beta_1 lnCOM_{it} + \beta_2 LOAN_{it} + \beta_3 INF_{it} + \beta_4 LAW_{it} + e_{it} \quad (3.1)$$

Income Inequality Equation

$$GINI_{it} = \beta_0 + \beta_1 lnCOM_{it} + \beta_2 LOAN_{it} + \beta_3 INF_{it} + \beta_4 LAW_{it} + e_{it} \quad (3.2)$$

Where
GDP = Economic growth
GINI = Income inequality
INF = Inflation
LAW = Institutional or legal environment variable
Ratnawati (2020) applied: Dynamic panel data analysis, and Generalized Method of Moments (GMM). This method helps to control endogeneity, unobserved heterogeneity, and dynamic relationships in panel datasets.
Dependent variables: Economic growth, poverty, inequality, financial stability.
Independent variables (financial inclusion): bank accounts, bank branches, ATMs, deposits, loans, and NPLs.

Estimation method: Dynamic panel regression using GMM.
However, the adapted model 3.0 above was then modified to focus on the financial inclusion indicators specific to this study, which would then be used in the test of postulated hypotheses. This study modified the above model, by using two different proxies for the Independent variables and Control variables and employed real GDP growth rate as a measure of Economic Growth. The adapted (Ratnawati, 2020) but modified statistical model is outlined to determine the effect of financial inclusion on the economic growth of lower-middle income Africa countries. In addition, as indicated earlier, the dynamic panel data analysis and Generalized Method of Moments (GMM) techniques which are adopted to control endogeneity, unobserved heterogeneity, ensure dynamic relationships in panel datasets and for hypotheses testing.

In achieving this, the proxies for financial inclusion (FI), being the independent variables are represented: thus, numbers of ATMs per 100,000 adults (ATMs), and number of Outstanding loans from commercial banks per 1,000 adults (OUTSLO). The dependent variable is Economic Growth which is represented by real gross domestic product (rGDP). For the purpose of this research, the panel data empirically analysed a 20-year financial inclusivity ranging from 2004 to 2023. Hence, the panel regression (Generalised Methods of Moment) model that is used to test the posited hypotheses are used thus:

Model Modification

However, this study modifies the above model to focus specifically on two key financial inclusion proxies relevant to lower-middle income African countries:

ATM Density (ATM) → Financial access

Outstanding Loans (OUTSLO) → Financial depth

The dependent variable is:

Economic Growth (RGDPGR) → Real GDP growth rate

Dependent Variable

Y = Economic growth (EG)

EG = Real Gross Domestic Product Growth Rate (RGDPGR)

Independent Variables

X = Financial Inclusion

FI = f (ATM, OUTSLO).....(3.3)

The functional form of the econometric model and the relationship between financial inclusion and economic growth will be outlined based on the following functional equation:

Y = f (X1, X2).....(3.4)

Where, Y is real gross domestic product of Economic Growth (EG) Dependent Variable

X1, X2 are proxies of the independent variables or explanatory variables

F = represents the functional notation.

The explicit forms of the models for the six hypotheses are stated thus:

$RGDP_{GRit} = \alpha 0 + \alpha_1 ATM_{it} + \alpha_2 OUTSLO_{it} + \varepsilon_{it}$.....(3.5)

Where:

$RGDPGR_{it}$ = Real Growth Domestic Product Growth Rate

ATM = number of ATMs per 100,000 adults

OUTSLO = outstanding loans from commercial banks per 1,000 adults

$\alpha 0$ = Regression Constant / intercept

α_{1-2} = Coefficient of Explanatory Variables

ε_{it} = Error term
i = country
t = time (year)

$$RGDPGR_{it} = \alpha 0 + \alpha_1 ATM_{it} + \alpha_2 OUTSLO_{it} + \varepsilon_{it} \quad (3.6)$$

Estimation Technique

The study employs Panel Least Squares (PLS) regression technique to estimate the model (Baltagi, 2005). Panel data estimation is appropriate because it:
-Captures both time-series and cross-sectional variations
-Controls for unobserved heterogeneity across countries
-Improves efficiency of estimates .
-The analysis is conducted using E-Views version 10.0 (Gujarati & Porter, 2009)

Justification of Method

The choice of panel regression is justified because it allows the researcher to examine the individual and joint effects of financial inclusion variables (ATM density and outstanding loans) on economic growth across countries and over time. The use of beta coefficients enables the estimation of the magnitude of impact of each independent variable, and the direction of relationships (positive or negative). Standard errors are used to test the statistical significance of the estimated coefficients, ensuring the reliability of the results (Wooldridge, 2010).

Data Analysis Techniques

The study employs descriptive statistics to summarize the data (mean, standard deviation, minimum, maximum). Inferential Statistics for multiple regression analysis to test the formulated hypotheses. To make methodology stronger, the following should also be included: Hausman Test (Fixed vs Random Effects); Unit Root Test (Stationarity); and Multicollinearity Test (VIF).

Scope of the Study

Assess the effect of automated teller machines (ATMs), outstanding loans from commercial banks, and financial inclusiveness on growth of economy in lower-middle income of 10 Africa countries. These LMI Africa countries include: Northern Africa (Tunisia and Egypt); West Africa (Nigeria and Cape Verde); Central Africa (Angola and Cameroon); East Africa (Comoros and Zambia); and South Africa (Lesotho and Eswatini) indicating two countries from each region that is made up Africa region. The variables of financial inclusivity which serves as independent variables are: number of ATMs per 100,000 adults, and number of outstanding loans from commercial banks while the dependent variable for the growth of

economy is the real gross domestic product (RGDP). The study employs panel data covering ten selected lower-middle income African countries over a 20-year period (2004-2023) whose data were sourced and available from world bank's of World Development indicator database. The panel structure allows for the analysis of both cross-sectional (between countries) and time-series (over time) variations.

RESULTS AND DISCUSSIONS

Descriptive Statistics for the Model

The descriptive statistics of the selected proxies of Financial Inclusion used in the study were (number of ATMs per 100,000 adults, and number of outstanding loans from commercial banks) and economic growth (real gross domestic product per capital) as itemised in this section. In examining the distribution and behavior of the variables prior to econometric estimation, Descriptive statistics were used. Generally, measures of central tendency and dispersion, including the mean, minimum, maximum values, and standard deviation of each variable were discussed. Each variable of the mean implies the average value, while the standard deviation measures the degree of variability or dispersion from the mean. The minimum and maximum values provide insights into the range and spread of the data across the sampled countries and time period. This preliminary analysis is vital as it assists in identifying potential inconsistencies in the dataset, outliers, and anomalies thereby ensuring the reliability of subsequent regression results. In addition, understanding of data structure, which is necessary before fitting the panel regression model as provided by descriptive statistics.

This statistics ex-post the principal characteristics of the data set, including the mean which is the measure of central tendency, standard deviation that measures the variability; the maximum and the minimum values of each of the variables for both independent and dependent, given the summary of samples and observations used for the study which form the basis of the dataset description. The descriptive statistics is a precondition for fitting the panel regression model. Below is the summary of descriptive statistics for all variables used in the study as depicted in Table 4.1.

Table 4.1: Summary of Descriptive Statistics

Description	RGDPGR	ATMs	OUTSLO
Mean	1.682522	15.68910	68.23082
Median	1.710123	11.76500	36.76681
Maximum	15.15451	52.07000	249.0470
Minimum	-20.89375	0.000000	0.000000
Std. Dev.	3.681832	13.46451	69.70613
Skewness	-1.053677	1.097826	1.090240
Kurtosis	10.98761	3.305542	2.996984
Jarque-Bera	568.6901	40.95205	39.62087
Probability	0.000000	0.000000	0.000000
Sum	336.5044	3137.820	13646.16
Sum Sq. Dev.	2697.622	36077.31	966930.0
Observations	200	200	200

Source: Elaboration and computation by the authors using E-Views 10 (2025)

The summary of key characteristics of the variables used in this study as stated Table 4.1. For the dependent variable, economic growth—measured by real GDP growth rate (RGDPGR)—the mean value is 1.682522 across the selected ten lower-middle income (LMI) African countries. This implies that, on average, the economies experienced modest positive growth during the period under consideration. The maximum and minimum values of **15.15451** and **–20.89375**, respectively, reveal significant fluctuations in economic growth across countries and over a period of time. This implies that while some countries experienced strong economic expansion, others were confronted periods of significant economic shrinking. The RGDPGR standard deviation is **3.681832**, which is higher than the mean. Meaning a high level of variability in economic growth, implies that growth rates are widely dispersed around the average, and that the economies exhibit instability over the period under study.

For the financial inclusion variables, 15.68910 is mean value for ATM density, indicating that, on average, about 16 ATMs per 100,000 adults are in ten selected countries. When compared to global standards, it reflects relatively low financial infrastructure. **13.465** represents standard deviation indicating moderate variability in ATMs distribution across countries. Likewise, 68.23082 is the mean value for outstanding loans from commercial banks (OUTSLO), indicating a relatively higher level of credit provision compared to ATM availability. The standard deviation of **69.70613**, which is approximately equal to the mean, indicates a high degree of dispersion in loan distribution across the countries. The maximum values for ATM density (**52.070**) and outstanding loans (**249.047**) suggest that some countries have relatively well-developed financial systems, while the minimum values of **0.000000** for both variables

indicate that certain countries or periods experienced extremely low levels of financial inclusion.

Pretest Analysis

Unit Root Test

In analysing the order of integration based on a series of unit root tests by using Augmented Dickey Fuller test, the stochastic properties of the variables are well thought out in the model ADF test, unit roots test were run on the variables at levels and first difference. The results presented in table 4.2: below confirm that the study variables are stationary at 1(0) only. Before estimation, it is necessary to test whether the panel data series are stationary to avoid spurious regression results. This study employs panel unit root tests such as:

Levin, Lin & Chu (LLC) test

Im, Pesaran and Shin (IPS) test

These tests examine the null hypothesis that the variables contain a unit root (non-stationary).

Decision Rule:

If p-value < 0.05 - Reject null - Variable is stationary

If p-value > 0.05 - Fail to reject - Variable is non-stationary

If variables are non-stationary at level, they will be differenced until stationarity is achieved.

Table 4.2: Result of Unit Root (Stationarity) Test of 10 Countries

VARIABLES	LEVEL		FIRST DIFFERENCE		ORDER OF INTEGRATION
	Levin, Lin & Chu t*	PP-Fisher Chi-square tests	Levin, Lin & Chu t*	PP-Fisher Chi-square tests	
RGDPGR	-3.3537**	68.7926**	-8.3230**	618.516**	1(0)
ATMs	-7.03182**	39.2310	0.43329**	79.5949**	1(0)
OUTSLO	-3.95888**	43.2581**	-6.16714**	167.195**	1(0)

**The levin, Lin and Chu test; Null hypothesis: Unit root (assumes common/group unit root process).*

Source: Elaboration and computation by the authors using E-Views 10 (2025)

The results of the panel unit root tests indicate that all the variables—Real Gross Domestic Product Growth Rate (RGDPGR), ATM density (ATM), and outstanding loans from commercial banks (OUTSLO)—are stationary at level, that is, they are integrated of order zero, I(0), at the 5% level of significance. This implies that the null hypothesis of a unit root is rejected for all variables, confirming that the series do not contain stochastic trends and are stable over time. As a result, the variables can be used in their level form without the need for

differencing. The stationarity of the variables ensures that the regression results are reliable and not spurious. Consequently, the study proceeds with further econometric analysis using the panel regression model.

Data Analysis

Regression Analysis

Data analysis obtained from the study's variables sourced from World Bank website. Analysing all the items using multiple regression technique on E-views 10 software. The regression co-efficient is shown in Table 4.3 below.

Table 4.3. Regression Co-efficient

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.331062	0.889649	3.744244	0.0002
ATMs	-0.114768	0.042694	-2.688140	0.0011
OUTSLO	0.000829	0.006921	0.119798	0.0048
R-squared	0.770016	**Mean dependent var**	1.682522	
Adjusted R-squared	0.641105	**S.D. dependent var**	3.681832	
S.E. of regression	3.605367	**Akaike info criterion**	5.437097	
Sum squared resid	2508.744	**Schwarz criterion**	5.552538	
Log likelihood	-536.7097	**Hannan-Quinn criter.**	5.483814	
F-statistic	2.421759	**Durbin-Watson stat**	1.501671	
Prob(F-statistic)	0.000069			

Source: Elaboration and computation by the authors using E-Views 10 (2025)

The regression results indicate differing effects of financial inclusion proxies on economic growth in selected ten lower-middle-income (LMI) African countries from 2004 to 2023.

Effect of Automated Teller Machines (ATMs) The number of ATMs exhibits a negative relationship with the real GDP growth rate (RGDPGR). Specifically, the regression coefficient of –0.114768 suggests that, on average, an increase of one ATM per 100,000 adults is associated with a 0.115% decrease in economic growth. The probability value ($p = 0.0011$) is well below the 5% significance level, indicating that the negative effect is statistically significant. The outcomes implies that ATMs infrastructure may enhance financial services access, its expansion in the studied countries may not directly transform into higher economic growth. Uneven spatial distribution of ATMs, with concentration in urban areas, limited usage in rural areas or among economically active populations, and low complementarity with other financial services, such as credit or digital finance as explained.

The number of outstanding loans from commercial banks has a positive relationship with economic growth. The coefficient of 0.000829 shows that, on average, an increase in outstanding loans is related to a 0.0008% increase in real GDP growth. The associated p-value ($p = 0.0048$) confirms that this positive effect is statistically significant at the 5% level. This implies that credit provided by commercial banks plays a vital role in encouraging consumption, investment, and overall economic activity in these LMI African countries. The relatively small coefficient may reflect that loans are congregated in specific sectors (e.g., trade, government, or urban businesses). Limited credit access are still being faced numerous SMEs' or rural borrowers still face.

0.770016 is the R-squared value showing that about 77% of the variation in the real GDP growth rate as explained by ATMs and number of outstanding loans per 1,000 adults. Meaning a moderately high goodness-of-fit, with 23% of the variation attributed to factors outside the model. The Durbin-Watson statistic is 1.501671 signals a potential presence of autocorrelation, this address robustness checks in future or using dynamic panel estimators. 2.421759 is the F-statistic with a probability of 0.000069 confirms that the overall regression is statistically significant. Meaning that independent variables, considered jointly, having a meaningful impact on economic growth.

Hypotheses Evaluation
H_1 (ATMs → Economic Growth): Supported with a significant negative effect.
H_2 (Outstanding Loans → Economic Growth): Supported with a significant positive effect.
The results are summarized in Table 4.3. The model is confirmed as appropriate for evaluating the relationship between financial inclusion and economic growth in LMI African countries.

DISCUSSION OF FINDINGS

Outstanding loans from the commercial banks have a positive and statistically significant relationship with economic growth (real GDP growth rate) in the ten selected LMI African countries as shown by the study. Meaning that increased access to credit improves consumption, investment, and productive activities, thereby stimulating economic growth. The outcome underscores the significance of strengthening fundamental components of credit management within the banking sector. These are effective credit risk assessment preceding to lending, robust monitoring and early warning systems, improved loan structuring, efficient non-performing loan (NPL) management, adoption of financial technologies and automation, and strong governance and risk management frameworks. These mechanisms are vital aim at making sure that increased lending translates into sustainable economic growth while maintaining low levels of default risk. This finding align with the study by Okonkwo and Nwanna (2021), who found that loans given by commercial banks particularly through rural

branches have a positive and significant impact on economic growth in Nigeria. Similarly, a positive relationship between bank credit and economic growth was also found by (Ibrahim, Akano, and Kazeem, 2015). Increased credit availability plays a vital role in promoting economic development in African economies as collectively meant by these results.

In comparison, a negative and statistically significant relationship with economic growth in the ten selected LMI African countries as found by the number of ATMs. Meaning that increases in ATM density are associated with a decline in real GDP growth, contrary to expectations. The outcome is of the view that exclusive ATMs deployment alone may not be a strong or sufficient indicator of financial inclusion capable of driving economic growth in LMI African countries. Uneven distribution of ATMs, with concentration in urban areas, persistent reliance on cash-based transactions, limited access in rural and underserved regions, security challenges, including fraud, card skimming, and cyber threats, and operational inefficiencies such as cash shortages and long queues are several structural and operational factors that may explain this outcome. These issues lower the efficiency and effectiveness of ATMs as tools for promoting inclusive financial access and economic activity. Moreover, the outcome contrasts with some existing studies that report a positive relationship between ATMs usage and economic growth, particularly in country-specific contexts such as Nigeria. This discrepancy suggests that the impact of ATMs' may be context-dependent, varying across countries based on infrastructure quality, financial literacy, and complementary financial services.

From a theoretical perspective, the negative impact of ATMs does not fully align with the propositions of the Schumpeterian finance-growth nexus theory, which posits that improved financial services access enhances innovation, productivity, and economic growth. The outcome shows that mere financial infrastructure availability, without effective utilization and supporting systems, may not return the expected growth results. The coefficient of determination (R^2) shows that about 77% of the variation in real GDP growth is explained by the independent variables included in the model. A relatively strong explanatory power of the model was reflected. Overall, the outcomes indicate that while financial depth (credit provision/loans) plays a significant role in driving economic growth, financial access via ATMs infrastructure only was inadequate without effective utilization, institutional quality, and supporting financial systems. The need for a more integrated approach to financial inclusion in lower-middle income African countries was highlighted.

CONCLUSION

Assessing the effects of automated teller machines (ATMs), outstanding loans from commercial banks as proxies for financial inclusion on economic growth in the selected ten lower-middle income (LMI) African countries using annual time series data from 2004 to 2023.

The study made use of descriptive statistics and panel least square regression techniques with the aid of statistical package E-view version 10.0 to evaluate the relationships among the variables. The analysis was based on panel data obtained from world development indicator of world bank, and central bank of Nigeria statistics database.

The empirical findings reveal that ATM density has a **negative and statistically significant relationship** with economic growth. This suggests that, despite the role of ATMs in enhancing access to financial services, their presence alone is insufficient to drive economic growth in LMI African countries. The outcome reflects structural challenges like infrastructural limitations, which hinder their effectiveness in promoting inclusive financial access, uneven distribution of ATMs, and concentration of these ATMs in urban areas. On the other hand, outstanding loans from commercial banks exhibit a **positive and statistically significant relationship** with economic growth. Meaning that increased credit access plays a vital role in stimulating investment, enhancing overall economic growth, and supporting business activities. However, despite the growth in lending, credit access remains strained by factors like high lending risks, sectoral imbalances, and weak institutional frameworks.

Overall, the outcomes indicate that financial inclusion contributes to economic growth primarily through **financial depth (credit provision)** rather than **financial access (ATM infrastructure)** in the 10 selected LMI African countries. This underscores the need for a more comprehensive approach to financial inclusion that integrates both access and effective utilization of financial services. In conclusion, ATMs remain an important element of the financial system, their effect on economic growth is limited without supportive infrastructure and widespread usage. Conversely, strengthening credit delivery mechanisms within the banking sector is necessary for promoting sustainable economic growth in LMI African countries.

Recommendations

The underlisted are hereby recommended based on the outcomes of this study Governments and financial institutions should expand credit/loans access to small and medium enterprises (SMEs), conditions of securing loans facilities like high collateral requirements, and encourage sectoral diversification in lending should be reduced.

Commercial banks should enhance credit appraisal systems, reduce non-performing loans through proactive management, and implement robust monitoring and early warning mechanisms, thereby strengthen Credit Risk Management.

Ensure equitable distribution, especially in rural areas, address infrastructural challenges like improve maintenance and reduce downtime, electricity and network issues, and rather than

focusing exclusively on increasing the number of ATMs, thus, optimizing ATMs Deployment.

Policymakers should encourage mobile banking and fintech innovations, reduce dependence on cash transactions, and expand agent banking networks thereby promoting digital financial inclusion.

Enhance Financial Literacy: Governments and stakeholders should implement nationwide financial education enlightenment and programs, improve users' ability to effectively utilize financial services, and increase awareness of financial products and services.

Contribution to Knowledge

This study contributes to the existing knowledge on financial inclusion and economic growth in several ways. First, a multidimensional approach to financial inclusion by simultaneously examining financial access (ATM density) and financial depth (outstanding loans from commercial banks) was adopted. Unlike several previous studies that rely solely on single proxy or composite indices, this approach provides a more nuanced understanding of how different components of financial inclusion influence economic growth. Second, the study provides empirical evidence from a panel of ten selected lower-middle income (LMI) African countries, hence extending the literature beyond single-country analyses that dominate existing research. This cross-country perspective improves the findings generalizability within the African context. Third, the study reveals a divergent impact of financial inclusion proxies, where ATM density exhibits a negative relationship with economic growth, while outstanding loans show a positive effect. This finding challenges the conventional assumption that all forms of financial inclusion uniformly boost economic growth. Fourth, the study integrates insights from the Schumpeterian finance-growth nexus theory and financial literacy theory, thereby contributing to the theoretical discourse by demonstrating that financial infrastructure only is not sufficient without effective utilization and financial capability.

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