Scientific Annals of Economics and Business
70 (4), 2023, 629-650
DOI: 10.47743/saeb-2023-0036

Mobile Money and Banking Development in Sub-Saharan Africa

Jonathan Tembo*

Abstract: The study investigated the relationship between mobile money growth and banking development in Sub-Saharan Africa. The question of whether mobile money threatens or supports traditional banks is contentious. Therefore, the motivation was to comprehensively examine the extent of mobile money's influence on banking development. The study used a quantitative research design with aggregated quarterly panel data from the four regions of Sub-Saharan Africa. The Panel ARDL estimation was applied to quantify the nature of the relationship between mobile money and banking development variables. Study findings showed that an increase in active mobile money accounts and volumes was associated with a decline in bank accounts, bank branches, and ATMs in the long run. At the same time, this trend was offset by positive impacts on private sector credit and total bank assets again in the long run. The findings align and extend the technology acceptance models and show that increased use of mobile money technology has substitution and complementary effects on banking development. Policymakers and financial institutions should carefully consider the potential trade-offs and synergies between mobile money adoption and traditional banking services, leveraging the positives while addressing challenges arising from the disruptive forces of technological innovation.

Keywords: mobile money; banking development; financial development; Sub-Saharan Africa.

JEL classification: G21; O1.

* Department of Finance and Investment Management, College of Business and Economics, University of Johannesburg, Johannesburg, South Africa; e-mail: *jtembo@uj.ac.za*.

Article history: Received 21 August 2023 | Accepted 7 December 2023 | Published online 13 December 2023

To cite this article: Tembo, J. (2023). Mobile Money and Banking Development in Sub-Saharan Africa. *Scientific Annals of Economics and Business*, 70(4), 629-650. https://doi.org/10.47743/saeb-2023-0036.

1. INTRODUCTION

The fourth industrial revolution has engendered sweeping technological advancements worldwide, ushering in automation across diverse sectors. While traditional services and industries have embraced smart technology and artificial intelligence for enhanced efficiency (Schwab, 2016) the digital revolution in Africa has shown a distinctive trajectory. Notably, adopting mobile money and related financial services is a singular indicator of progress in this domain (Ndung'u & Signe, 2020). Mobile money, a digital financial service accessible through mobile phones and reliant on mobile network infrastructure, encompasses a range of offerings such as international and peer-to-peer remittances, merchant and bill payments, bulk transactions, savings, and insurance services (GSMA, 2020). The Sub-Saharan African (SSA) region has emerged as a global leader in mobile financial services, with pivotal statistics released by the GSMA (2023) reflecting its prominence. SSA contributes to 50% of global mobile money live services and boasts the highest number of registered mobile money accounts, totaling 605 million. Moreover, its transactional value amounts to USD 697.7 billion, constituting 40% of the global total (GSMA, 2023), underscoring the thriving nature of the mobile financial sector in the region.

Several factors have propelled mobile money's remarkable growth and dominance in SSA. The rapid expansion of mobile communication infrastructure across even remote areas has facilitated the accessibility of mobile money services, overcoming barriers posed by limited traditional banking infrastructure (Siano *et al.*, 2020). Scholars like Jong-Moon and Hyunju (2016) and Mothobi and Grzybowski (2017) emphasize the ease with which mobile money facilities can be established in rural regions compared to traditional bank branches. Additionally, supportive regulatory frameworks have contributed to the sector's growth by facilitating the establishment and adoption of mobile money services (Naghavi, 2019; Siano *et al.*, 2020). The attractiveness of mobile money lies in its provision of four key benefits: reduced transaction costs, formal financial system integration, enhanced liquidity access for the unbanked, and empowerment of African women through private savings ownership (Ahmad *et al.*, 2020). Adaba *et al.* (2019) highlight its role in empowering users, improving livelihoods, and offering choice, while Chukwumah and Islam (2017) and Mago and Chitokwindo (2014) emphasize its convenience, citing reduced access time, transport costs, and affordability as major draws. However, despite the widespread adoption of mobile money across SSA, variations in adoption and usage patterns persist across the region.

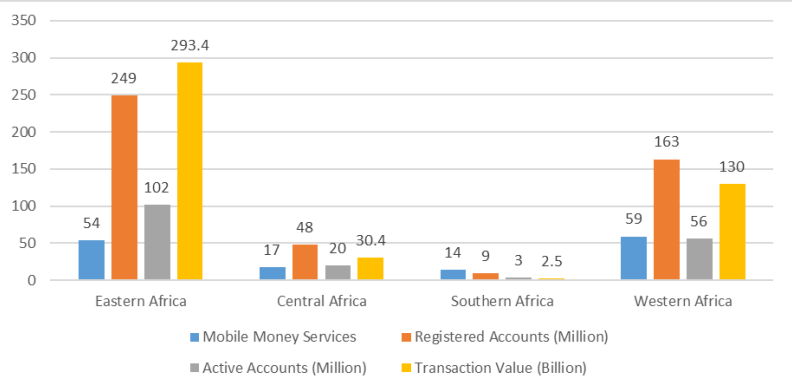

Figure no. 1 – Mobile Money usage in Sub-Saharan Africa
Source: author compilation from GSMA (2023) Data

Figure no. 1 shows the extent of mobile money usage across SSA regions. Regionally, Eastern Africa has emerged as a prominent hub for mobile money usage, boasting substantial live services, registered accounts, active users, and transaction volumes. Although Western Africa exhibits slightly higher live services, Eastern Africa's 249 million registered accounts and 102 million active accounts signify its dominance (GSMA, 2023). The region's pioneering introduction of mobile money through platforms like Kenya's M-Pesa has cultivated high mobile account ownership rates, with Kenya at 88%, Uganda at 67%, and Tanzania at 53% (GSMA, 2023). Meanwhile, Western Africa, buoyed by initiatives such as MTN Money and Orange Money, demonstrates remarkable growth rates and rapid mobile money integration with banking systems, leading to a 27% increase in transaction volumes in 2023 (GSMA, 2023).

While convenient for users, the increasing interoperability between mobile money platforms and banks has sparked concerns regarding the potential threat to the financial development of traditional institutions (Nantege, 2015; Severino & Tonderai, 2015; Nyakwana, 2016). Financial development in the context of this study refers to improvement in the breadth and depth of financial services available in financial markets (Nyasha *et al.*, 2017; Bist & Bista, 2018). It can be an increase in financial market assets, enhanced access to services, or improvement in the range of financial services offered in the financial market (Tembo & Makina, 2020). As mobile money platforms evade certain regulatory standards applicable to banks, they compete in the same financial services domain, posing challenges to the established financial ecosystem. This concern is amplified by initiatives like the pan-African interoperability platform launched by MTN Money and Orange Money, enabling fund transfers across the continent through mobile money wallets (MTN, 2018). However, the precise impact of mobile money on savings mobilization, deposit growth, interest incomes, and banking margins remains a subject requiring empirical investigation.

Undoubtedly, mobile money has played a pivotal role in enhancing financial inclusion in SSA, as depicted in Figure no. 2. Financial inclusion is an element of financial development which focuses on the availability and accessibility of financial services to an individual without consideration of their economic status (Fanta *et al.*, 2016; Sekantsi & Motelle, 2018; Sosu, 2019).

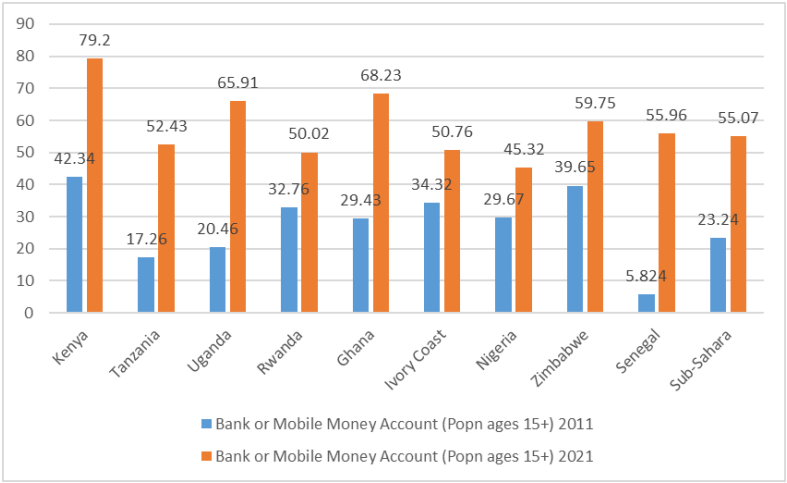

Figure no. 2 – Account Ownership Growth
Source: author compilation from World Bank (2023)

In Kenya, account ownership has increased from 42.34% to 79.2%, while in Tanzania, account ownership has trebled from 17.26% to 52.43%. The highest growth is observed in Senegal, where account ownership grew from 5.824% to 55.96, a growth rate of around 1000%. The overall growth for Sub-Saharan Africa shows an increase in account ownership from 23.24% to 55.07. According to the International Finance Corporation IFC (2022), such growth rates would have been inconceivable in SSA without the introduction of mobile money. The substantial growth in account ownership, particularly in countries like Kenya, Tanzania, and Senegal, underscores the positive effects of mobile money adoption (IFC, 2022). However, the ramifications of this growth on banking sector development remain unexplored from an empirical standpoint, necessitating further inquiry. This study endeavors to fill this gap by examining the influence of mobile money growth on banking sector development in SSA. Focusing on banking development, the research aims to elucidate how mobile money has transformed the conventional banking model across SSA countries, contributing to the broader discourse on the changing financial landscape in the region. Therefore, this study contributes to the growing literature on mobile money's impact on banking development, specifically tailored to the unique context of Sub-Saharan Africa. The following section explores the empirical and theoretical literature on mobile money and financial development.

2. LITERATURE REVIEW

This section critically reviews the theoretical and empirical literature on mobile money and its impact on financial development.

2.1 Theoretical framework

The study's theoretical framework is based on the Technology Acceptance Models (TAMs), which explain how individuals and organizations accept and adopt new technologies. The original Technology Acceptance Model (TAM) was proposed by Davis (1989) and suggested that a technological product is based on the product's perceived usefulness and ease of use. The TAM was later modified by Venkatesh *et al.* (2003) to formulate the Unified Theory of Acceptance and Use of Technology (UTAUT) model. The UTAUT proposed that the use of technology is determined by behavioural intention shaped by performance expectancy, effort expectancy, social influence, and facilitating conditions. Performance expectancy is the individual`s belief that the technology will improve performance, while effort expectancy is the ease of using the technology. Social influence is the weight that society places on the belief that technology should be used, and facilitating conditions are the infrastructure support available to enable the use of the technology. The adoption of mobile in Sub-Saharan Africa has been observed to be driven by factors specified in the TAM models. For instance, Siano *et al.* (2020) suggest mobile money has mainly been facilitated by growth in mobile infrastructure even in rural areas, while Chukwumah and Islam (2017) and Mago and Chitokwindo (2014) emphasize its convenience, reduced access time, transport costs, and affordability as the main drivers. From a societal perspective, mobile money is seen as beneficial to society through providing liquidity access for the unbanked, empowering African women through private savings ownership, improving livelihoods, and offering choice (Ahmad *et al.*, 2020). The study builds on the TAMs theoretical models by proposing that increased use of mobile money facilitated by the above stated factors has

substitution and complementary effects on banking development. In terms of the substitution effects, the study proposes that increased use of mobile money will see a gradual replacement of conventional banking services such as ATMs and bank accounts as mobile money supplants traditional banking. For the complementary effect, the study proposes that increased mobile money use is reshaping banking development through increased interoperability which increases the financial assets available to the banking sector. The findings from the current study will prove or disprove the proposed theory.

2.2 Empirical Perspectives on Mobile Money and Financial Inclusion

Numerous studies on the impact of mobile money have predominantly focused on its impact on financial inclusion (Fanta *et al.*, 2016; Sekantsi & Motelle, 2018; Sosu, 2019). For instance, Lehmann-Uschner and Menkhoff (2020) delved into the matter, evaluating the role of mobile money in financial development across Africa. They measured financial development using metrics like mobile money usage frequency, financial service demand, and levels of financial inclusion. Notably, their findings revealed that mobile money usage remained lower than anticipated relative to the number of registered mobile money accounts, primarily attributing this to issues like inadequate network coverage and financial illiteracy (Lehmann-Uschner & Menkhoff, 2020). Nonetheless, the study was critiqued for drawing generalized conclusions from observations of only one country, thus limiting the applicability of the findings to a broader context. Similarly, Ahmad *et al.* (2020) conducted a literature assessment of Africa`s experiences of mobile money relative to financial inclusion and financial development and concluded that mobile money improves financial inclusion and allows those who use it to withstand shocks. The study, however, fell short in that it only used financial inclusion as the sole measure of financial development. In contrast, Donovan (2012) scrutinized the intricate interplay between mobile money and financial inclusion in the context of M-Pesa, a leading mobile money service spanning six countries. This study indicated that mobile money positively impacted livelihoods but did not necessarily stimulate demand for other innovative financial services. The study by Donovan (2012) has the advantage that it extended over six countries, thus, the diversity gave in-depth understanding of mobile money which can be applied to a broader context. Furthermore, regulatory restrictions hindered its successful penetration into more traditional banking markets. Notably, the study did not thoroughly explore the potential impact of mobile money on the established banking model. On the other hand, Lashitew *et al.* (2019) sought to delineate the disparities in the impact of mobile on financial inclusion across countries. Their study took a quantitative cross -country approach and attributed differences in financial inclusion to institutional, economic, and regulatory variables. The study by Lashitew *et al.* (2019) adds to the methodological rigor through the use of regression approaches to determine the relationship between mobile money and World Bank financial inclusion indices. Additional studies by Vong *et al.* (2012); Yenkey *et al.* (2015); Della Peruta (2018); Gasperin *et al.* (2019), (Mutsonziwa & Maposa, 2016)) further corroborated the affirmative link between mobile money and financial inclusion. The reviewed literature offers diverse perspectives on the impact of mobile money from varying geographical and methodological contexts. It also covers different aspects of the impact in the form of financial inclusion, livelihoods, and regulatory challenges, giving a vivid picture of the impact of mobile money.

However, these analyses often concentrated solely on one aspect of financial development, overlooking the broader impact on banking development. The potential challenge posed by mobile money to established banking institutions has been highlighted in several studies. Nantege (2015); Severino and Tonderai (2015); Nyakwana (2016) have alluded to the disruptive influence of mobile money on banking. Nonetheless, an empirical consensus on this matter remains elusive. Consequently, this study aims to comprehensively examine the extent of mobile money's influence on financial development through the lens of banking development.

2.3 Empirical perspectives on mobile money and banking development

Banking development is a component of financial development, referring to the improvement in the banking sector`s ability to carry out the financial intermediation role in the economy (Venkatesh *et al.*, 2003; Čihák *et al.*, 2013; Aluko & Ajayi, 2018). It encompasses aspects such as increases in the depth of the sector, improvements in efficiency, and the extent to which citizens of a country have access to banking services (Sibindi & Bimha, 2014; Mhadhbi *et al.*, 2017)). In Sub-Saharan Africa, financial markets are poorly developed and are mainly bank based with relatively new stock markets (Aluko & Ajayi, 2018; Tembo & Makina, 2020). Consequently, financial development indicators in Sub-Saharan Africa mainly point to banking sector development. Current literature on the determinants of banking development in Sub-Saharan Africa has shown that levels of banking development vary across countries and depend on a number of factors. For instance, Chow and Fung (2013); Nyasha *et al.* (2017); Bist and Bista (2018) suggested levels of banking development depend on the extent of economic growth of a country and proposed that there is bi-directional causality between the two. On the other hand, Kodila-Tedika and Asongu (2015); Ozkok (2015); Asongu and Odhiambo (2019) attributed differences in banking development levels to differences in education, intelligence, and cognitive ability. Accordingly, higher levels of education, intelligence, and cognitive ability were seen to be positively correlated with a greater appreciation of financial markets. Further, Kodila-Tedika *et al.* (2017) assessed the effect of geographical location on banking development, and in agreement with Acemoglu *et al.* (2001) endowment theory, their findings showed landlocked countries and countries close to the equator have lower levels of bank development. The strength and types of legal systems have also been observed to influence banking development. In this regard, La Porta *et al.* (1997); La Porta (1999) opine that weak investor protection laws and inadequate legal enforcement are associated with smaller and narrower financial markets. The previous studies by Ozkok (2015); Kodila-Tedika *et al.* (2017); Nyasha *et al.* (2017); Bist and Bista (2018) do not take into account the changes brought about by fintech innovations such as mobile money. Therefore, findings from such studies fail to capture changing dynamics in financial development from fintech adoption and use. However, contemporary studies on financial development have gone further to include the role of Fintech in the financial development process. In the context of Sub-Saharan African countries, Fintech is mainly dominated by mobile money (Im *et al.*, 2003; Venkatesh *et al.*, 2003; Nantege, 2015; Naghavi, 2019; GSMA, 2020; Ndung'u & Signe, 2020; GSMA, 2023; Mohamed, 2023). There is however, a paucity of empirical studies examining the relationship between mobile money and banking development. The closest empirical studies have come to examining the mobile money and banking development relationship is in the assessment of

mobile money, mobile banking and credit availability. One of such studies by Beck *et al.* (2015) looked at mobile money and ability to access credit. Using a dynamic equilibrium model, the study found that low access to trade credit promotes increased use of mobile money. The study however takes a short-term approach in its focus on access to credit, ignoring the long-term effects of integration of mobile money into the financial landscape. Alhassan and Koaudio (2019) took a different approach and focused on the macroeconomic effects of mobile money and its effects on funding of developmental projects. Unlike previous studies, Alhassan and Koaudio (2019) made use of secondary data and a partial least squares model to examine the relationships between variables. Findings revealed the positive impacts of mobile money on economic growth and a private sector credit from the financial sector. The study has the strength that it used real world observations in its examination of impact thus enhancing the credibility of its findings. However, it failed to address the questions as to the contribution of mobile money towards banks' physical infrastructure and asset changes. Rouse and Verhoef (2017) scrutinised the impact of mobile money from a Sub-Saharan Africa context and attributed poor banking infrastructure across SSA to the growth in mobile banking. While capturing the impact of mobile money on banking infrastructure, the study fails to capture impact on other banking development aspects such as total assets, credit and bank accounts. Alternatively, Alleman and Rappoport (2010) assessed the impact of mobile money in terms of the benefits it brings. Accordingly, the study revealed that mobile money presents a threat to the banking sector as it is a store of value and a medium of exchange. This perspective was also amplified by Maurer (2012) in their prescription of mobile as a banker to the unbanked. In contrast, Pelletier *et al*. (2020) suggested that mobile money is not a threat but a tool which can facilitate further banking sector development. In this regard, Pelletier *et al.* (2020) propounded that the spillover effects of mobile money are greater when it is offered by banks. In support of Pelletier *et al.* (2020), Munalye (2015) observed that the introduction of mobile money has positively impacted the retail banking side through an increase in their clientele base as interoperability of the mobile money and banking platforms enables banks to capture users who are on the mobile money platform. Further, the study findings showed mobile money platform has improved efficiency for banks as clients are able to carry out some transactions on the mobile money platforms. The studies however, do not thoroughly investigate the relationship between mobile money with other banking functions and thus fail to touch on the potential effects of mobile money on the overall banking model, including changes to infrastructure and financial assets. In addition, the studies ignore the temporal dimension and do not show how the relationship between mobile money and banking development has changed over different time periods. The current study fills this gap by adding a temporal dimension covering the short run and long run.

Therefore, whether mobile money threatens or supports traditional banks is contentious. Perspectives range from perceiving mobile money as a store of value and exchange medium, potentially threatening banks (Alleman & Rappoport, 2010), to viewing it as a facilitator of banking development, especially when integrated with banking services (Pelletier *et al.*, 2020). The divergence of perspectives highlights the need for comprehensive empirical investigations. This study seeks to bridge the gap by examining the influence of mobile money growth on banking development within Sub-Saharan African countries, contributing to a deeper understanding of the evolving financial landscape. It departs from previous literature, which predominantly focused on financial inclusion, by examining the relationship between mobile money and banking development using broader measures of banking development.

3. METHODOLOGY

This section explains the methodology adopted for the study. The study applied a quantitative research design. Numerical data on mobile money active accounts, mobile money transaction volumes, and the different measures of banking development was used to explore the nature of the relationship between mobile money growth and banking development in Sub-Saharan Africa.

3.1 Data sources

The data used in the study were obtained from public domains. The GSMA database provided data on active mobile money accounts and the volume of mobile money transactions in Sub-Saharan Africa. Data on banking development measures such as the number of bank branches, ATMs available, bank private sector credit, total bank assets, and bank accounts were obtained from the World Bank`s Global Financial Development Database. Control variables data on Political stability was also obtained from the World Bank`s World Governance Indicators, while Trade Openness data was accessed through the UNCTAD database. GSMA data on mobile money in Sub-Saharan Africa starts from the year 2011. Therefore, the data collected covered 10 years from 2011 to 2021.

3.2 Model estimation

A Pooled Mean Group (PMG) panel Autoregressive Distributed Lag (ARDL) proposed by Pesaran *et al.* (1999) was applied in this study. The PMG-ARDL model uses lagged values of the dependent and independent variables as explanatory variables. It allows for short-run coefficients and errors to vary across panel groups while long-run coefficients remain the same (Pesaran *et al.*, 1999). This pooling and averaging enable the PMG-ARDL to generate consistent means of short-run coefficients while maintaining homogenous long-run coefficients. However, the assumption of homogenous long-run coefficients may be a possible source of weakness if the slopes are heterogeneous, leading to biased estimates. In addition, the PMG method has the advantage that it can be estimated with a mix of I(0) and I(1) variables and estimates both short and long-run coefficients (Olayungbo, 2021; Shahid *et al.*, 2022). The PMG-ARDL also has the added benefit of being suitable for small cointegrated samples (Akinlo & Olayiwola, 2021). The ability to generate short and long-run coefficients aligns with the need to uncover the impact of mobile money in the short and long run. While the model assumes exogeneity of regressors, the use of lags of the dependent and independent variables in the PMG-ARDL alleviates any endogeneity problems (Pesaran *et al.*, 1999), where explanatory variables may be correlated with the error term. As such, through control of endogeneity, the model generates reliable and unbiased estimates. Outliers in the panel cross-sections may also adversely influence PMG estimates. However, in the current study, such outliers were handled through winsorization.

The panel comprised the four regions of Sub-Saharan Africa: Eastern Africa, Middle Africa, Southern Africa, and Western Africa. Quarterly aggregate data stretching from 2011 to 2021 was obtained to make up 160 observations.

The Panel ARDL model was specified as follows:

$$D\big(\ln(BD)\big) = b_0 + b_1 \ln(BD_{t-1}) + b_2 \ln(Mobile\ Money_{t-1}) + b_3 \ln(TradeOpen_{t-1}) + b_4 \ln(POl_{t-1}) + \sum_{i=1}^{q} a1\ D \ln(BD_{t-1})) + \sum_{i=1}^{q} a2\ D \ln(Mobile\ Money_{t-1})) + \sum_{i=1}^{q} a3\ D \ln(TradeOpen_{t-1})) + \sum_{i=1}^{q} a4\ D \ln(Pol_{t-1})) + e_{it} \quad (1)$$

where,

BD is the measure of Banking Development. Five measures of banking development were applied in the study: number of bank accounts per 1000 adults, Bank Branches available per 100 000 adults, ATMs available per 100 000 adults, Bank Private Sector Credit to GDP, Total Deposit Bank Assets to GDP. These measures have been applied in previous studies by Naghshpour and Davis (2018) and Eryigit and Dulgeroglu (2015). The number of bank accounts has been used as a proxy for banking and financial development in studies by Kendall *et al.* (2010) and Asongu and Odhiambo (2019) while Benmelech *et al.* (2023) and El Ouakdi *et al.* (2022) have proxied banking development using bank branches. In addition, the number of ATMs has been applied as a measure of banking and financial development in Maity and Sahu (2022) and Gehrung (2020). Private sector credit and total bank assets are common banking development measures applied in previous studies, including Tembo and Makina (2020) and Aluko and Ajayi (2018).

$Mobile\ Money$ is the proxy for mobile money measured by active mobile money accounts and volume of mobile money transactions and has been included in the model in line with Mas and Morawczynski (2009) and Son *et al.* (2020).

$TradeOpen$ is Trade Openness measured by net of exports and imports to GDP while Pol is the measure of political instability.

These variables have been observed to be significant determinants of banking development in previous studies by Tembo and Tembo and Makina (2020) and Campos *et al.* (2019). D is the first difference operator, b_1 to b_4 are the long-run coefficients, b_0 is a constant, and $a1$ to $a4$ are short run coefficients. The lag is represented by q while e_{it} is an error term. With the presence of cointegration, equation 1 above becomes a panel error correction model (ECM) specified as follows:

$$D\big(\ln(BD)\big) = b_0 + \sum_{i=1}^{q} a1\ D \ln(BD_{t-1})) + \sum_{i=1}^{q} a2\ D \ln(Mobile\ Money_{t-1})) + \sum_{i=1}^{q} a3\ D \ln(TradeOpen_{t-1})) + \sum_{i=1}^{q} a4\ D \ln(Pol_{t-1})) + \lambda ECT_{it-1} + e_{it} \quad (2)$$

where ECT is the error correction term, and λ measures the speed of adjustment of the variables from short run to long run equilibrium. Before running the model, preliminary tests were

conducted. Cross-sectional dependence tests were done using the Breusch-Pagan LM (Breusch & Pagan, 1980), Pesaran Scaled LM (Pesaran, 2004), and the Pesaran CD (Pesaran, 2004) tests. After cross-sectional dependence was established, unit root tests were carried out using first-generation and second-generation unit root tests. Therefore, the first-generation IPS unit root test by Im *et al.* (2003) and the Cross Sectionally Augmented (CIPS) test, a second-generation unit root test introduced by Pesaran (2007), were applied in unit root testing. After unit root tests, preliminary estimations and the Hausman (1978) tests were carried out to determine the most efficient estimator between the PMG and the Mean Group (MG).

4. FINDINGS

This section presents the findings of the study, starting with the descriptive statistics, correlation analysis, and unit root tests before proceeding to the regression estimations.

4.1 Descriptive statistics

Table no. 1 shows the descriptive statistics of 9 variables used in the study using 160 observations.

Table no. 1 – Descriptive statistics of variables

Descriptive Statistics Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Active Accounts	160	23400000	30500000	2435.25	1.21E+08	1.473	4.264
Volume	160	2.50E+08	4.08E+08	9242.5	1.93E+09	2.126	6.88
Bank Accounts	160	339.65	232.938	39.16	860.903	0.529	2.232
Bank Branches	160	6.244	3.195	0.837	11.495	-0.142	1.728
ATMs	160	13.977	11.785	1.038	36.754	0.756	2.079
Private Sector Credit	160	27.294	19.73	3.586	85.927	1.867	5.879
Total Assets	160	31.273	16.723	8.316	90.699	1.787	7.636
Trade Openness	160	26169.844	7402.321	14743.5	38260	-0.027	1.541
Political Stability	160	36.665	11.281	21.19	56.16	0.404	1.779

Source: author computation

The average number of mobile money accounts across Sub-Saharan Africa was 23.4 million, while the standard deviation was 30.5 million, demonstrating high variation in active mobile money accounts across SSA countries. The positive skewness of 1.473 suggests that most active accounts observations were clustered towards the lower end, with a few extreme values on the higher end. The average mobile money transaction volume was USD 250 million with a standard deviation of 408 million, again showing significant variation in transaction volumes across countries. The difference between the minimum observed transaction volume of USD 9 425 and the maximum of USD 1.93 billion reflects the wide span of transactional activity between the periods covered by the study. The preliminary findings on the mobile money variables suggest substantial variation in mobile money activity across SSA. Results on banking development showed the average number of bank accounts in SSA was 339, with a standard deviation of 232. The range between the minimum value of 39.16 and the maximum value of 860.903 indicates substantial disparities in the number of accounts across SSA countries. The data on bank accounts had a positively skewed

distribution (skewness = 0.529), pointing to the fact that most observations have fewer bank accounts, with a few outliers and a higher number of accounts. The average number of bank branches was observed to be 6.24, while the standard deviation was 3.19. In terms of ATM access, findings showed the average number of ATMs in SSA was 13.97 with a standard deviation of 11.78, hinting at variations in ATM distribution across countries. The difference between the minimum number of ATMs of 1.038 and the maximum of 36.75 shows the disparities in terms of access range for ATMs. Bank credit to the private sector as a ratio of GDP had a mean of 27.29 and a standard deviation of 19.73. The difference between bank private sector credit minimum and maximum values shows significant disparities in the range of banking development over the period. Trade openness measured by the average of export and imports of each region had an average of USD 26169 million and minimum and maximum values of USD 14 743 million and USD 38 260 million, respectively. The political stability index had a mean of 36.66 and a standard deviation of 11.28, indicating low levels of political stability in SSA.

4.2 Correlation analysis of mobile money and related variables

Table no. 2 – Correlation Analysis of Mobile Money and Related Variables

Pairwise correlations									
Variables	**-1**	**-2**	**-3**	**-4**	**-5**	**-6**	**-7**	**-8**	**-9**
(1) ActiveAccounts	1								
(2) Volume	0.973*	1							
(3) Bank Accounts	0.541*	0.607*	1						
(4) Bank Branches	0.469*	0.514*	0.884*	1					
(5) ATMs	-0.048	0.032	0.764*	0.702*	1				
(6) Private Sector Credit	-0.171*	-0.122	0.143	0.165*	0.123	1			
(7) Total Assets	0.058	0.102	0.413*	0.411*	0.340*	0.654*	1		
(8) Trade Openness	-0.422*	-0.421*	-0.172*	-0.178*	0.109	0.504*	0.294*	1	
(9) Political Stability	-0.078	0.005	0.702*	0.667*	0.631*	0.165*	0.377*	0.128	1

Note: *** p<0.01, ** p<0.05, * p<0.1

Source author computation

Correlation analysis showed a strong and significant positive correlation (0.973) between active mobile money accounts and mobile money transactions, suggesting that as active accounts increase, the volume in monetary terms of transactions also increases. Moderate and significant positive linear associations were also observed between bank accounts and active mobile money accounts (0.541) and bank accounts and volume of mobile money transactions (0.607). This hints towards an increase in bank accounts as access to mobile money improves. Moderate and positive correlations (0.469 and 0.514) were also noted between bank branches and the two measures of mobile money activity. The remaining measures of banking development (ATMs, Private sector credit and total assets) had no significant correlations with either active mobile money accounts or volume of mobile money transactions. The political stability index was consistently positively correlated to banking development variables such as bank accounts (0.702), bank branches (0.667), and ATM availability (0.631). The correlations did not show multicollinearity between variables to be applied in the regression estimations.

4.3 Cross-sectional dependence tests

The increased interconnectedness of countries implies that they may be susceptible to common shocks or policies. In such cases, panel data will show cross-sectional dependence in the panel units. Cross-sectional dependence tests were carried out on the panel using the Breusch-Pagan LM (Breusch & Pagan, 1980), Pesaran Scaled LM (Im *et al.*, 2003; Pesaran, 2004), and the Pesaran CD (Pesaran, 2004) tests.

Table no. 3 – Cross-Sectional Dependence Tests

Equation 1 Tests	**BankAccounts (1)**	**Branches (2)**	**ATMs (3)**	**Credit (4)**	**Total Assets (5)**
	Prob.	**Prob.**	**Prob.**	**Prob.**	**Prob.**
Breusch-Pagan LM	0.0000	0.0000	0.0000	0.0000	0.0000
Pesaran Scaled LM	0.0000	0.0000	0.0000	0.0000	0.0000
Pesaran CD	0.8000	0.0000	0.0000	0.1061	0.0133
Equation 2 Tests	**BankAccounts (6)**	**Branches (7)**	**ATMs (8)**	**Credit (9)**	**Total Assets (10)**
	Prob.	**Prob.**	**Prob.**	**Prob.**	**Prob.**
Breusch-Pagan LM	0.0000	0.0000	0.0000	0.0000	0.0000
Pesaran Scaled LM	0.0000	0.0000	0.0000	0.0000	0.0000
Pesaran CD	0.0127	0.0000	0.0000	0.0848	0.0077

Source*:* author computation

The findings showed cross-sectional dependence in the panel as the null hypothesis of no cross-sectional dependence was rejected in all the models run. Therefore, in addition to the first-generation IPS unit root test by and Im, Pesaran and Shin IPS (Im *et al.*, 2003), the Cross Sectionally Augmented (CIPS) test, a second-generation unit root test introduced by Pesaran (2007) was also applied in unit root testing.

4.4 Tests for stationarity

Table no. 4 – Unit Root Tests

	CIP				**CIPS**			
Variable	**C**	**C&T**	**C**	**C&T**	**C**	**C&T**	**C**	**C&T**
	Level		**Ist Difference**		**Level**		**Ist Difference**	
Active Accounts	5.60	0.08	-2.75***	-4.22***	7.80	2.78	-3.81***	-5.31***
Volume	9.04	3.46	-0.12	-2.58***	1.0E+01	6.1E+00	-2.54***	-5.82***
Bank Accounts	-1.21	-0.82	-6.84***	-5.74***	6.3E-01	-7.2E-01	-7.64***	-6.88***
Bank Branches	-1.25	-1.12	-6.01***	-5.12***	5.1E-01	-3.0E-01	-6.53***	-5.93***
ATMs	-1.25	7.0E-02	-6.48***	-5.93***	6.5E-01	1.5E+00	-7.14***	-7.06***
Private Sector Credit	1.44	1.7E+00	-5.73***	-4.81***	1.4E+00	2.2E+00	-6.16***	-5.64***
Total Assets	0.93	8.5E-01	-5.91***	-5.12***	1.4E+00	2.1E+00	-6.39***	-6.12***
Trade Openness	-0.92	5.9E-01	-5.66***	-5.12***	-3.2E-01	1.6E+00	-6.07***	-5.20***
Political Stability	-0.98	-9.9E-01	-5.64***	-4.66***	-1.6E-01	4.7E-01	-6.04***	-5.21***

Note: *** p<0.01, ** p<0.05, * p<0.1 stationarity tests with constant (C) and Constant and Trend C&T)
Source: author computation

The unit root tests were carried out with constant and constant and trend to confirm the order of integration of variables. The test results showed that all the variables were not stationary at level but stationary after first differencing for both the CIP and CIPS. In line with Pesaran *et al.* (1999), the ARDL model can be estimated irrespective of whether variables are I (1) or I(0)

but not with I(2) variables. Hausman (1978) tests confirmed the PMG estimator to be more efficient than the MG estimator. Therefore, with all the variables I(1), an ARDL model was estimated with automatic lag selection through the Akaike Information Criterion.

4.5 Findings on active mobile money accounts and banking development

The panel ARDL findings on the relationship between active mobile money accounts and the different measures of financial development applied are shown in Table no. 5. The estimations show that in the short run, when bank accounts are used as the proxy for banking development, there is no relationship between the number of active mobile money accounts and banking development. However, in the long run, a negative and significant coefficient (-0.37) shows that continued growth in active mobile money accounts contributes to a corresponding decrease in the number of bank accounts in Sub-Saharan Africa. The findings suggest that in the long run, active mobile money accounts reduce levels of banking development proxied by bank accounts, in line with Alleman and Rappoport (2010) and Maurer (2012).

Model 1 findings also showed that the control variables, Trade openness, and Political instability had no impact on the number of bank accounts in the short run. However, the two variables' long-run coefficients were significant in the long run. Trade openness had a positive impact (0.9391) on the number of bank accounts in the long run, suggesting an improvement in trade openness attracts capital flows which require new bank accounts to facilitate the movement of funds and settlement of transactions as observed by Elseoud and Alkawari (2020) and Mohamed (2023). On the other hand, the long-run coefficient of political instability (-5.66) was also negative and significant, indicating that political unrest in Sub-Saharan Africa may be detrimental to banking development, as observed by Roe and Siegel (2011). The negative and significant error correction term (-0.5153) on model 1 confirms the long-run relationship between active mobile money accounts, trade openness, political instability, and the number of bank accounts. The ECT shows that the speed of adjustment from short-run to long-run equilibrium occurs at a rate of 51.53% per annum. Therefore, the variables self-correct from deviations over time to jointly influence banking development proxied by bank accounts.

In model 2, banking development was measured through the number of bank branches across Sub-Saharan African countries. The Panel short-run coefficient for the first difference of active mobile money accounts was observed to be a significant determinant of bank branches. However, all the lags of the first difference were insignificant. Wald tests for restrictions showed that the combined effect of the active mobile money active accounts difference operators was zero in the short run. In concurrence with the findings of model 1, the long-run coefficient for active accounts in model 2 was significant and negative (-0.08), pointing to the effect that growth in mobile money active accounts has a negative impact on bank branch establishments in the long run. This finding concurs with observations by Rouse and Rouse and Verhoef (2017), who attributed the poor growth in banking infrastructure in Sub-Saharan Africa to the growth in mobile money. In Model 2, the short-run first difference and first lag of the first difference operators for Trade openness and political instability also had negative and significant coefficients. However, Wald tests for restrictions again confirmed that the combined effect of all the difference operators was zero. The long-run coefficient for Trade openness was negative (-0.056) and significant for model 2, implying that Trade openness negatively impacts bank branch establishment in the long run. The long-run coefficient for political instability was, however, insignificant. The error correction term for Model 2 was -0.2912, confirming that

active mobile money accounts, trade openness, political instability, and banking development as measured by the number of bank branches are cointegrated. Therefore, the speed of adjustments towards equilibrium for the variables was 29.12% per annum.

Table no. 5 – Panel ARDL Estimations for Active Mobile Money Accounts and Banking Development

	(1)	(2)	(3)	(4)	(5)
Long Run	**Bank Accounts**	**Branches**	**ATMs**	**Credit**	**Total Assets**
Active Accounts	-0.3713***	-0.08***	-0.02**	0.09**	0.19***
	(0.0019)	(0.01)	(0.04)	(0.4)	(0.03)
Trade Openness	0.9391**	-0.056***	-0.1267*	-04350	-1.3850**
	(0.3368)	(0.010)	(0.00011)	(0.0400)	(0.0072)
Political	-5.6638***	0.1995	-0.1092	-0.7812*	-0.5675*
	(0.8847)	(0.0283)	(0.1750)	(0.4217)	(0.3032)
Short Run					
ECT	-0.5153**	-0.2912**	-0.1022**	-0.0683**	-0.1372**
	(0.3622)	(0.2307)	(0.0758)	(0.0537)	(0.0820)
D.Bank Accounts(-1)	0.0131*				
	(0.2361)				
D.Bank Accounts(-2)	0.0720				
	(0.1993)				
D.Bank Accounts(-3)	-0.0230				
	(0.1654)				
D.ActiveAccounts	-0.247**	-0.01*	-0.08*	0.032	0.07
	(0.0623)	(0.0002)	(0.010)	(0.0031)	(0.056)
D.ActiveAccounts (-1)	-0.01610	0.00011			
	(0.01840)	(0.00006)			
D.ActiveAccounts (-2)	-0.01610	-0.00022			
	(0.00594)	(0.0026)			
D.ActiveAccounts (-3)	0.01320	-0.0017			
	(0.01070)	(0.00021)			
D.TradeOpenness	-0.0021**	-0.0004**	0.0001**	0.0093*	-0.0001*
	(0.0024)	(0.0007)	(0.009)	(0.0097)	(0.012)
D.TradeOpenness (-1)	0.000	-0.002650*			
	(0.004413)	(0.04960)			
D.TradeOpenness (-2)	0.00000	-0.000926			
	(0.004165)	(0.0004580)			
D.TradeOpenness (-3)	-0.005	0.0407			
	(0.0022)	(0.003430)			
D.Political	2.0521	-0.0395*	-0.0972**	-0.2597*	-0.1061*
	(3.4273)	(0.0380)	(0.0646)	(0.3170)	(0.1533)
D.Political (-1)	2.0010	-0.0138*			
	(2.4464)	(0.0236)			
D.Political (-2)	1.5699	0.0093			
	(1.9647)	(0.0163)			
D.Political (-3)	0.1552	-0.0067			
	(2.1063)	(0.0185)			
constant	162.6775**	-0.1966*	1.1146***	4.6665**	11.3563**
	(67.7996)	(0.2696)	(0.3077)	(3.8822)	(5.6618)
Observations	156	156	156	156	156

Note: Standard errors are in parentheses *** p<.01, ** p<.05, * p<0.1

Source: author computation

Model 3 replaced the number of bank branches accessible with the number of ATMS available in Sub-Saharan countries as the dependent variable for banking development. The findings in Model 3 closely resembled those for Model 2. The short-run coefficients for active mobile money accounts and political instability were negative and strongly significant, indicating a negative relationship with banking ATM infrastructure availability. As active mobile money accounts increase, they replace bank products as a medium of exchange and a store of value (Alleman & Rappoport, 2010). In addition, the less stringent requirements for opening mobile money accounts imply that they are becoming a preferred option relative to banks, leading to a decrease in bank infrastructure such as ATMs as the number of active mobile money accounts increases. The long-run coefficients for Model 3 were consistent with the short-run results. In the long run, the number of active mobile money accounts remained a negative and significant determinant of bank ATM availability. Similar findings were observed for trade openness and political instability, which also were observed to have a negative and significant relationship with ATM availability in the long run.

Thus, the findings from Model 3 also indicate that in the long run, active mobile money accounts, trade openness, and political instability all negatively impact banking development in Sub-Saharan Africa. The speed of adjustment for model 3 as measured by the error correction term, was -0.1022, indicating that convergence towards equilibrium is at a rate of 10.22% per annum. The findings support the view that political instability contributes to bank crises, especially where conflicts and fiscal crises converge (Ouedraogo *et al.*, 2022). Political instability also creates uncertainty, which may hamper investment and financial development, thus leading to fewer investments in banking infrastructure. Models 4 and 5 showed contrasting results to the previous three models on the impact of active mobile money accounts on banking development. While active mobile money accounts were shown to be insignificant determinants for banks' private sector credit and banks' total assets in the short run, the long run coefficients (0.09 and 0.19) showed active mobile money accounts positively and significantly related to the two measures of banking development. The increase in private sector credit and banks' total assets as active mobile money accounts increase may be attributed to the increased interoperability between banks and mobile money platforms. The increased integration between mobile money platforms and banks may increase the pool of savings available to banks. It may also encourage increased usage of banking platforms, increasing banks' total assets and private-sector credit. These findings align with the observations of Muir (2015) and de Mel *et al.* (2022). In models 4 and 5, the political instability coefficients maintained negative and significant coefficients in both the short and long run, further confirming that conflicts and political instability contribute to banking crises and negatively impact banking development. Trade openness was observed to have a significant negative relationship with total bank assets in both the short and long run.

In contrast, the relationship with private sector credit was insignificant for both periods. The negative impact of trade openness on bank assets may be due to the fact that Sub-Saharan African countries import more than they export, thus putting pressure on their countries' currencies, leading to weaker currencies, which reduces the values of assets held by the bank relative to foreign currencies thus negatively impacting total bank assets. The error correction terms for models 4 and 5 were also negative (-0.0683 and 0.1372), implying that the variables are cointegrated and speed of adjustment for the variables occurs at 6.83% and 13.72% per annum, respectively.

4.6 Findings on volume of mobile money and banking development

Table no. 6 shows panel estimations with mobile money volumes as the primary explanatory variable while maintaining the same measures of banking development. The findings are consistent with earlier findings with active mobile money accounts as the main explanatory variable. Estimations showed that the volume of mobile money transactions appears to have no relationship with bank accounts in the short run. However, the long-run coefficient shows a negative, significant relationship of -0.2464. The findings may indicate the slow process mobile money users go through as they shift from bank accounts to mobile money accounts such that the adverse effects are not immediate but will only be realised in the long run.

Table no. 6 – Panel ARDL Estimations for Mobile Money Volume and Banking Development

Long Run	**(6)** **Bank Accounts**	**(7)** **Branches**	**(8)** **ATMs**	**(9)** **Credit**	**(10)** **Total Assets**
Mobile Volumes	-0.2464***	-0.0014**	-0.0212***	0.0076*	0.0168*
	(0.0594)	(0.0007)	(0.0051)	(0.0048)	(0.0091)
Trade Openness	0.6746	0.2456**	-0.1098*	0.0169	-0.0960
	(0.6472)	(0.12141)	(0.0664)	(0.1896)	(0.2221)
Political	-2.3028*	0.1240	0.1556	-0.6527**	-0.9452**
	(1.4234)	(0.0878)	(0.1458)	(0.3094)	(0.3668)
Short Run					
ECT	-0.2025**	-0.0967**	-0.1020*	-0.1093***	-0.1358***
	(0.1492)	(0.0505)	(0.0804)	(0.0403)	(0.0182)
D.Bank Dvlpmnt (-1)	-0.1197				
	(0.1768)				
D.Bank Dvlpmnt (-2)	-0.1121				
	(0.1713)				
D.Bank Dvlpmnt (-3)	-0.1074				
	(0.1659)				
D.Mobile Volumes	-0.6983	-0.0047*	0.0108	0.1008	0.1772
	(0.6448)	(0.0025)	(0.0072	(0.1544)	(0.2358)
D.Trade Openness	-2.0848	-0.0623	-0.0109	0.8999	-0.1426***
	(2.7247)	(0.0560)	(0.0798)	(0.9737)	(0.0457)
D.Political	-0.9441	-0.0138	-0.1068*	-0.2561	-0.0387
	(3.1997)	(0.0476)	(0.0648)	(0.3253)	(0.1071)
Constant	55.2291***	-0.2634*	0.7416**	4.7778**	8.9100***
	(11.3622)	(0.2781)	(0.3220)	(2.3346)	(2.2306)
Observations	156	156	156	156	156

Note: Standard errors are in parentheses *** p<.01, ** p<.05, * p<0.1

Source: author computation

For model 6, the political instability coefficient remained negative, confirming the adverse impact political instability has on banking development. The error correction term was significant at 5%, indicating that in the long run, the volume of mobile money transactions, trade openness, and political instability have a relationship with banking development through changes in the number of bank accounts available. The same trend of results was generated in model 7. However, in model 7, the volume of mobile money transactions was seen to have a negative impact both in the short and long runs (-0.0047 and -0.0014), strengthening the

argument that the emergence of mobile money has slowed down growth in banking infrastructure and in turn banking development ((Rouse & Verhoef, 2017)). The coefficient for Trade openness was positive, reflecting the possible positive effect of growth in trade, bringing in more capital flows and necessitating the need for increased bank infrastructure. The error correction term for model 7 was again within the acceptable range and significant to confirm the long-term relationship between the variables in Sub-Saharan countries. In model 8, a unit increase in mobile money transaction volumes was associated with a 0.02 decrease in ATM availability. The possible explanation for this trend is that as the transition to mobile money occurs, the demand for banking infrastructure decreases, and banks respond to the decrease by reducing the bank infrastructure setup and maintenance. While mobile money transaction volumes were seen to have adverse effects on bank accounts, bank branches, and ATM infrastructure growth, the same could not be said for bank private sector credit and total bank assets as noted in models 9 and 10. In models 9 and 10, the long-run coefficients for mobile money transaction volumes were positively and significantly linked to bank private sector credit and total bank assets. The possible contrast in findings with the other three measures of banking development may be due to the fact that growth in mobile money impacts the many facets of banking development differently. While mobile money growth contributes to a decrease in bank accounts and bank infrastructure in the form of branches and ATMs, the interoperability between banking and mobile money platforms implies that mobile money growth will also contribute to a corresponding growth in liquid assets within banks such that the effect on banks total assets will be positive. In the same breadth, as the amount of liquid assets increases, there will also be a corresponding growth in funds available for lending businesses, leading to a growth in banks' private-sector credit. These findings support the views that the spillover effects of mobile money are greater when banks offer it (Pelletier *et al.*, 2020) and that the introduction of mobile money has positively impacted the retail banking side through an increase in their clientele base as interoperability of the mobile money and banking platforms enables banks to capture users who are on the mobile money platform (Munalye, 2015). The Trade Openness long-run coefficients were insignificant in models 9 and 10, while political instability was consistently negative in the long run, indicating that political disturbances adversely impact banking development. However, the short-run coefficients for both control variables were largely insignificant, pointing to the fact that the system response to changes in trade openness and instability shocks is long-term. This assertion is supported by the error correction terms (-0.1093 and -0.1358), which were within the acceptable negative range and significant, showing that the system adjusts towards long-run equilibrium in the long term at rates of 10.93% and 13.58%. Therefore, the cointegrated variables have convergence towards equilibrium in the long run. The study builds on the TAMs models identified in the theoretical framework and proposes that increased use of mobile money has substitution effects on traditional banking services. The long-run findings show a negative relationship between active mobile money accounts, mobile money volumes, and traditional banking services such as bank accounts, bank branches, and ATMs, supporting the substitution concept. This suggests that as mobile money grows, there is a gradual replacement of some traditional banking services. On the other hand, the study findings align and extend the TAMs theoretical framework by showing that increased use of mobile money technology also has complementary effects on banking development. Results show positive and significant long-run coefficients between active mobile money accounts and bank private sector credit and total assets, supporting the idea that mobile money interoperability with banking systems also complements banking development.

5. CONCLUSIONS AND RECOMMENDATIONS

The study examined the relationship between active mobile money accounts, mobile money volumes, and different measures of banking development in Sub-Saharan Africa. Panel ARDL estimations revealed a sophisticated interaction between mobile money growth and banking development indicators. In the long run, an increase in active mobile money accounts and volumes was associated with a decline in the number of bank accounts, bank branches, and ATMs, pointing to a shift in consumer preferences towards convenience and accessibility offered by mobile money platforms. However, this trend was offset by positive impacts on private sector credit and total bank assets again in the long run, possibly driven by increased interoperability between mobile money and banking systems. The findings align and extend the TAMs models and show that increased use of mobile money technology has substitution and complementary effects on banking development. The control variable trade openness showed varying long-run effects, positively impacting the number of bank accounts and negatively impacting bank branches, ATMS, and total bank assets. This contrast emphasises the need for striking a delicate balance between trade-driven capital flows and potential currency vulnerabilities in the region. Political instability consistently displayed adverse long-run implications for banking development across the different measures of banking development, clearly showing political disruptions adversely impact investments and financial development. The study has several practical and policy implications. Financial institutions in Sub-Saharan Africa, such as banks, may have to reassess the viability of the traditional banking model and reassess their bank branch and ATM availability strategies taking into account the growth of mobile money. Such banks may need to consider investment in technology and digital banking. In the same breadth, banks are encouraged to develop adaptable business models to keep abreast of mobile money innovations and possible regulatory changes. In the same context, policymakers and regulators should maintain a balance between innovation and necessary banking infrastructure. For instance, there is a need to ensure that innovations do not bring further marginalisation through closure of bank branches in remote or rural areas where access to financial services is already compromised. As such, regulations should be dynamic and respond to changes brought by innovation to ensure consumer protection and maintain financial stability. The findings also show that there is an opportunity for banks to leverage the interoperability of mobile platforms to reach the unbanked populations and enhance financial inclusion.

Further, policymakers in Sub-Saharan African countries should establish innovation-friendly policies that encourage research collaboration between fintech startups, established institutions such as banks, and research institutions to share research information and develop new financial products and services that cater to consumers' needs. Research collaboration also ensures all parties comprehensively understand market dynamics and keep abreast of new developments. Lastly, regional policymakers and financial institutions should carefully consider the potential trade-offs and synergies between mobile money adoption and traditional banking services, leveraging the positives while addressing challenges arising from the disruptive forces of technological innovation and external shocks. This study contributes to the growing literature on mobile money's impact on banking development, specifically tailored to the unique context of Sub-Saharan Africa. Further research should focus on the mechanisms underlying the observed relationships and explore potential policy interventions that exploit the benefits of mobile money while mitigating its potential drawbacks.

ORCID

Jonathan Tembo http://orcid.org/ 0000-0003-4652-1840.

References

Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. *The American Economic Review*, *91*(5), 1369-1401. http://dx.doi.org/10.1257/aer.91.5.1369

Adaba, G. B., Ayoung, D. A., & Abbott, P. (2019). Exploring the contribution of mobile money to well-being from a capability perspective. *The Electronic Journal on Information Systems in Developing Countries*, *85*(4), e12079. http://dx.doi.org/10.1002/isd2.12079

Ahmad, A. H., Green, C., & Jiang, F. (2020). Mobile Money, Financial Inclusion and Development: A Review With Reference to African Experience. *Journal of Economic Surveys*, *34*(4), 753-792. http://dx.doi.org/10.1111/joes.12372

Akinlo, O. O., & Olayiwola, J. A. (2021). Dividend policy-performance nexus: PMG-ARDL approach. *Future Business Journal 7*(1), 1-9. http://dx.doi.org/10.1186/s43093-021-00066-9

Alhassan, T. F., & Koaudio, A. J. (2019). Mobile money development in sub-Saharan Africa: Its macroeconomic effects and role in financing development. *Advances in Economics, Business and Management Research*, *105*, 314-318. http://dx.doi.org/10.2991/iscde-19.2019.60

Alleman, J., & Rappoport, P. (2010). Mobile Money: Implications for Emerging Markets. *Communications and Strategies*(79), 15-28.

Aluko, O. A., & Ajayi, M. A. (2018). Determinants of banking sector development: Evidence from Sub-Saharan African countries. *Borsa Istanbul Review*, *18*(2), 122-139. http://dx.doi.org/10.1016/j.bir.2017.11.002

Asongu, S. A., & Odhiambo, N. M. (2019). Governance, capital flight and industrialisation in Africa. *Journal of Economic Structures*, *8*(36), 1-22. http://dx.doi.org/10.1186/s40008-019-0170-2

Beck, T., Pamuk, H., Ramrattan, R., & Uras, B. (2015). Mobile Money, Trade Credit and Economic Development: Theory and Evidence. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.2588392

Benmelech, E., Yang, J., & Zator, M. (2023). Bank Branch Density and Bank Runs. *Nber Working Paper Series*. http://dx.doi.org/10.3386/w31462

Bist, J. P., & Bista, N. B. (2018). Finance–Growth Nexus in Nepal: An Application of the ARDL Approach in the Presence of Structural Breaks. *Vikalpa*, *43*(4), 236-249. http://dx.doi.org/10.1177/0256090918813211

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange Multiplier Test and its Applications to Model Specification in Econometrics. *The Review of Economic Studies*, *47*(1), 239-253. http://dx.doi.org/10.2307/2297111

Campos, N. F., Karanasosa, M., & Koutroumpis, P. (2019). The growth-finance nexus in Brazil: Evidence from a new dataset. *School of Economics and Finance 885*.

Chow, W. W., & Fung, M. K. (2013). Financial development and growth: A clustering and causality analysis. *The Journal of International Trade & Economic Development*, *22*(3), 430-453. http://dx.doi.org/10.1080/09638199.2011.570364

Chukwumah, S., & Islam, N. (2017). Adoption of mobile banking service in rural Nigeria. *Turku School of Economics*.

Čihák, M., Demirgüč-Kunt, A., Feyen, E., & Levine, R. (2013). Financial Development in 205 Economies, 1960 to 2010. *Journal of Financial Perspectives*, *1*(2), 17-36. http://dx.doi.org/10.3386/w18946

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Management Information Systems Quarterly*, *13*(3), 319-339. http://dx.doi.org/10.2307/249008

de Mel, S., McIntosh, C., Sheth, K., & Woodruff, C. (2022). Can Mobile-Linked Bank Accounts Bolster Savings? Evidence from a Randomized Controlled Trial in Sri Lanka. *The Review of Economics and Statistics, 104*(2), 306-320. http://dx.doi.org/10.1162/rest_a_00956

Della Peruta, M. (2018). Adoption of mobile money and financial inclusion: a macroeconomic approach through cluster analysis. *Economics of Innovation and New Technology, 27*(2), 154-173. http://dx.doi.org/10.1080/10438599.2017.1322234

Donovan, K. (2012). *Mobile Money for Financial Inclusion*. http://dx.doi.org/10.1596/9780821389911_ch04

El Ouakdi, J., Ftiti, Z., Guermazi, D., Alimi, K., & Louhichi, W. (2022). Banking development and corporate innovation. *Bankers, Markets Investors, 170*(3), 2-13. http://dx.doi.org/10.54695/bmi.170.4793

Elseoud, M. S. A., & Alkawari, A. R. (2020). *The Impact of Trade and Financial Openness on Banks Financial Development in GCC Countries.* Paper presented at the 2020 International Conference on Decision Aid Sciences and Application, DASA 2020.

Eryigit, S. B., & Dulgeroglu, E. (2015). *How to Measure the Level of Financial Development*.

Fanta, A. B., Mutsonziwa, K., Goosen, R., Emanuel, M., & Kettles, N. (2016). The role of mobile money in financial inclusion in the SADC region Evidence using FinScope Surveys. (3).

Gasperin, D., C., R., V., & Stanca, L. (2019). Mobile Money and the Labor Market: Evidence from Developing Countries. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.3360234

Gehrung, M. (2020). The ATM Around the Corner - How Financial Development, Access, and Integration Influence Economic Growth and Inequality. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.3595265

GSMA. (2020). *State of the Mobile Money Industry in Africa*. Retrieved from https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/10/State-of-the-mobile-money-industry-in-Africa-SOTIR19-cut.pdf

GSMA. (2023). *State of the Industry Report on Mobile Money 2023*. Retrieved from

Hausman, J. (1978). Specification Tests in Econometrics. *Econometrica, 6*(46), 1251-1271.

IFC. (2022). African Fintech Rises to The Challenge.

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics, 115*(1), 53-74. http://dx.doi.org/10.1016/S0304-4076(03)00092-7

Jong-Moon, J., & Hyunju, P. (2016). Mobile Money in Sub-Saharan Africa and Its Implications. *World Economy, 6*(3).

Kendall, J., Mylenko, N., & Ponce, A. (2010). Measuring Financial Access around the World. *The World Bank*. http://dx.doi.org/10.1596/1813-9450-5253

Kodila-Tedika, O., & Asongu, S. A. (2015). The effect of intelligence on financial development: A cross-country comparison. *Intelligence, 51*, 1-9. http://dx.doi.org/10.1016/j.intell.2015.04.010

Kodila-Tedika, O., Asongu, S. A., & Cinyabuguma, M. M. (2017). Financial Development and Geographic Isolation: Global Evidence. *SSRN Electronic Journal*. http://dx.doi.org/10419/173647

La Porta, R. (1999). The quality of government. *Journal of Law Economics and Organization, 15*(1), 222-279. http://dx.doi.org/10.1093/jleo/15.1.222

La Porta, R., Lopez-De-Silanes, F., Shleifer, A., & Vishny, R. W. (1997). Legal Determinants of External Finance. *The Journal of Finance, 52*(3), 1131-1150. http://dx.doi.org/10.1111/j.1540-6261.1997.tb02727.x

Lashitew, A. A., van Tulder, R., & Liasse, Y. (2019). Mobile phones for financial inclusion: What explains the diffusion of mobile money innovations? *Research Policy, 48*(5), 1201-1215. http://dx.doi.org/10.1016/j.respol.2018.12.010

Lehmann-Uschner, K., & Menkhoff, L. (2020). Mobile Money is Driving Financial Development in Africa. *DIW Weekly Report, 10*(21/22), 253-259.

Mago, S., & Chitokwindo, S. (2014). The impact of mobile banking on financial inclusion in Zimbabwe: A case for Masvingo province. *Mediterranean Journal of Social Sciences, 5*(9), 221-230. http://dx.doi.org/10.5901/mjss.2014.v5n9p221

Maity, S., & Sahu, T. N. (2022). Bank branch outreach and access to banking services toward financial inclusion: An experimental evidence. *Rajagiri Management Journal*, *17*(2), 170-182. http://dx.doi.org/10.1108/RAMJ-01-2022-0004

Mas, I., & Morawczynski, O. (2009). Designing Mobile Money Services: Lessons from M-PESA. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/SSRN.1552753

Maurer, B. (2012). Mobile Money: Communication, Consumption and Change in the Payments Space. *Journal of Development Studies*, *48*(5), 589–604. http://dx.doi.org/10.1080/00220388.2011.621944

Mhadhbi, K., Terzi, C., & Bouchrika, A. (2017). Banking sector development and economic growth developing countries: A bootstrap panel Granger causality analysis. *Empirical Economics*.

Mohamed, S. I. (2023). Trade openness, financial development and economic growth in North African countries. *International Journal of Finance & Economics*, *28*(2), 1729-1740. http://dx.doi.org/10.1002/IJFE.2503

Mothobi, O., & Grzybowski, L. (2017). Infrastructure Deficiencies and Adoption of Mobile Money in Sub-Saharan Africa.

MTN. (2018). Orange and MTN launch pan-African mobile money interoperability - MTN Group.

Muir, I. (2015). *The Mobile Alternative to Banking: Patterns of Financial Transactions in Emerging Countries.* (Senior Thesis in Economics), Haverford College. Retrieved from https://scholarship.tricolib.brynmawr.edu/server/api/core/bitstreams/3820d4c4-2ea1-4041-a428-9b5b330f9b8d/content

Munalye, C. (2015). The effects of mobile money transfer services on traditional banking services offered by banks: Case Study of BancABC.

Mutsonziwa, K., & Maposa, O. K. (2016). Mobile Money - A Catalyst for Financial Inclusion in Developing Economies: A Case Study of Zimbabwe using FinScope Survey Data. *International Journal of Financial Management 6*(3), 45-56. http://dx.doi.org/10.26643/GIS.V12I1.3378

Naghavi, N. (2019). Sub-Saharan Africa Mobile Money: Diverse Use Cases, Enabling Environment Boost Adoption. *Center for Financial Inclusion*.

Naghshpour, S., & Davis, H. L. (2018). The impact of commercial banking development on economic growth: A principal component analysis of association between banking industry and economic growth in Eastern Europe. *International Journal of Monetary Economics and Finance*, *11*(6), 525-542. http://dx.doi.org/10.1504/IJMEF.2018.097204

Nantege, H. B. (2015). The threat of mobile money services to the financial performance of commercial banks in Uganda: A case of Stanbic Bank.

Ndung'u, N., & Signe, L. (2020). The Fourth Industrial Revolution and digitization will transform Africa into a global powerhouse. *Foresight Africa Report*.

Nyakwana, M. (2016). *Is mobile money competing with banks?* . Retrieved from https://www.thestandard.co.zw/2016/01/24/is-mobile-money-competing-with-banks/

Nyasha, S., Gwenhure, Y., & Odhiambo, N. (2017). The dynamic causal linkage between financial development and economic growth: empirical evidence from Ethiopia. *International Economics*, *70*(1), 73-102.

Olayungbo, D. O. (2021). Global oil price and food prices in food importing and oil exporting developing countries: A panel ARDL analysis. *Heliyon*(7), 1-10. http://dx.doi.org/10.1016/j.heliyon.2021.e06357

Ouedraogo, R., Mlachila, M., Sourouema, W. S., & Compaoré, A. (2022). The impact of conflict and political instability on banking crises in developing countries. *World Economy*, *45*(6), 1937-1977. http://dx.doi.org/10.1111/TWEC.13218

Ozkok, Z. (2015). Financial openness and financial development: An analysis using indices. *International Review of Applied Economics*, *29*(5), 620-649. http://dx.doi.org/10.1080/02692171.2015.1054366

Pelletier, A., Khavul, S., & Estrin, S. (2020). Innovations in emerging markets: The case of mobile money. *Industrial and Corporate Change*, *29*(2), 395-421. http://dx.doi.org/10.1093/ICC/DTZ049

Pesaran, M. H. (2004). General Diagnostic Tests for Cross Section Dependence in Panels. *IZA Discussion Paper*(1240). http://dx.doi.org/10.2139/ssrn.572504

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, *22*(2), 265-312. http://dx.doi.org/10.1002/JAE.951

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association*, *94*(446), 621-634. http://dx.doi.org/10.1080/01621459.1999.10474156

Roe, M. J., & Siegel, J. I. (2011). Political instability: Effects on financial development, roots in the severity of economic inequality. *Journal of Comparative Economics*, *39*(3), 279-309. http://dx.doi.org/10.1016/j.jce.2011.02.001

Rouse, M., & Verhoef, y. G. (2017). Mobile banking in Sub-Saharan Africa: setting the way towards financial development. *MPRA Paper*(78006).

Schwab, K. (2016). The Fourth Industrial Revolution: what it means and how to respond. *World Economic Forum*.

Sekantsi, L., & Motelle, S. (2018). The Role of Mobile Money In Financial Inclusion in Lesotho. *MEFMI Research and Policy Journal*.

Severino, M., & Tonderai, N. (2015). Impact of mobile banking on traditional banking practices in Zimbabwe. *International Journal of Economics, Commerce and Management*, *III*(1).

Shahid, R., Shijie, L., Yifan, N., & Jian, G. (2022). Pathway to green growth: A panel-ARDL model of environmental upgrading, environmental regulations, and GVC participation for the Chinese manufacturing industry. *Frontiers in Environmental Science*, *10*, 972412. http://dx.doi.org/10.3389/fenvs.2022.972412

Siano, A., Raimi, L., Palazzo, M., & Panait, M. C. (2020). Mobile Banking: An Innovative Solution for Increasing Financial Inclusion in Sub-Saharan African Countries: Evidence from Nigeria. *Sustainability (Basel)*, *12*(23), 10130. http://dx.doi.org/10.3390/su122310130

Sibindi, B. A., & Bimha, A. (2014). Banking sector development and economic growth: evidence from Zimbabwe. *Banks & bank systems*.

Son, T. H., Liem, N. T., & Khuong, N. V. (2020). Mobile Money, Financial Inclusion and Digital Payment: The Case of Vietnam. *International Journal of Financial Research*, *11*(1), 417-424. http://dx.doi.org/10.5430/IJFR.V11N1P417

Sosu, B. (2019). Mobile money in ghana: a financial inclusion enabler.

Tembo, J., & Makina, D. (2020). Regional financial integration and its impact on banking development: Evidence from Southern African Development Community countries. *Business Strategy & Development*, *3*(3), 356-368. http://dx.doi.org/10.1002/BSD2.101

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *Management Information Systems Quarterly*, *27*(3), 425-478. http://dx.doi.org/10.2307/30036540

Vong, J., Fang, J., & Insu, S. (2012). Delivering financial services through mobile phone technology: A pilot study on impact of mobile money service on micro-entrepreneurs in rural Cambodia. *International Journal of Information Systems and Change Management*, *6*(2), 177-186. http://dx.doi.org/10.1504/IJISCM.2012.051152

World Bank. (2023). Account ownership at a financial institution or with a mobile-money-service provider (% of population ages 15+). Data.

Yenkey, C. B., Doering, L., & Aceves, P. (2015). The Financialization of Everyday Life: Mobile Money and (In)Formal Activity in a Developing Context. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/SSRN.2562518