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Dynamics of Digital Finance and Financial Inclusion Nexus in Sub-Saharan Africa

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Abstract

With the revolution in the financial technology space occasioned by competition among financial market intermediaries, there is no doubt that more unbanked and under-banked citizens will be captured into the financial net of the economy. This study examined the dynamic relationship between digital finance and financial inclusion in 27 sub-Saharan African countries. Granger Error Correction Method (ECM) with General Methods of Moments (GMM) of Arellanon and Bond (1991) were used to analyze the short panel data. The study found that a positive long-run relationship exists between digital finance and financial inclusion. It therefore recommends amongst others that monetary authorities of emerging and developing economies in sub-Sahara African countries should embrace digital financial technologies by encouraging commercial banks to install more ATMs and discourage acceptance of cash payment and withdrawals within established thresholds across bank counters in their respective countries.

Keywords: Financial inclusion, Digital Financial Technology, financial intermediation, ATMs.

JEL Code: G21, G23, 017, 055

Introduction

Overtime the financial sector in most African economies have transformed from just providing access to credit for the poor, to rural banking, community banking and more recently to micro financing, financial inclusion and wellness. All these strategies were geared towards ensuring that the active poor in rural communities have access to the needed finance for productive ventures. Investment in financial or real asset by these segment of the society will help them to engage in sustainable economic activities that will engender food and financial security. When indigent citizens are financially empowered, they can provide for themselves and families, pay for their children education and hospital expenses, save for retirement and social security, as well as weather economic shocks as they arise.

According to Honohan and Beck, 2007 as cited by (Beck and Call, 2013), there are four major challenges constraining the provision of affordable and sustainable financial services to the poor in rural communites in sub-

Saharan African economies, not withstanding technological, political, structural and socio-cultural differences in these countries. These challenges stem from the small size of some African economies which does not allow financial servce providers to obtain the full benefits associated with economies of large scale production. The paucity of demand for financial products like pension, insurance, savings/deposit account and payment instrments make financial service providers not to realise their full potentials and maximize profit. Second on the list is the geographical distribution of the population which makes the rural dwellers who are larger in number to embrace more of the informal financial products or shadow banking services than the formal financial service delivery. The pattern of the population distribution and the requirements for formal financial transactions makes it cumbersume and uneconomical for both the supply and demand side of the financial system to intermediate. The distribution also makes it difficult for those in rural communities to be captured in the formal financial net as a result of distance to the service point. Another major reason, is the perception of the active rural poor as high risk customers by the formal financial service providers. Due to the fluctuations and volatility in the income streams of microenterprises and individuals in rural communities, financial service providers become apprehensive in rendering any form of financial assistance to them which will expose them to high risk. Therefore, to mitigate the risk and contend with expected high non performing loans they demand a cut throat interest rate as a premium for assuming such risk. This high interest charges and other service fees constrain the poor from accessing bank facilities and other financial services from the formal sector, hence, they patronize more of the informal financial services. Finally, another major problem constraining the expected financial inclusive growth is governance and regulatory issues which does not allow full scale competition between the traditional banking institutions and non-bank financial institutions in the intermediation process.

Studies have shown than more than half of the poorest forty percent of citizens in developing economies are without formal account whereas thirty five percent of start-up companies have troubles accessing credit from the formal financial institutions. Also large gaps in access to formal financial products exists between the rich and poor in the rural and urban communities as well as between women and men (Ratna, Martin, Diaye, Barajas, Mitra, Kyobe, Mooi,, 2015). A survey conducted by the Consultative Group to Assist the Poor (CGAP/World Bank Group) in 2010 shows that the statistics of unbanked poor in almost all economies in sub-Saharan Africa rank below the world benchmark , while high-income countries were above it. Sub-Saharan Africa and South Asia are the regions with the lowest share of banked households. With an increasing demand for an all-inclusive growth by almost all sovereign nations by 2030 there is an urgent need to eliminate the widening gap between the rich elites that are financially included and the poor that lack financial services especially in rural communities. According to (Agarwal, 2010), the active poor and down trodden in rural communities who are the growth engine of every economy should benefit more from using formal financial product than anyone else. Despite the visible progress achieved by financial institutions, in some sub-Saharan African countries (like Kenya, Mauritius, South-Africa, Tanzania, Ghana, Nigeria etc) it is still worrisome that majority of the world's poor who remain unserved by formal financial intermediaries come from this region.

With the changing business environment occasioned by the revolution in financial or digital technology those who do not have access to formal financial products and services may suffer severe consequences now and in the future. Examples includes the cashless policy which requires a minimal use of cash for economic and financial activities, possession of financial identity through bank verification number for all individuals without which the person will be shut out of banking transactions, the e-dividend policy which stipulates a direct credit or payment of dividends into current account of shareholders as against cash payment of dividend, pension policy that requires collection of pension proceeds through a designated current account with a bank (micro-pension), insurance policy which requires that insurance claims are received through designated account (micro-insurance), the list is unending. For this and more reasons, there is an urgent need to bring the unbanked or underserved into the financial service playground using digital technology that will reduce cost of service delivery, reach the unbanked in most remote areas, provide convenience with less documentations as opposed to what obtains with account opening in traditional banks, offer small loans needed by the rural poor in the society at little or no cost, provide security for their investment as well as provide financial advisory services that will enable customers manage their funds prudently.

Statement of Research Problem

Studies as well as financial literature have shown that when financial inclusion is driven on digital technological platforms, it has the potential to break all necessary barriers including physical, social, language and financials. A digital disruption is taking place almost in all sectors of the economy, for instance, there is disruption in the traditional transportation systems to the use of Uber, Taxify and Go-Kada as well as under-ground railway systems.

In the agricultural sector, robotics and other state of the act equipment are now deployed to cultivate crops and manage farm products on-behalf of farmers. In the automobile industry, driverless vehicles and biometric configured vehicles are presently manufactured to disrupt the traditional automobile systems, also electronic vehicles are currently produced to take over from vehicles using fossil fuel. Drones are now being deployed to record, video and take cameras of events where human photographers could not reach. In the hospitality and health sectors, there are robotic waiters at hotels and big restaurants that offer customer services in some developed countries. Furthermore, modern hospitals and health centres are now employing robots to take over the jobs of nurses and other ancillary health workers. The financial service sector is not left out, with a host of non-bank innovators offering both customer facing and back office financial technology products and services.

This transformation includes emerging market economies which offer an array of viable digital alternatives to traditional bank services which could not capture a significant population of the underbanked (International Financial Corporation, 2017). One main benefit in the digital technological revolution currently pervading all aspects of the financial systems all over the world is its ability to reduce transaction cost by leveraging on the already established platforms of telecommunication companies and mobile money operators to provide quality financial products that meets the needs of the active poor in rural communities.

For instance countries like Kenya, Tanzania, South Africa, Mauritius, Ghana have attained a high level of digital financial inclusiveness. While Kenya has become a model for all African countries for adopting the telecom model with the use of M-Pesa, a mobile telephone network, Ghana has made significant progress towards digital financial inclusion by creating a telecom subsidiary to drive inclusive growth in Ghana. Research shows that more than half of Kenyans GDP are achieved from the activities of those who engage M-Pesa as channels for financial transactions. However the case is different for Nigeria because of its adoption of the bank-led model to drive financial inclusion despite its attainment of a high tele density and mobi density of 108 percent and the presence of 21 licensed mobile money operators which are expected to provide the needed platform to capture unbanked and underbanked in rural communities.

Despite these significant progress recorded by some sub-Saharan African countries in digital financial inclusion, the International Telecommunication Union (ITU, 2016) as cited by (Odili, 2018) shows that most developing countries still face considerable challenges in digital technology in business transactions. The report reveals that small businesses in most rural and urban communities are still apprehensive in accepting digital payment as a means of bill settlement because of the high bank fees and high cost of setting up digital payment platform. By so doing, the active poor who possess digital financial credentials are excluded from using such products. Other factors that prevent digital financial inclusiveness may be attributed to lack of trust in the financial technology landscape as a result of increase in cybercrimes and cyber theft in most developing countries. This problem has become more formidable in countries with weak consumer protection institutions and frameworks. According to an African Development Bank (ADB, 2016) report, another major limitation for digital financial inclusion is the low level of financial literacy and awareness. The active poor in rural communities with low income do not have the needed information that can motivate them to use digital financial platforms for their payment needs. Rather they resort to informal financial channels which most at times are even more expensive to use than the digital financial platforms.

In view of the above identified challenges, this study examined the nexus between digital financial technology and financial inclusion in sub Saharan African counties. The question posed by this research is whether any causality exist between financial inclusion and digital finance? The hypothesis stated in its null form argues that no relationship exists between financial inclusion and digital finance.

The study is divided into five sections. Section one already discussed above focused on setting the foundation and motivation for the study. Section two will review some concepts as well as theoretical and empirical literature. Section three will foray into the methodology for this study and its justification. Section four will analyse the statistical and inferential data obtained from the World Bank data base as well as discuss the findings whereas the final section will summarize the report, conclude and make policy recommendations for implementation by regulatory bodies.

Literature Review

Conceptual framework

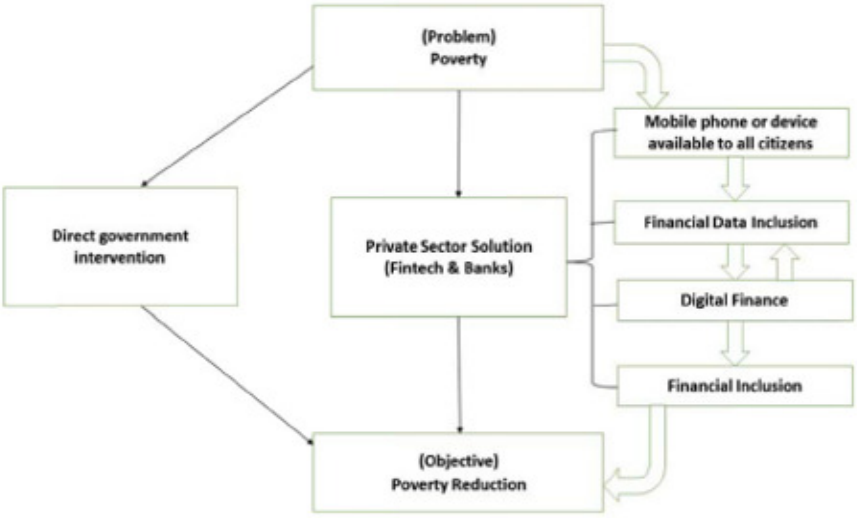


Figure 1: Framework to illustrate role of government, fintech and banks in digital finance and financial inclusion

Source: (Odili, 2018)

The diagram above shows how through direct government intervention and regulation of the partnership between financial technology companies or mobile money operators with traditional banking institutions can help spur the inclusion of the active poor into the mean stream of formal financial activities. When the poor are well engaged and empowered they will be able to cater for their financial needs and that of their families' thereby reducing poverty rate and improving their welfare and wealth.

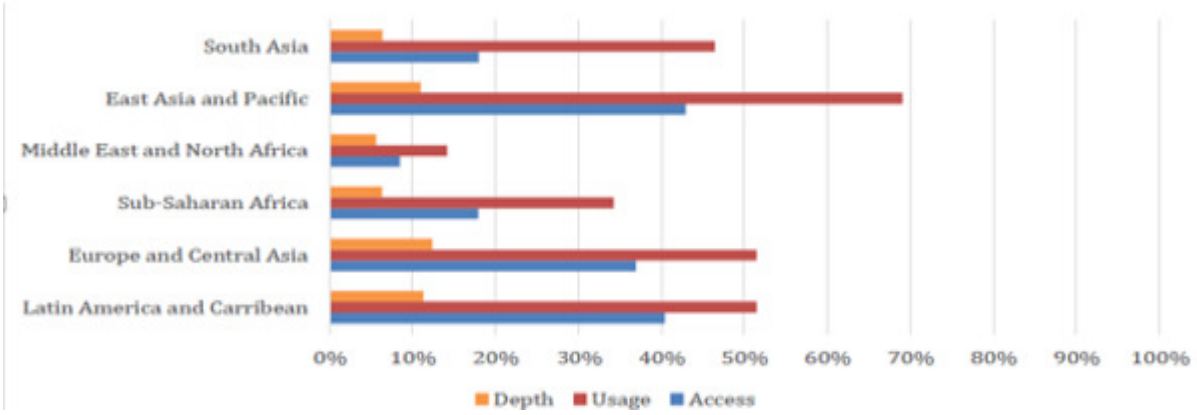


Figure 2: Financial Inclusion Data, 2014

Source: Elaborated data from World Bank little data book, 2015

The diagram above used three key strands of access, usage and depth to measure financial inclusion in sub-Saharan Africa (SSA) countries. The figure shows that SSA countries fall below global benchmark in financial inclusive growth. Apart from Middle East and North Africa, Sub-Saharan Africa is the lowest using criteria such as access, usage and depth. This shows that the Sub-Saharan African countries are below world average in terms of financial development. With increased competition in the financial intermediation market between the traditional financial institutions and mobile money network operators who are the drivers of financial technology there is no doubt that

this widening gap in financial inclusive growth and development between Africa and the rest of the world will be closed. This however, will be made possible if government and relevant regulatory authorities provide the necessary enabling environment for a complete implementation of legal and operational framework that will drive the telecommunication led model of financial inclusion.

Theoretical Literature

Several theories in financial literature have made attempt to justify the reason individuals and firms adopt new technology in their work process. The Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975) and Technology Acceptance Model as propounded by Davis (1986) as cited by (Okoye, Omankhenlen, Okoh, Ezeji and Achugamonu, 2019) argue that the main reason firms and individuals accept new technology is because of its apparent usefulness and user friendly. Davis (1986) propound that a technology is useful if as a result of engaging the equipment performance is improved. Also a piece of equipment is user friendly when with little or no effort the equipment is seamlessly applied to work and deliver results. When such innovation is used continuously, value is created and as a consequence the user becomes satisfied and contended using the item going forward. Another theory reviewed by this study is the Innovation Diffusion Theory propounded by Roger (1983) as cited by (Isibor, Omankhanlen, Okoye, Achugamonu, Adebayo, Afolabi and Ayodeji, 2018). The theory explains what drives an individual in accepting an innovation as alternative channel for the traditional techniques is based on some critical factors. Such factors generally includes: relative advantage, compactibility, complexity, and observability. It argues that the knowledge about the use of the technology is transmitted among the people belonging to a professional or social group. The process of the transmission begins with the knowledge of its existence and understanding its roles; persuasion through showing favourable attitude to the technology; decision through accepting the technology, implementation by actively using it and confirmation through value addition.

From the foregoing, this study will zero in on the Theory of Reasoned Action (Fisher and Ajzen, 1975 and Technology Acceptance Model (1983) as cited by (Okoye, Omankhenlen, Okoh, Ezeji and Achugamonu, 2019). The justification for its adoption stem from the fact that when financial inclusion is driven on digital technology platform (mobile/telecommunication networks) it has the potential to capture the unbanked or underbanked poor in rural communities into the formal financial net. When the products or services offered by financial and non financial digital institutions become acceptable to them due to its cost effectiveness, compactibility with existing strucures, usability as well as convinient, they will use more of such services thereby reposing trust and confidence in the financial system. This will enable all economic agents to participate fully to create wealth and improve their standard of living. High level of activities in the real sector will enable individuals and firms to mobilize funds which will be reinvested inform of deposits (savings, TB, fixed deposit, micro pension. micro insurance, equity holding and debenture holding) to deepen the financial sector. In like manner, the financial expansion will further accelerate economic growth through efficient allocation of resources and low risk investible fund to the investment unit. All things being equal and barring unexpected economic shocks, the cycle continues for a reasonably foreseeable period.

Empirical Framework

In a study conducted by Jack and Suri (2014) where they examined the effect reduced transaction cost enabled by the use of mobile money has on risk sharing in Kenya. Result from the findings shows that those that used M-PESA platforms were able to tolerate large economic and financial shocks (such as severe illness, job loss, livestock death, and harvest or business failure) without necessarily plummeting domestic consumption. Those households not included on the M-PESA platform had their household consumptions reduced by 7 percent in response to a major shock.

In another study conducted by Honohan and King (2012) in which the causes and effect of financial access were examined using financial-scope survey dataset, it found that income and education are major contributing factors to access to formal financial products. The study confirmed that highly educated and financial literate persons are more dispose to embracing formal financial services than the uneducated and financial illiterate citizens. This is because the financial technology savvy individuals understand the rudiments and processes of digital financial services and therefore repose higher trust in them more than the uneducated rural dwellers

From the survey data gathered in 2010, Demombynes and Thegeya (2012) studied mobile savings phenomenon in Kenya. The study confirmed that the wealthy groups in Kenya were more disposed to using integrated mobile

savings products than the rural poor. The same study also found that married men are more likely to save than women and that a bulk of the population make use of mobile phones for financial transaction especially amongst those who are unlikely to save using formal channels. They also found that those who registered with M-PESA accounts were 32% more likely to have some savings than those who did not register. This evidence shows that with M-PESA, savings will more likely increase due to the convenience and safety the product offers which far outweighs the benefits expected to be derived from the marginal interest payment.

According the Oumaa, Odongob and Were (2017) delivering financial services on digital platform in Africa has become helpful in incorporating the hitherto unbanked segments of the population to the mainstream financial systems in Africa. The study founded this connection by investigating whether the universal use of mobile telephony to deliver commercial services is a benefit for savings deployment in designated nations in sub Saharan Africa. The study confirmed that households who used mobile phones to deliver financial services are more likely to save than those who used manual means of delivering financial services. Not only does contact to mobile financial services increase the probability to save, but also has a momentous influence on the sums saved, possibly owing to the regularity and expediency with which such dealings can be embark on using a mobile phone. Both methods of savings, that is, basic mobile phone savings deposited in the phone and bank integrated mobile savings are likely to be promoted by use of mobile phones. This implies that intense use of mobile financial services is an opportunity for encouraging savings mobilization, especially among the poor and low income groups with constrained access to formal financial services. (Oumaa, Odongob and Were, 2017)

(Koppensteiner and Olukorede, 2016) investigated the effect of mobile money adoption by households in Tanzania on consumption smoothing, poverty and human capital investments. The results shows that while per-capita total expenditure is not smoothed within recommended specifications, per-capita expenditure pattern for the extremely poor households is significantly smoothed in periods of negative idiosyncratic shocks for mobile money adopter households. The study indicate that mobile money adopter households conveniently shield against sliding into transient extreme poverty while there is an increase in head count living below US$1.25 per day for non-adopter households. At the individual level, the effect on children's absenteeism from school as a result of the rainfall-driven income shock is cushioned for mobile money adopter households. This is complemented by more time for school homework and children spending less time engaging in household chores.

Another study on the impact of e-banking on banks' performance, customers' satisfaction and economic growth using a Pair Sample t-test found that e-banking has improved both customers' satisfaction and economic growth in Nigeria. The study recommends adequate legislation on all aspects of e-banking so that both the operators of the system and the public can be adequately protected. Also, banks should charge low or no fees for e-banking services in order to motivate their customers to take advantage of e-banking services. (Isibor, Omankhanlen, Okoye, Achugamonu, Adebayo, Afolabi and Ayodeji, 2018) (Forgelli and Rubino, 2016) investigated how mobile banking can increase finncial inclusion as well as improve the welfare and wealth of indivuduals in developing countries. The study employed content analysis of data from world bank database to access how much new technologies affect financial inclusion. The found a slighly positive relatonship between mobile banking and financial inclusions. It therefore recommends a further empirical analysisi using data from other sources to susbtantiate or repudiate the result from this research. As posited by (Achugamonu, Taiwo, Ikpefan, Olurinola and Okorie, 2016) to be able to break geographical boudaries limiting financial inclusion, reduce cost of service or product delivery as well as empower all economic agents, there is an urgent need to leverarge on the opportunities offered by mobile money and telecommunication operators.

Methodology

Study Population and Sample Size

The study population comprises of the fifty (50) countries located within the sub-Saharan African region. However using a purposeful sampling technique, only twenty seven (27) countries were selected for the period of 2007 to 2017 from the data sourced from the World Bank database (see diagram below for the list of selected countries). The sample size therefore accounts for fifty four (54) percent of the total population. This study adopted a Granger Error Correction Method (ECM) specification for a short panel data structure. To deal with the problem of persistency, heterogeneity and endogeneity associated with short panel data the study employed differenced Generalize Methods of Moments (GMM) of Arellanon and Bond (1991) for the model specification. The estimator is subjected to first

and second order serial correlation test and test for valid instruments using Sargan over identifying restriction test. Therefore, the nature of our panel data is such that the individual dimension is larger than the time dimension (N > T).

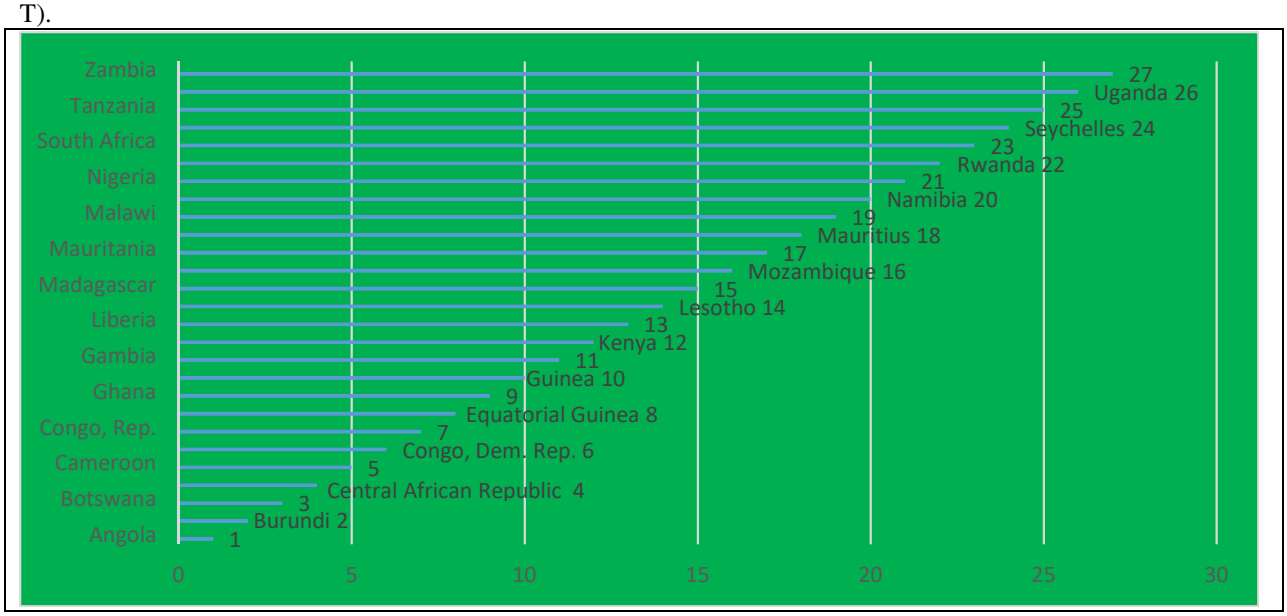


Figure 3: Sample Identification Number

The figure above shows the names of all the countries used in this study and their associated codes or identification numbers. For example, the identification number for Angola is 1, Burundi is 2, Botswana 3 progressively till the last country Zambia which is 27. The choice of this identification number is based on the position of a country in the alphabetical order. Therefore, it does not have any statistical importance/value for explanation except for identification purpose.

Table 1: Definition of Variables

Variable description	**Type of Data/Source/Measurement**	**Literature justification**	**Parameter's *a priori***
Financial Inclu (Usage): **dcpa=** deposits in commercial banks per 1000 adults	Secondary/World Bank database. This measures the amount of deposits by customers in commercial banks in the 27 selected SSA countries.	https://data.worldbank.org/indicator,	Positive: dcpa > 0
FI (Quality) **rdtb =** ratio of depositors to borrowers	This measures the ratio of depositors to borrowers.	https://data.worldbank.org/indicator,	Positive: rdtb > 0
Digital Fin: **ppua=** percentage of people using ATM	Secondary/World Bank DB This proxy measures how financial technology help to drive financial inclusion in the selected SSA countries.	https://data.worldbank.org/indicator,	Positive: ppui > 0

Source: Author compiled

Model Specification

This study follows the views of Chibba (2009) and Cihak et al (2016), to initiate a dynamic short run and long run specification, alternatively referred to as ECM-ARDL Granger frameworks. Thus, this augmented model is defined by financial inclusion as the endogenous variable {represented by deposits in the commercial bank per 1000 adults (dcpa), credit to the private sector (ctps) and ratio of depositors to borrowers (rdtb)} and digital finance as the exogenous variable {also proxy by percentage of persons using ATM (ppua)}.

$$\ln dcpa_{it} = f_0 + f_1 \ln dcpa_{i,t-1} + f_2 \ln dcpa_{i,t-2} + f_3 \ln ppui_{it} + f_4 \ln ppui_{i,t-1} + f_5 \ln ppui_{i,t-2} + \psi_{t1} + v_{it1} \quad 1.0$$

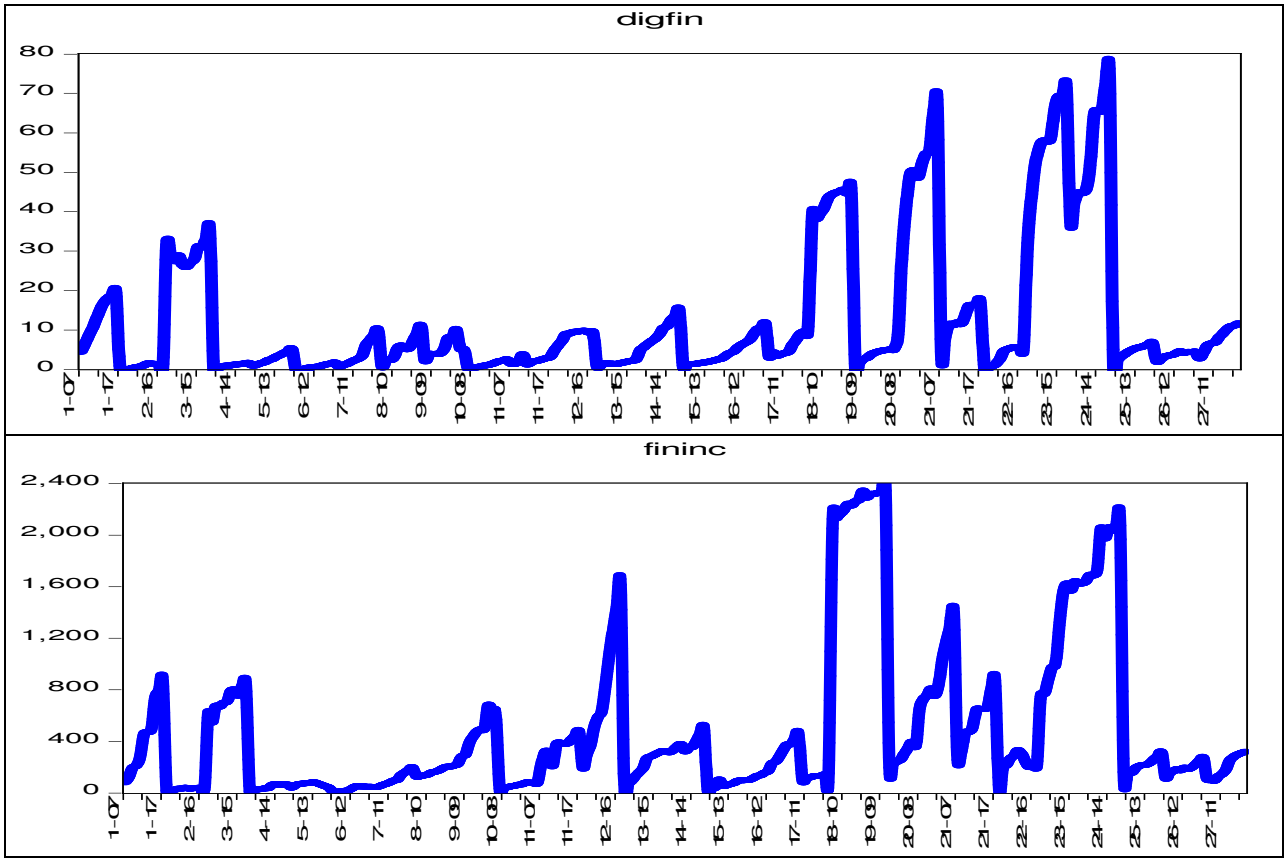
$$\ln rdtb_{it} = g_0 + g_1 \ln rdtb_{i,t-1} + g_2 \ln rdtb_{i,t-2} + g_3 \ln ppui_{it} + g_4 \ln ppui_{i,t-1} + f_5 \ln ppui_{i,t-2} + \psi_{t2} + v_{it2} \quad 2.0$$

Where: $\ln ppui, \ln dcpa, and \ln rdtb$ are natural log of percentage of persons using ATM, deposit in commercial banks per 1000 adults, and ratio of depositors to borrowers respectively.

Analysis of Results

Descriptive Statistics-Visual Method

This study showed the movements and the distribution pattern of the underlying variables over time/across countries using line graphs. The line graphs are presented below.



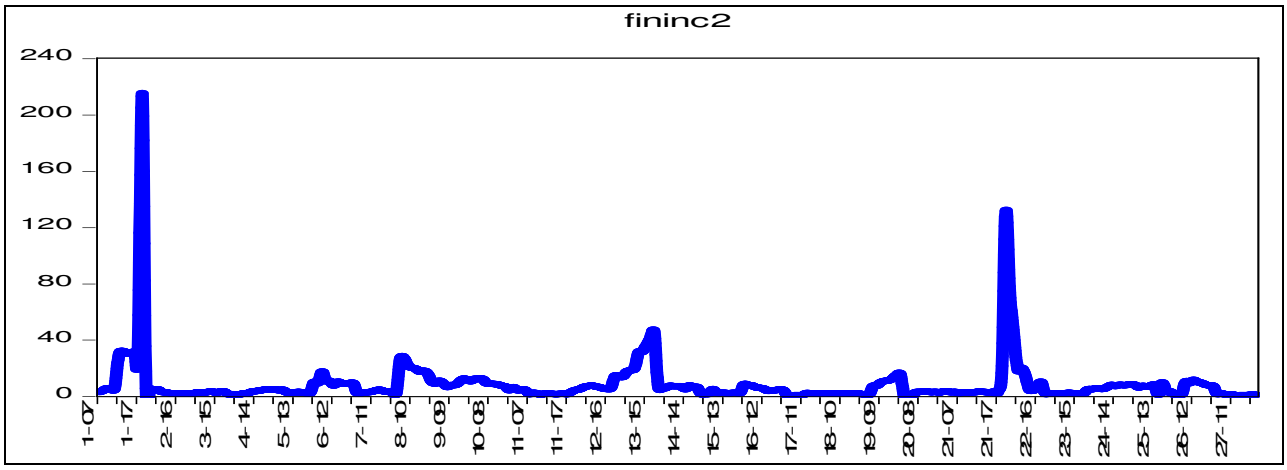


Figure 4: Line Graphs showing the Movements of underlying Variables
Note that each line graph shows the movement of the prescribed underlying variable across countries and overtime, the identification number for each country is displayed in figure 2, while all the variables are already defined in chapter 3.

The first line graph displays the movements of digital finance (number of persons operating ATMs) overtime for each country. As shown in the graph, country 24 (Tanzania) has the highest number of persons operating ATMs, followed by country 23(South Africa) and country 21 (Nigeria). The least countries that operate ATMs are 2, 5 and 7, which are Burundi, Cameroon and Congo Republic respectively. The second line graph shows the movements of financial inclusion by usage (number of persons using deposit-product line service). It is observed in the graph that countries 19, 18, 24 and 25 (respectively Malawi, Mauritius, Seychelles and Tanzania) have the highest number of persons using the services of banks for depositing purpose. The study also observed that countries like Burundi, Central African Republic, Cameroon, Congo Republic and Congo Democratic Republic (2, 4, 5, 6 and 7) have the lowest usage. Meaning that they have very low magnitude of inclusion in term of usage. The third graph presents the movements of financial inclusion by quality of services (ratio of depositors to borrowers, it is conventionally agreed that high quality of bank service would generate sufficient deposits to satisfy the needs of borrowers). A high ratio mobilizes much from the surplus unit to deficit unit, and it is an indication of high quality of financial inclusion. The countries with the highest ratios are 21, 23, 17, 18, 15, 11, 2, 3 and 4 (respectively Nigeria, South Africa, Mauritania, Mauritius, Madagascar, Gambia, Burundi and Botswana), while those with the lowest ratios are 1 and 22 (Angola and Rwanda respectively). Therefore, Angola and Rwanda have the lowest financial inclusion in terms of quality.

Descriptive Statistics-Statistical Method

Another means of describing data is to compute some statistics such as mean, standard deviation, skewness, kurtosis and Jarque-Bera (JB). The JB statistic is calculated with probability to test the null hypothesis of normality. Table 4. 4 presents the outputs of these statistics.

Table 2: Descriptive Statistics from 2007-2017 (Variables are in their raw values)

	FININC1	FININC2	DIGFIN
Mean	4.826391	8.246747	12.65485
Std. Dev.	6.019476	16.40644	17.77193
Skewness	1.866003	8.679656	1.876601
Kurtosis	5.496563	98.53028	5.416488
Jarque-Bera	249.4886	116663.8	246.5836
Probability	0.000000	0.000000	0.000000
No Countries	27		
Year	10		
Observation	270		

The mean value of each of the variables is positive. Financial inclusion by usage, financial inclusion by quality and digital finance have the mean values of 4.83, 8.25 and 12.65, respectively. This implies that all these variables have displayed increasing tendency throughout the sampling period. The average inclusion by usage is approximately 5 depositors for every 1000 adults. This average value is small when considering the number of banks/branches in this region. Furthermore, average inclusion by quality is approximately 8. This indicates that borrowers are 8 times more than depositors. Digital finance by the number of person operating ATMs has average of 13 person per 1000 adults. This simply means that average of 13 persons for every 1000 persons operate ATMs in the selected SSA. All the variables have larger value for their standard deviations more than their means. This is an indication that the variables are highly volatile around their mean values. The skewness scores for each of the variables is larger than zero and positive. By implication the variables are each positively skewed, meaning that there is tendency of large values in the nearest future. The kurtosis value for each variable is approximately larger than 3, thus, the variables are leptokurtic in nature with indication of possible outliers. All the computed JB statistics are asymptotic with zero percent probability value. This means that each of the variable does not follow a Gaussian process confirming.

Inferential Statistics and Post Estimation Results

In this section, the parameters of the models stated in chapter three are estimated using one step Diff-GMM estimation technique. This technique provides robust test for the hypotheses stated for this study. The hypotheses focus on the dynamics of inclusion and digital finance. Before reporting the results on the tests of these hypotheses, the study displays graphical reports on sample identification number, average individual country financial inclusion usage and average group usage for the purpose of decomposing the countries into high usage (large saving countries) and low usage (small saving countries) to enhance the uniqueness of the results.

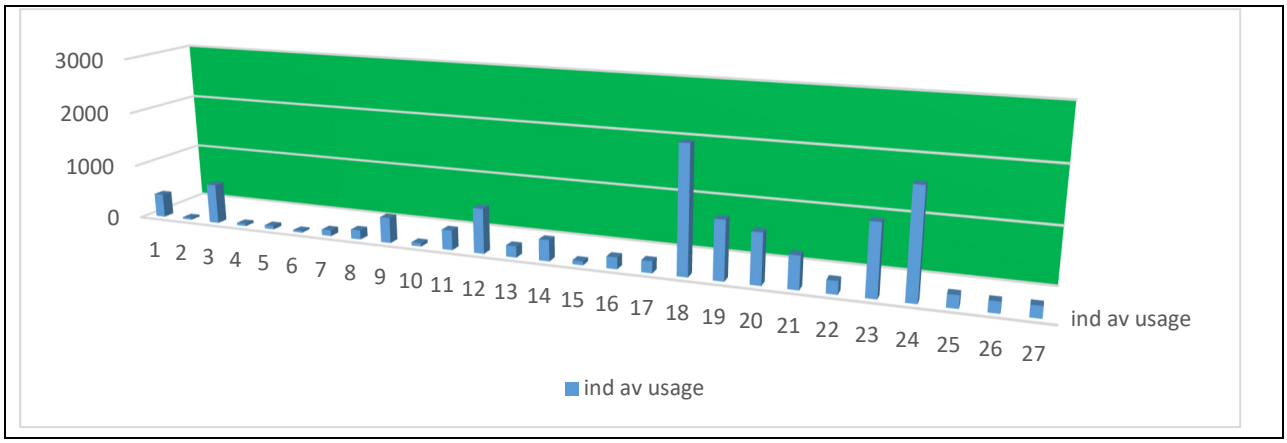


Figure 3:Individual Country's Average Financial Service Usage

A sight view of figure 3 above shows that countries with identification numbers such as 2, 4, 5, 6, 7, 8, 10 and 15 have very low usage of financial services, followed by countries with id such as 1, 3, 9, 11, 12 etc. Nevertheless, countries like 18, 19, 20, 23 and 24 are large saving countries because they display high usage of financial services. (See figure 1above for the names of these countries).

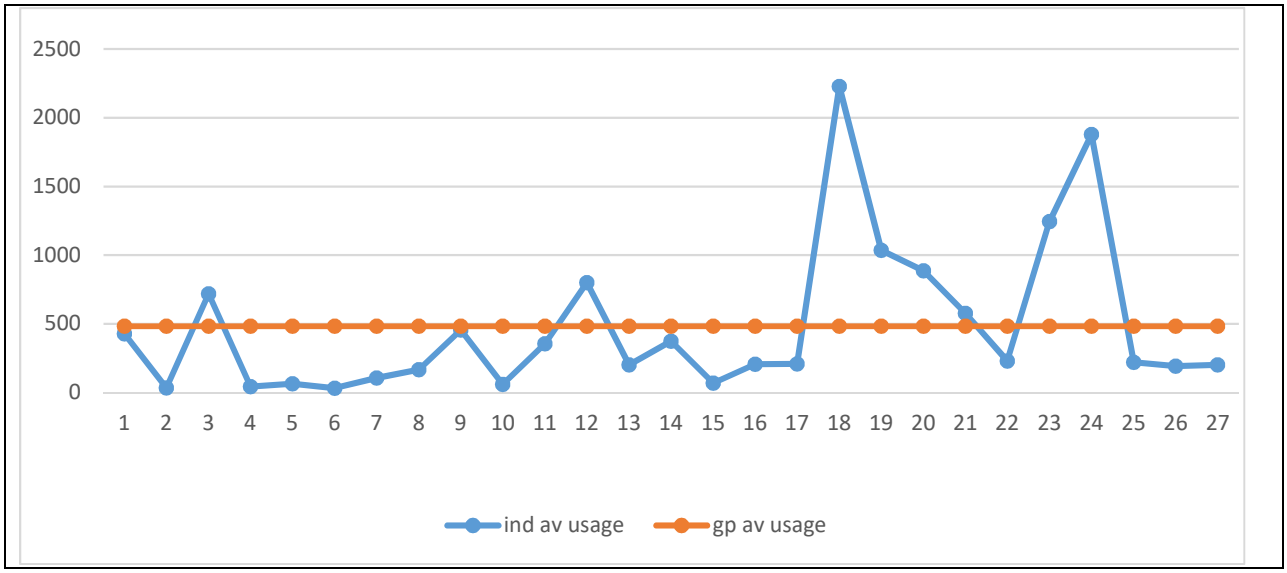


Figure 5: Decomposing Countries into High Usage and Low Usage of Financial Services

The line marked by blue collar indicates the movement of individual average usage, while the group average usage is marked by orange color. The group average usage is constant (value=482.64 approximately from the above graph) and any country that has average return above group average return is considered as large saving country or high usage of financial service; such countries are 3, 12, 18, 19, 20, 21, 23 and 24 (see figure 1: sample identification number). While other countries whose individual average return falls below the group average return are called low saving countries. Thus, the test of the short run and long run dynamics of financial inclusion and digital finance is conducted for the low saving, high saving and the overall countries in the sample for the study.

Dynamics of Financial Inclusion and Digital Finance

This study investigates whether there is significant influence/causation from digital finance to financial inclusion in terms of usage of financial service in a sample of countries with high usage, low usage and combination of the two. The results of the investigation are reported in table 3 below

Table 3: Long-run and Short-run Dynamics of FI and Digital Finance for Overall Sample

Regressors	Coef.	Std. Err.	Z-stat	P-value
Δ lnfininc1 (-1)	-.2955683	.099644	-2.97	0.003
Δ lndigfin1	-.07827	.0664995	-1.18	0.239
Δlndigfin1 (-1)	.0432098	.0665752	0.65	0.516
ECM	-.3041471	.085378	-3.56	0.000
lndigfin1(-2)	-.2442999	.0611352	-4.00	0.000
Summation of Short-Run Coef.	-0.03506			
Short-Run Wald Test (P-Value)	0.0896			
Long Run Coefficient	0.196771			
Long Run Coefficient (P-Value)	0.3110			
Sargan Difference Test (P-Value)	0.745			
Sargan Test (P-Value)	0.727			
AR1 (P-Value)	0.00			
AR2 (P-Value)	0.84			
Number of Observations	270			
Number of Countries	27			

NOTES:
1) The dependent variable is Δ(lnfininc1)
2) Estimation by one step Diff-GMM (Arellano, and Bond)
4) The Sargan test is based on the assumption that the instruments are not correlated with the residuals.
5) AR1 and AR2 tests are based on the hypothesis that the errors are serially correlated
6) The instruments used are the lags of the regressors.
7) Yearly dummies are excluded.

Table 3 provides the estimated value on the short run and long run dynamic relationship between financial inclusion and digital finance for a full sample of some selected SSA countries. The ECM coefficient (-0.30) has probability value of 0 percent. This is in consonant with a priori and it suggests that a long run relationship exists between financial inclusion and digital finance in SSA countries. Furthermore, the statistical significance of the ECM coefficient implies that if there is deviation from this long run equilibrium, short run adjustment in financial inclusion is necessitated to re-establish the long run relationship. Therefore, financial inclusion responses to temporal shocks in digital finance. The coefficient of the short run effects -0.04 approximately associates with 9 percent probability value. This means that at 10 percent level of significance, short run dynamic influence runs from digital finance to financial inclusion in a manner that a percent increase in digital finance spelt about 4 percent decrease in financial inclusion in terms of usage. The coefficient of the long run coefficient by approximation is 0.20 or 30 percent, while the associated probability value 31 percent is asymptotically large. Thus, there is no significant response of financial inclusion to permanent shocks in digital finance for the overall sample of the selected SSA countries. It means that financial inclusion only responds/adjusts to temporal digital finance shocks, and not to its permanent shocks. For the of robustness check, these results are confirmed based on both large and small sub-sample of average usage. Sargan test and Sargan in Difference test produce probability values of 0.727 and 0.745 respectively. Meaning that the test results fail to reject the null that the legitimate instruments does not correlate with the model residuals. The AR at lag 1 and lag 2 displays probability of 0.00 and 0.84 respectively; thought the first

order autocorrelation is not rejected bur the second order autocorrelation is. Therefore, there is sufficient evidence in support of the appropriateness of the model specification.

Table 4 : Long-run and Short-run Dynamics of FI and Digital Finance for Large Saving Countries

Regressors	Coef.	Std. Err.	Z-stat	P-value
Δ lnfininc1(-1)	-.0418218	.115423	-0.36	0.717
Δ lndigfin1	-.9264673	.446969	-2.07	0.038
Δlndigfin1 (-1)	.4672208	.2266606	2.06	0.039
ECM	-.1782159	.0546977	-3.26	0.001
lndigfin1(-2)	-.0934051	.0465019	-2.01	0.045
Summation of Short-Run Coef.	-0.4592465			
Short-Run Wald Test (P-Value)	0.0208			
Long Run Coefficient	0.475887954			
Long Run Coefficient (P-Value)	0.0278			
Sargan Difference Test (P-Value)	0.988			
Sargan Test (P-Value)	0.995			
AR1 (P-Value)	-			
AR2 (P-Value)	0.690			
Number of Observations	80			
Number of Countries	8			

NOTES:
1) The dependent variable is Δ(lnfininc1)
2) Estimation by one step Diff-GMM (Arellano, and Bond)
4) The Sargan test is based on the assumption that the instruments are not correlated with the residuals.
5) AR1 and AR2 tests are based on the hypothesis that the errors are serially correlated
6) The instruments used are the lags of the regressors.
7) Yearly dummies are excluded.

The above table presents the results on the dynamics of financial inclusion and digital finance for large saving countries among the selected SSA. As revealed in the table, the adjustment coefficient is found to be negative (-0.18 app.) and significant at 1 percent. This indicates that long run influence/causation runs from digital finance to financial inclusion, and when there is deviation in this influence, financial inclusion adjusts at the speed of 18 percent to every unit change/shock in digital finance within a short period (1 year here). In addition, the coefficient of the short run effects is approximately -0.46 (-46%), which is significant at 5 percent. This suggests that significant short run dynamic relationship exists between inclusion and digital finance in a manner that 1 percent increase in digital finance induces inclusion (by visiting bank) to reduce by 46 percent. This equally means that the presence of digital finance reduces the rate at which depositors visit bank for either receipts or payments on yearly basis. So also, the long run elasticity coefficient (0.48) is significant at 5 percent. This confirms the long run relationship earlier established by the ECM coefficient, and therefore, financial inclusion responses positively to permanent shocks in digital finance. Meaning that in the long run, any 1-unit change in digital finance will induce financial inclusion to change by 48 percent in the sample of large saving countries. The Sargan and Sargan in difference tests are not significantly different from zero, meaning that the instruments used are not weak. Likewise, the AR at lag 2 shows no autocorrelation in the residuals, thereby confirming the model to be adequate.

Table 5: Long-run and Short-run Dynamics of FI and Digital Finance for Small Saving Countries

Regressors	Coef.	Std. Err.	Z-stat	P-value
Δ lnfininc1(-1)	-.369746	.0968988	-3.82	0.000
Δ lndigfin1	-.0671738	.0562784	-1.19	0.233
Δlndigfin1 (-1)	.0050556	.0607665	0.08	0.934
ECM	-.3227168	.0889531	-3.63	0.000
lndigfin1(-2)	-.2885243	.060493	-4.77	0.000
Summation of Short-Run Coef.	-0.0621182			
Short-Run Wald Test (P-Value)	0.2818			
Long Run Coefficient	0.10595203			
Long Run Coefficient (P-Value)	0.5366			
Sargan Difference Test (P-Value)	0.111			
Sargan Test (P-Value)	0.040			
AR1 (P-Value)	0.000			
AR2 (P-Value)	0.729			
Number of Observations	190			
Number of Countries	19			

NOTES:
1) The dependent variable is Δ(lnfininc1)
2) Estimation by one step Diff-GMM (Arellano, and Bond)
4) The Sargan test is based on the assumption that the instruments are not correlated with the residuals.
5) AR1 and AR2 tests are based on the hypothesis that the errors are serially correlated
6) The instruments used are the lags of the regressors.
7) Yearly dummies are excluded.

The results in above table are based on small saving countries, The ECM coefficient (-0.32) has a probability value of 0.00. Therefore, at alpha value of 1 percent, a long run dynamic relationship exists between financial inclusion and digital finance in the sample of low saving countries among the SSA. Besides, 32 percent disequilibrium in the long run is corrected within a short period (1 year). However, the coefficient of the long run elasticities is positive (0.11 app.) but not significant even at 10 percent alpha value. This infers that unlike large saving countries where financial inclusion responses to permanent shocks in digital finance, in small saving countries inclusion does not response to permanent shocks in digital finance. To the contrary, in small saving countries, financial inclusion adjusts faster to temporal shocks in digital finance than in large saving countries. The short run effects are negative in both small and large saving countries, though not significant in small saving countries. Thus, within the purview of short run, financial inclusion does not significantly decrease with any increase in digital finance for the small saving countries. For the post estimation tests, while the Sargan test reject the null hypothesis, Sargan in difference test fail to reject it. Likewise, the AR(1) is in support of autocorrelation, while the AR(2) rejects it. This means that there is no strong evidence in support of the adequacy of the model for small saving countries.

Summary, Conclusion and Recommendation

Summary of Findings

From the above results this study posits that there is a strong evidence that digital finance and financial inclusion maintain a long run relationship for both large and small saving countries. This relationship is confirmed for the overall sample (that is the combination of the two set of countries). Notwithstanding, digital finance responds faster

to the temporal breaks in financial inclusion for low saving countries than for large saving countries. It is equally clear that digital finance responds slower to temporal changes in financial inclusion for the overall sample than for the low saving countries; but faster than large saving countries. We discover that digital finance maintains consistent negative short run effects on financial inclusion for both high and small saving countries, also for the overall sample. To the contrary, there is positive long run multiplier effects between digital finance and financial inclusion for all the three sets of countries. This altogether means that in the short run dynamics, any unit increase in digital finance induces a decline in financial inclusion, but in the long run, digital finance appears to be a positive determinant of financial inclusion for the selected SSA countries.

Conclusion and Recommendation

In view of the findings summarized above and based on the objective of this study it concludes that the impact of digital finance on financial inclusion varies differently over the short run and long run go-ahead. In the short run, digital finance influences financial inclusion negatively, however, in the long run digital finance exerts positive impact on financial inclusion. Therefore, the study further concludes that in the long run, digital finance drives financial inclusion positively. It therefore recommends that Banks should encourage customers to be withdrawing, transferring and depositing money through ATMs. The orthodox method of paying and receiving money through counters should be discouraged. This will increase the use of digital finance to positively motivate financial inclusion. In view of this, banks should desist from the practice of not funding their ATMs adequately with cash assets and strive to improve their network services across all their ATM centres. To achieve this, the central banks of respective countries should introduce a policy that can disallow certain amount of money not to be posted or received through the counter.

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